# THE INFILTRATION CAPACITY OF SOILS UNDER DIFFERENT LAND-USE SYSTEMS IN YENAGOA AND SOUTHERN IJAW LOCAL GOVERNMENT AREAS OF BAYELSA STATE

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**ABSTRACT:** *The study aimed to determine the effect of different land-use systems on soils in Yenagoa and Southern Ijaw Local Government Area of Bayelsa State. Four land use types were considered namely Fallow land, virgin land, oil palm plantation, and plantain plantation. Soil samples were randomly collected at three depths (0-15, 15-30, and 30-45cm) from three locations in the respective land-use types. The samples were bulked and prepared for the determination of some chemical properties. Core sampling was done to determine bulk density, porosity, and saturated hydraulic conductivity. A double-ring infiltrometer was used to determine the infiltration rate and cumulative infiltration. Sorptivity and transmissivity were determined from Philip's infiltration model. The research revealed that the soils were acidic with a pH range of 4.4-4.7. There were differing levels of organic matter amongst the lands, the progression was Virgin (43.33g/kg)> oil palm plantations (34.67g/kg)> fallow land (23.33g/kg)> plantain plantations (14.67g/kg). The sand fraction dominated the various land-use systems, having loamy sand in the plantain plantation, sandy loam in the oil palm plantation and fallow land, and a range of sandy loam to sandy clay loam in the virgin land. Cumulative and infiltration rates were measured at an interval of 1, 3, and 5 minutes. The infiltration rate was slowest at the oil palm plantation (PPT) with an average cumulative infiltration of 36.3cm, and highest at the virgin land (VVL) at 67.4cm. The average cumulative infiltration of 42.2cm and 53.3cm were in the plantain plantation (OPT) and Fallow land (FFL). VVL>FFL>PPT>OPT was the progression from highest to lowest. Bulk density across the four land-use types did not exceed the critical level of 1.63g/cm$^3$. The highest gravimetric moisture content of 25% was found in the virgin land > oil palm plantation (24%) > (fallow land) 21.6% > plantain plantation (20.3%). The virgin land had the highest sorptivity (64.5 cm/hr) while the oil palm plantation had the lowest (39.9 cm/hr) - VVL (64.5cm/hr) >FFL (55.6 cm/hr) >PPT (43.1 cm/hr) > OPT (39.9 cm/hr). Transmissivity was lowest (2.4 cm/hr) in the plantain plantation and highest (4.0cm/hr) was in the fallow land. Oil palm plantation and virgin land had transmissivity of 3.7 and 2.8cm/hr. The research showed that there were considerable impacts of land use on infiltration capacity. Soils of natural vegetations would easily support irrigation activities due to their organic matter content and should, therefore, be conserved or utilized with conservative measures, while cultivated lands should be improved regularly.*

**KEYWORDS**: Land-Use Types, Infiltration Rate, Cumulative Infiltration, Sorptivity, Transmissivity

## INTRODUCTION

Changes in land use have an impact on soil properties such as water retention and availability, nutrient recycling, gas flux, plant root growth, and soil conservation (Shukla *et al.*, 2003). Soil structure, aggregate stability, particle size distribution, and land use types significantly affect infiltration capacity, which is also an important soil hydrological feature (Fu *et al.*, 2000), geomorphologic and climatic impacts, as well as vegetation (including plants and litter canopy and kind, along with soil organic composition) (Jimenez *et al.*, 2006).

Water enters the soil through its surface, which is known as infiltration. Its rate is the amount of water that flows into the soil per unit of soil surface area, whereas cumulative infiltration is the total amount of water that enters the soil over a period of time (Kirkham, 2014). Infiltration is a key component in soil hydrology because it controls the amount of runoff after a rainfall, the amount of water stored in the root zone and groundwater recharge, as well as the adsorption of dissolved chemicals (nutrients and pollutants) and soil erosion (Pla, 2007).

Soil bulk density, porosity, aeration, permeability, water storage, water transmission properties, and runoff all vary considerably when land-use transitions from native or semi-natural vegetation to persistent tillage and grazing. Soil infiltration potential has been demonstrated in numerous studies to be a good indicator of soil quality and health (Bennett et. al, 2010).

The ability to absorb water quickly is found in most tropical soils under tree cover. However, changes in land use, particularly from native vegetation to cultivation and grazing, have resulted in significant changes in the properties of many tropical soils, including loss of organic matter, increased bulk density, decreased aggregate stability, and, as a result, lower infiltration rates. The parameters of the infiltration process have a big role in predicting overland flow in catchments. The hydraulic features of the various soil layers, such as unsaturated or saturated conductivity and soil water retention characteristics, as well as the antecedent soil moisture levels, regulate infiltration during a runoff-generating rainfall event. (Wildenschild *et al.*, 2001).

In Bayelsa State, there is a fundamental dearth of data on soil hydrological parameters in connection to various land-use patterns. Changes in infiltration capacity will have a significant impact on surface runoff and river hydrology, which will affect lower catchment areas in the state.

The study aims to assess the impact of different land-use types on infiltration capacity.

## MATERIALS AND METHODS

### Study Area

The study was conducted in Bayelsa State. Bayelsa is located in the southern part of Nigeria's Niger Delta, between latitudes 04°4 N and 05°, 02 N, and longitudes 006°, 15 E and 006°, 24 E. It is sweltering all year, with the wet season being warm and overcast and the dry season being hot and generally cloudy. The temperature normally ranges from 71°F to 87°F


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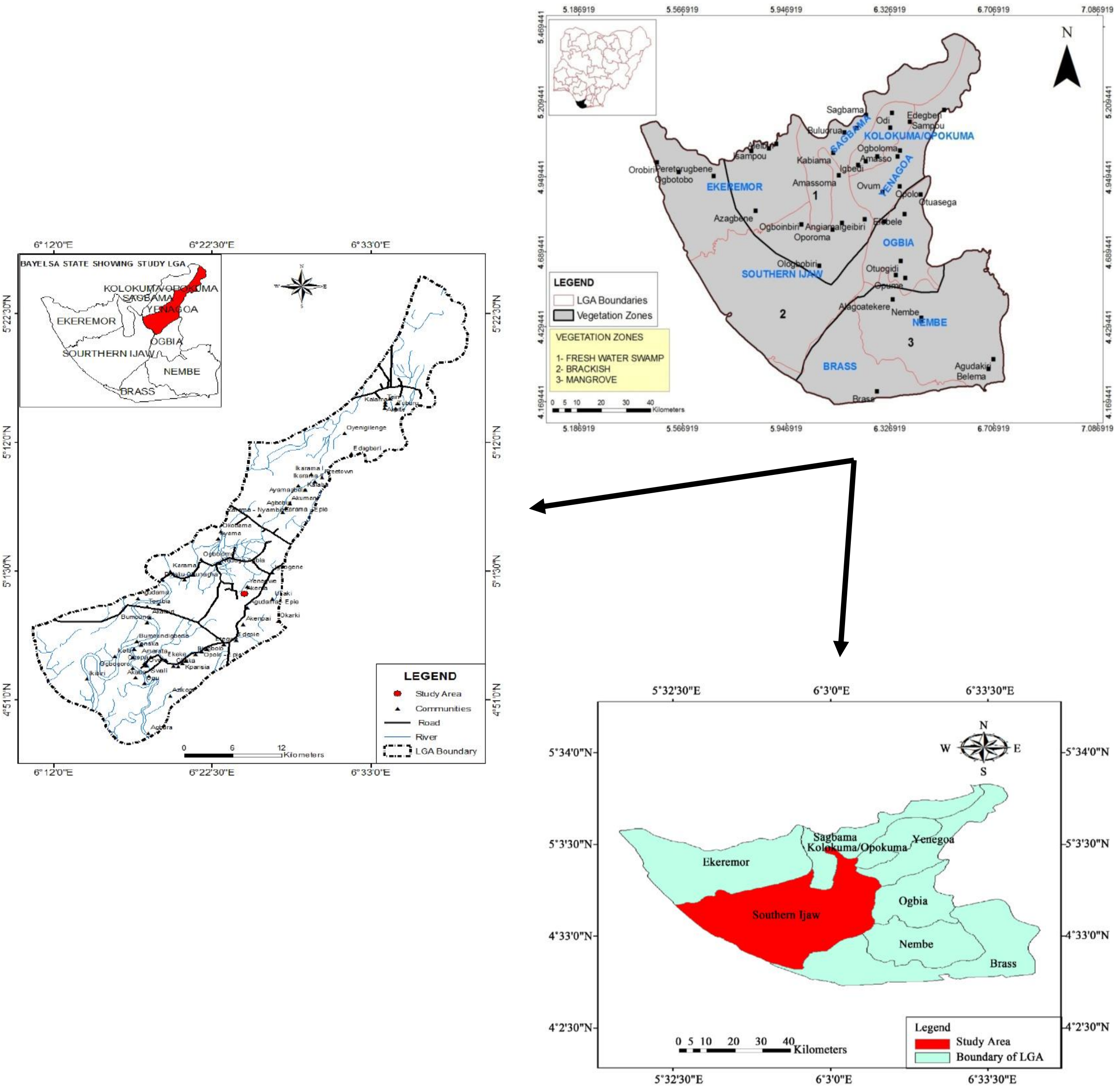
throughout the year, with temperatures rarely falling below 63°F or rising over 90°F. The study area receives 2000–4500mm of annual rainfall, which is distributed across 8–10 months of the year and is bimodal, peaking in June and September. The state's average relative humidity is 80%, and the natural vegetation zone is tropical rainforest.

Two Local Government Areas in the State, Southern Ijaw, and Yenagoa encompass the various land-use forms. Virgin Land (4059'35" N 6007'21" E), Oil Palm Plantation (also known as Bayelsa Palm) (4058'50" N 6006'15" E), Plantain Plantation (4059'45" N 6022'20" E), and Fallow Land (4053'06" N 6019'26" E) were the four land-use categories assessed.




**Map showing Southern Ijaw and Yenagoa Local Government Area of Bayelsa State**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## Soil Sampling

At the experimental sites, soil samples were taken using a hand soil auger at a randomized distance from one another. The soil samples were taken at three different depths: 0–15cm, 15–30cm, and 30–45cm, and stored in properly labelled containers. For chemical analysis, three replicates of the samples were taken from three distinct locations and bulked to form a representative sampling unit. After the tillage operations, soil attributes will be measured. Physical properties to be examined include antecedent moisture content, bulk density, particle size analysis, and porosity; chemical properties include pH, electrical conductivity, organic carbon/matter, accessible phosphorus, exchangeable bases, total nitrogen, and so on.

## Laboratory Analysis

The pH of the soil was measured in a soil-water medium at a 1:1 ratio using Coleman's pH meter, and particle size were determined using the hydrometer method according to the Bouyoucous method (1951). According to Nelson and Sommers (1982), soil organic carbon (SOC) was measured using the Wakley and Black approach (1934), and organic materials were calculated by multiplying the value of the organic carbon by a value of 2.0, as indicated by Douglas W. Pribyl (2010). The Olsen method was used to determine available phosphorus (Watanabe & Olsen 1965) and read on an atomic absorption spectrophotometer, while exchangeable cations (K, Ca, Na, and Mg) were extracted using the Chapman method (1965); the K, Na, and Ca were determined using a flame photometer, while Mg was read from an atomic absorption spectrophotometer (AAS). The titration method, as reported by Chapman (1965), was used to determine exchangeable acidity.

## Determination of Soil Physical Properties

### Soil moisture content

Soil samples from the different depths of the four treatments were taken at random locations with a soil core sampler were oven-dried at 105°C for 24 hours to determine the soil moisture content gravimetrically (ASABE Standards, 2008). The gravimetric moisture content was calculated as the mass of moisture in the soil sample divided by the mass of the dry soil multiplied by 100 (Aikins and Afuakwa, 2012)

$$\text{MC} = \frac{(wet\ soil\ weight) - oven\ dried\ soil\ weight}{oven\ dried\ soil\ weight} \times 100 \qquad (1)$$

### Bulk Density

Soil bulk density in the three depths was determined using the core method. The core samples were randomly taken using a stainless steel core sampler. The collected soil cores were trimmed to the exact volume of the cylinder and oven-dried at $105^0$C for 24 hours. Precautions were taken to avoid causing compaction in the core.

The bulk density was determined from the ratio of the mass of dry soil per unit volume of soil cores (Aikins and Afuakwa, 2012).

$$\text{Bulk density} = \frac{mass\ of\ oven\ dried\ soil\ (g)}{total\ volume\ of\ soil\ (cm^3)} \qquad (2)$$


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### Total porosity

The total porosity was calculated from the values of the bulk density and an assumed particle density of 2.65 $g/cm^3$ using the following equation (Aikins and Afuakwa, 2012).

$$TP = 1 - \left(\frac{Bulk\ density}{particle\ density}\right) \times 100 \qquad (3)$$

### Saturated hydraulic conductivity (Ksat)

Constant head approach as described by Tuffour *et al.*, 2014 was used to determine the saturated hydraulic conductivity (Ksat) in the laboratory. After being carefully trimmed to the size of the core ring, the undisturbed soil core was secured with a piece of muslin cloth held with a rubber band on both ends to prevent the soil from spilling while allowing water passage. Water percolation tests were performed after the samples were soaked for 24 hours. The volume of water that passed through the soil sample was measured and recorded until a constant average was achieved. The Ksat was calculated as;

$$Ksat = Q \times \left(\frac{L}{A\ x\ T\ x\ H}\right) \qquad (4)$$

Where Q is the discharge or percolate through the soil ($cm^3$), L is the length of the soil core (cm), A is the cross-sectional area of the soil core ($cm^3$), T is the time taken (hours), and H is the hydraulic head difference (cm).

## INFILTRATION MEASUREMENTS

A double-ring infiltrometer was used to measure the amount of infiltration. The infiltrometer was driven into the soil, and the readings were recorded using a measuring tape mounted inside the inner cylinder. The outer cylinder was initially filled with water to function as a buffer zone, and then the inner ring was filled. To determine the amount of water infiltrated throughout the time interval, the water depth in the inner cylinder was read at intervals of 1, 3 and 5 minutes until a stable state was obtained. There was a total of twelve (12) infiltration runs (three replicates per land use).

### Computation of sorptivity and transmissivity

The approximate Philip (1957) algebraic infiltration equation was fitted into the field data to determine the soil water sorptivity (S), which represents the ability of a soil to absorb or desorb water by capillary processes, and transmissivity (A), which is a measure of the ability of the soil to conduct the flow of water. Measured values of cumulative infiltration I expressed in cm as a function of time were used as the primary data.

$$I = St^{1/2} + At \qquad (5)$$

Where I [cm] is cumulative infiltration at time t [sec]. S [cm $sec^{-1/2}$] is the soil water sorptivity obtained as the slope of I versus $\sqrt{t}$, A [$cm^{-1}$] is the soil water transmissivity and is the intercept, and the infiltration rate is:

$$i = \tfrac{1}{2} St^{-1/2} + A \qquad (6)$$


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**Statistical Analysis**

The data were statistically analyzed using the Analysis of Variance technique appropriate for Randomized Complete Block Design and means will be compared using Duncan's multiple test range at a 0.05 level of probability.

## RESULTS AND DISCUSSIONS

**Physicochemical properties of the different land-use types**

The results in Table 1 showed that the average pH in all land-use types was acidic (4.4–4.7), with a significant difference ($p<0.05$) between them. The acidic state of soils was caused by the leaching of basic cations, according to Niu *et al.,* (2015). The electrical conductivity showed significant differences amongst the land use types; the lowest average EC (41.5S µ/cm: 0.0415ds/m) was found in the Plantain plantation, while the highest (66.83S µ/cm: 0.668 ds/m) was found in the virgin land. These values according to Ganjegunte *et al.* (2018) places the soil less than four (<4), which is non-saline. This indicates that there is no obstruction to the soil structure and poses no threat to seedlings and salt-sensitive crops.

The four land-use types had notably differing levels of organic matter: Virgin land had the highest value (43.33g/kg), followed by oil palm plantations (34.67g/kg), fallow land (23.33g/kg), and plantain plantations with the lowest value (14.67g/kg). The virgin land had the highest Cation Exchange Capacity (1.38cmol/kg) and the plantain plantation had the lowest (0.66cmol/kg). The base saturation which signifies the fertility status of the soils was highest at the virgin land (42.35%) and lowest at the plantain plantation (23.67%): Virgin land (42.35%)> oil palm plantation (31.73%) > fallow land (29.12%) > plantain plantation (23.67%).

The sand fraction had the highest values in the various land-use systems, which could be attributable to the parent materials' kaolinitic character (Fasina 2005).

**Effect of different land use on infiltration and cumulative rate**

Table 2 shows that the different land use had a significant effect ($p<0.05$) on the infiltration rate and cumulative infiltration. The result showed significant differences amongst the land use types. The infiltration rate was slowest at the oil palm plantation (PPT) with an average cumulative infiltration of 36.3cm, and highest at the virgin land (VVL) at 67.4cm. The average cumulative infiltration of 42.2cm and 53.3cm were in the plantain plantation (OPT) and Fallow land (FFL). VVL>FFL>PPT>OPT was the progression from highest to lowest. When compared to other land use types with lower organic matter content, the higher cumulative infiltration and infiltration rate in virgin land could be attributable to the higher organic matter present in the soil.

Although higher moisture content can reduce cumulative and infiltration rates, the initial moisture content of 25%, cumulative infiltration and infiltration rate of 67.4cm, and 30.7cm/hr observed in virgin land could indicate that the soil is capable of retaining more water than those with lower cumulative and infiltration rates. This was corroborated by the increase in clay content down the soil column.

Bulk density across the four land-use types did not exceed the critical level of 1.63g/cm$^3$, and as such, posed no impediment to the water flux.

The high gravimetric moisture content was because the samples were taken in October 2021 when rainfall was still at its peak in the region. The highest value of 25% was found in the virgin land > oil palm plantation (24%) > (fallow land) 21.6% > plantain plantation (20.3%).


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**Table 1: Some physicochemical properties of the different land use systems**

| CODE | Depth | pH | EC | Org.C | Org. M | T. N | EA | Na | K | Ca | Mg | Av.P | CEC | ECEC | BS | Sand | Clay | Silt | Soil texture |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | µS/cm | | g/kg | | | | | cMol/kg | | | | | (%) | | g/kg | | |
| **PPT** | **0-15** | 4.4a | 41b | 11c | 22c | 1c | 2.2b | 0.17c | 0.07c | 0.41c | 0.3c | 2.32c | 0.95c | 3.15c | 30.2c | 853.4c | 91.4a | 55.2a | loamy sand |
| **PPT** | **15-30** | 4.7b | 30.4a | 7b | 14b | 0.6b | 2a | 0.15b | 0.04b | 0.27b | 0.19b | 1.701b | 0.65b | 2.65b | 24.5b | 813.4b | 111.4b | 75.2b | loamy sand |
| **PPT** | **30-45** | 4.7b | 53.1c | 4a | 8a | 0.4a | 2a | 0.09a | 0.02a | 0.17a | 0.11a | 1.03a | 0.39a | 2.39a | 16.3a | 793.4a | 131.4c | 75.2b | sandy loam |
| | | **4.6** | **41.5** | **7.33** | **14.67** | **0.67** | **2.07** | **0.14** | **0.043** | **0.28** | **0.2** | **1.68** | **0.66** | **2.73** | **23.67** | **820.08** | **111.4** | **68.53** | |
| **OPT** | **0-15** | 4.5b | 78.1c | 36c | 72c | 3.3c | 2.3c | 0.32c | 0.18b | 0.89c | 0.51c | 5.824c | 1.9b | 4.20c | 45.2 | 773.4c | 111.4a | 115.2a | sandy loam |
| **OPT** | **15-30** | 4.5b | 36.3a | 11b | 22b | 1b | 2.1b | 0.19b | 0.07b | 0.41b | 0.27b | 2.237b | 0.94b | 3.04b | 30.9bc | 723.4b | 151.4b | 125.2b | sandy loam |
| **OPT** | **30-45** | 4.3a | 48.1b | 5a | 10a | 0.5a | 2a | 0.1a | 0.03a | 0.2a | 0.14a | 1.214a | 0.47a | 2.47a | 19.0a | 713.4a | 161.4c | 125.2b | sandy loam |
| | | **4.43** | **54.17** | **17.33** | **34.67** | **1.60** | **2.13** | **0.20** | **0.09** | **0.50** | **0.31** | **3.09** | **1.10** | **3.24** | **31.73** | **736.73** | **141.4** | **121.87** | |
| **VVL** | **0-15** | 4.7a | 74.3c | 29c | 58c | 2.6c | 1.9b | 0.26b | 0.15c | 0.7c | 0.47c | 3.516c | 1.58c | 3.48c | 45.4c | 693.4c | 191.4a | 115.2b | sandy loam |
| **VVL** | **15-30** | 4.7a | 58a | 22b | 44b | 2b | 1.9b | 0.25b | 0.11b | 0.64b | 0.45b | 3.37b | 1.45b | 3.35b | 43.3b | 683.4b | 211.4b | 105.2a | sandy clay loam |
| **VVL** | **30-45** | 4.7a | 68.2b | 14a | 28a | 1.3a | 1.8a | 0.17a | 0.09s | 0.53a | 0.33a | 2.411a | 1.12a | 2.92a | 38.4a | 653.4a | 221.4c | 125.2c | sandy clay loam |
| | | **4.7** | **66.83** | **21.67** | **43.33** | **1.97** | **1.87** | **0.23** | **0.12** | **0.62** | **0.42** | **3.10** | **1.38** | **3.25** | **42.35** | **676.73** | **208.07** | **115.20** | |
| **FFL** | **0-15** | 4.5a | 46.2b | 17c | 34c | 1.5c | 2.1a | 0.18c | 0.05b | 0.32b | 0.24b | 1.722b | 0.79b | 2.89b | 27.3b | 733.4c | 141.4a | 125.2a | sandy loam |
| **FFL** | **15-30** | 4.5a | 64.5c | 11b | 22b | 1b | 2a | 0.11b | 0.04b | 0.22a | 0.15a | 1.642a | 0.52a | 2.52a | 20.6a | 723.4b | 151.4b | 125.2a | sandy loam |
| **FFL** | **30-45** | 4.6b | 39.6a | 7a | 14a | 0.6a | 2a | 0.2a | 0.1a | 0.61c | 0.39c | 3.143c | 1.3c | 3.30c | 39.4c | 703.4a | 161.4c | 135.2b | sandy loam |
| | **MEAN** | **4.53** | **50.10** | **11.67** | **23.33** | **1.03** | **2.03** | **0.16** | **0.06** | **0.38** | **0.26** | **2.17** | **0.87** | **2.90** | **29.12** | **720.07** | **151.4** | **128.53** | |

Mean value(s) with the same letters(s) in the column are not significantly different from one another at 5% level of probability in each location.PPT-Plantain plantation, OPT-Oil Palm Plantation, VVL-Virgin land, FFL, Fallow land.


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**Table 2: Effect of different land-use types on the Cumulative Infiltration, infiltration rate, Gravimetric moisture content, bulk density, and porosity**

| Land use types | Cum. Time (mins) | Cumulative Infiltration (cm) | | | | Infiltration Rate (cm/hr) | | | | GMC % | BD g/cm$^3$ | POR % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | REP 1 | REP 2 | REP 3 | Average | REP 1 | REP 2 | REP 3 | Average | | | |
| FFL | 120 | 56.3c | 50.6c | 53.1c | **53.3c** | 30c | 25c | 23c | **26c** | 21.6a | 1.25a | 52.7c |
| PPT | 120 | 42b | 45.7b | 39 | **42.2b** | 20.8b | 20b | 19.5b | **20.1b** | 20.3b | 1.34d | 49.7a |
| OPT | 120 | 37.9a | 36a | 35a | **36.3a** | 15.6a | 12a | 13.2a | **13.6a** | 24c | 1.28b | 51.7b |
| VVL | 120 | 67.3d | 68.1d | 66.9d | **67.4d** | 31.2d | 30.5d | 30.5d | **30.7d** | 25d | 1.30c | 51b |

Mean value(s) with the same letters(s) in the column are not significantly different from one another at 5% level of probability in each location. PPT-Plantain plantation, OPT-Oil Palm Plantation, VVL-Virgin land, FFL, Fallow land; GMC - Gravimetric Moisture Content; BD – Bulk Density; POR – Porosity.


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**Effect of land-use types on transmissivity and sorptivity**

Sorptivity (S) represents the rate at which water is absorbed into the soil in the absence of gravity and is used to quantify infiltrability at the start of the infiltration process. It is made up of the combined effects of adsorption on soil particle surfaces and capillarity in soil pores (Akpan, 2004). The transmissivity term (A), on the other hand, is related to the effect of pore spaces on the flow of water through the soil under gravity (Akpan, 2004).

The virgin land (VVL) had the highest sorptivity (64.5cm/hr) while the oil palm plantation had the lowest (OPT). The Virgin Land's high adsorption rate can be attributed to its high organic matter content and denser soil texture, while the oil palm plantation's poor sorptivity can be linked to the inverse state. Sorptivity was 43.1 cm/hr in the plantain plantation (PPT) and 55.6 cm/hr on the fallow land (FFL), respectively. VVL (64.5cm/hr) >FFL (55.6cm/hr) >PPT (43.1cm/hr) > OPT (39.9cm/hr) was the sorptivity rate pattern. The lowest transmissivity value of 2.4cm/hr was found in the plantain plantation while the highest (4.0cm/hr) was in the fallow land. Oil palm plantation and virgin land had transmissivity of 3.7 and 2.8cm/hr (Table 3).

The high transmissivity value in the fallow land is credited to the low bulk density of 1.25g/cm$^3$ and porosity of 52.7%. This corroborates with the low transmissivity in the plantain plantation with a high bulk density of 1.34g/cm$^3$ and lower porosity of 49.7%. The higher the bulk density, the lower the amount of water infiltrated into the soil surface from the beginning of the infiltration test (Igbadun and Idris, 2007).

**Table 3: Sorptivity and Transmissivity of the different land-use systems**

| **Land-use type** | Cum. Time (mins) | **Sorptivity (cm/hr)** | | | | **Transmissivity (cm/hr)** | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | REP 1 | REP 2 | REP 3 | **Average** | REP 1 | REP 2 | REP 3 | **Average** |
| FFL | 120 | 56.3 | 55.5 | 55 | **55.6c** | 4.1 | 3.6 | 4.3 | **4.0d** |
| PPT | 120 | 45.9 | 40 | 43.5 | **43.1b** | 2.5 | 2.3 | 2.4 | **2.4a** |
| OPT | 120 | 39.6 | 40.1 | 39.9 | **39.9a** | 3.9 | 3 | 4.1 | **3.7c** |
| VVL | 120 | 67.7 | 65.6 | 60.1 | **64.5d** | 2.8 | 2.7 | 2.8 | **2.8b** |

Mean value(s) with the same letters(s) in the column are not significantly different from one another at a 5% level of probability in each location. PPT-Plantain plantation, OPT-Oil Palm Plantation, VVL-Virgin land, FFL, Fallow land; Rep - Replicates

**The correlation coefficient of the soil physical, chemical, and some hydraulic properties**

The correlation matrix showed that the following soil properties had negative correlations: bulk density (BD) and porosity (POR), sand and porosity, cumulative infiltration (CUM IF), infiltration rate (IR), electrical conductivity (EC), base saturation (BS), Cation Exchange Capacity (CEC), Gravimetric Moisture Content (GMC), Organic Carbon and Organic matter, sand and clay, sorptivity and sand.

Also, the positive correlation of soil properties includes Infiltration Rate and Porosity, Cumulative infiltration; EC and Cumulative Infiltration, Base saturation and EC, CEC and Cumulative Infiltration, EC, base saturation; Gravimetric moisture content (GMC) and EC,


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BS, CEC; organic carbon and BS, CEC, GMC; Organic Matter and cumulative infiltration, EC, BS, CEC, GMC, Organic carbon; Sand with BD; Clay with Cumulative Infiltration, IR, EC, BS, CEC, GMC, Organic carbon, organic matter; sorptivity with Cum IF, IR, EC, BS, CEC, organic carbon, organic matter, clay; transmissivity with BD, POR.

**Table 4: Correlation matrix showing selected soil physical, chemical and hydrological characteristics**

| | BD | POR | Cum IF | IR | EC | BS | CEC | GMC | Org C | Org M | Sand | Clay | Sorp | trans |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BD | 1 | | | | | | | | | | | | | |
| POR | -0.98* | 1 | | | | | | | | | | | | |
| CUM IF | -0.13 | 0.28 | 1 | | | | | | | | | | | |
| IR | -0.25 | 0.67 | 0.952* | 1 | | | | | | | | | | |
| EC | -0.24 | 0.27 | 0.69 | 0.49 | 1 | | | | | | | | | |
| BS | -0.21 | 0.20 | -0.13 | 0.54 | 0.99* | 1 | | | | | | | | |
| CEC | -0.25 | 0.25 | 0.58 | 0.36 | 0.99* | 0.97* | 1 | | | | | | | |
| GMC | -0.25 | 0.25 | 0.46 | 0.27 | 0.94* | 0.96* | 0.98* | 1 | | | | | | |
| ORG C | -0.28 | 0.27 | 0.51 | 0.28 | 0.27 | 0.95* | 0.99* | 0.99* | 1 | | | | | |
| ORG M. | -0.27 | 0.27 | 0.51 | 0.28 | 0.97 | 0.95* | 0.99* | 0.99* | 0.99* | 1 | | | | |
| Sand | 0.61 | -0.61 | -0.69 | -0.55 | -0.91 | -0.89 | -0.88 | -0.82 | -0.87 | -0.86 | 1 | | | |
| Clay | -0.29 | 0.28 | 0.85* | 0.70 | 0.96* | 0.97* | 0.91* | 0.81* | 0.87* | 0.87* | -0.93* | 1 | | |
| Sorp | -0.30 | 0.28 | 0.96* | 0.92* | 0.69 | 0.72 | 0.57 | 0.41 | 0.51 | 0.51 | -0.76 | 0.86* | 1 | |
| Trans | 0.91* | 0.86* | -0.13 | -0.14 | 0.05 | -0.01 | 0.06 | 0.10 | 0.10 | 0.10 | -0.36 | 0.02 | 0.004 | 1 |

## CONCLUSION

The goal of the study was to investigate the impact of various land-use types on soil infiltration capacity. The average infiltration rate of fallow land, plantain plantation, oil palm plantation, and virgin land was 26, 20.1, 13.6, and 30.7cm/hr, respectively, while the average cumulative infiltration was 53.3, 42.2, 36.3, and 67.4cm. This demonstrates that land use types had a significant impact on soil infiltration capacity; virgin land had the highest infiltration rate and cumulative infiltration, while oil palm plantations had the lowest infiltration rate and cumulative infiltration. Sorptivity, the rate at which soils adsorb and desorb water, was highest in virgin land and lowest in oil palm plantations, while transmissivity, the rate at which water moves through the soil, was slowest in the plantain plantation and fastest in the fallow land; which could be traced to the higher bulk density of the virgin and plantain plantations. Also, the lower bulk density of the fallow land and oil palm plantation induced the transmissivity to be faster than the others. It is, therefore, recommended that lands with high bulk density be tilled before any irrigation activity is carried out, to attain water efficiency, land use types with vegetation cover that can accommodate the optimum volume of water be used to cultivate crops with high water requirements and organic matter should be added to the soils to improve their fertility and water holding capacity.

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