

## Preliminary Soil Resistivity Survey to Evaluate Physical Properties of Soils in the Southern Suburb of Kumasi, Ghana

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**Abstract:** A surface geophysical survey was carried out to determine the variations of measured soil resistivity and some basic soil physical properties with particular reference to porosity, bulk density (BD) and moisture content (MC). Using *ex-situ* DC soil electrical resistivity method, the effect of the apparent soil resistivity on the physical properties was effectively determined. In all, sixty (60) soil samples were collected from six (6) different sites, with ten samples collected from each through six different profiles. Results obtained for the maximum and minimum mean soil resistivities were respectively 92.86  $\Omega\text{m}$  (profile 6) and 43.53  $\Omega\text{m}$  (profile 4). The mean minimum and maximum BD values were 2.138  $\text{gcm}^{-3}$  and 2.368  $\text{gcm}^{-3}$  from profiles 2 and 1 respectively. The mean porosity values were also between 49.88 % (profile 3) and 66.27 % (profile 4), and the mean MC values recorded were between 12.01 % (profile 1) and 39.72 % (profile 5). The apparent resistivity was highly correlated to BD with maximum and minimum positive correlation coefficients ( $R^2$ ) of 0.9467 and 0.7009 respectively. Both the MC and porosity showed negative correlation with the measured soil resistivity. The  $R^2$  value of 0.954 (maximum) and 0.3358 (minimum) were determined for the resistivity – MC relationship whereas, the resistivity – porosity relationship recorded 0.9399 (maximum) and 0.8334 (minimum). These results showed significant relationship developed between the soil electrical resistivity and the physical properties. In addition, locations that recorded high resistivity also produced high BD values as compared with the porosity and MC values. These results may be used to improve the soil characterization for soil genesis studies in Ghana, and map soils for precise agricultural practices, road construction and other foundation studies. Moreover, it can be used to evaluate surface and subsurface profile assessment with much emphasis on environmental and engineering applications.

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### 1. Introduction

Soils vary widely from place to place and from season to season, therefore, many factors come together to determine the physical structure as well as the chemical composition of the soil at any given location. The different kinds of rocks, minerals, and other geologic materials from which soils are originally formed however, play a vital role. The type of plants or vegetation that grow on the soil are also important so far as soil foundation study is concerned. According to Cosenza *et al.*, 2006; Soupios *et al.*, 2007; Sudha *et al.*, 2009; Farbisz *et al.*, 2010; Syed and Siddiqui, 2012; and Kowalczyk *et al.*, 2014, soil electrical resistivity is one of the leading geophysical methods applied for assessing the quality of foundation soil in civil engineering. Preliminary or foundation studies so far as soil survey is concerned, requires swift estimations of soil physical properties (Pozdnyakov and Pozdnyakova, 2002) such as bulk density, moisture content, porosity, temperature and soil profile assessment.

Understanding soil and its physical properties is also important in engineering and construction, since it aids soil scientists and engineers to carry out detailed analysis of the soil prior to building roads, houses and industries, as well as, groundwater survey (Kvamme, 2000) and agricultural activities.

This electrical geophysical survey employs the conventional method of soil analysis as described by Pozdnyakov and Pozdnyakova, 2002, which is an *ex-situ* method which mostly requires disturbing the soil matrix by collecting samples and analyzing them in the laboratory. However, the relationships between electrical properties and other soil physical properties vary as many soil properties may simultaneously influence in-situ measured electrical parameters (Pozdnyakova, 1999). It must be stressed that soil resistivity may vary widely within a very short distance on a profile and also with depth below the ground surface. Therefore, in sampling soils, many samples must be taken for accurate map of soil resistivities in the area (Almasoud and Al-Solami,

2014). The internal structure of the earth can also be investigated by taking into consideration the physical properties of the soil.

Engaging the surface or the subsurface for specific purposes such as road and bridge construction, fuel-filling stations, high-tension electric power stations, telephone and electricity mast stations and other manufacturing industries, require fresh soil or mechanically strong soils, which have often not undergone major degrees of weathering. For engineering purposes therefore, the most vital requirements are a report on the strength and behaviour of soil masses and not merely the mineral composition, soil texture and the true geological name which remain a priority to geoscientists. The objective of this paper therefore is the determination of the spatial variation of apparent soil resistivity along specific profiles. Specifically, the paper seeks to establish relationships between the measured soil electrical resistivities and the soil physical properties and also establish any possible correlation to further address any preliminary or foundation studies.

## 2. Material and Methods

### 2.1. Study Area and Site Description

The Kumasi Metropolis is centrally located in the Ashanti Region and specifically situated on latitude  $6.68^\circ$  North, longitude  $1.62^\circ$  West and 247 m above sea level. The metropolis is the most populous district in the region and consists of about 1,468,609 inhabitants. The Metropolitan area has a total surface area of 254 sq km (according to the year 2000 population census) with a population density of 5,419 persons per sq. km, which is second to the Accra metropolis (with 5,530 persons per sq. km). Six (6) different locations found at the southern suburb of the Kumasi metropolis were chosen as sample locations. Resistivity soil sampling were carried out six different profiles which were laid along the Kumasi-Ejisu section of the Kumasi-Accra highway (14 km) and along the Onwi-Asienimpong section of the Ejisu-Bekwai road (6 km). These areas are strongly affected by human activities with a very high vehicular traffic density. The total outstretch of the study site covered about 20 km in distance.

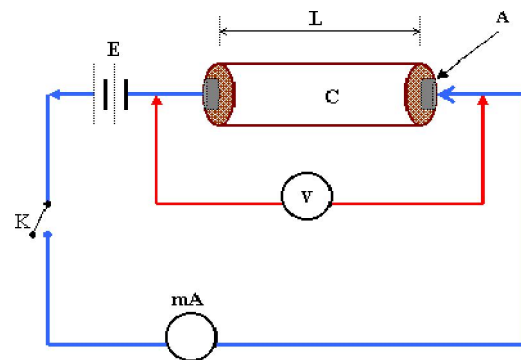
### 2.2. Soil Sampling and Laboratory Procedures

For each chosen site, ten (10) soil samples (in specific profiles) were collected, making the total number of soil samples collected and analyzed to be sixty (60). Each of these samples was taken on a profile at an interval of 10 m, eventually covering a profile length of hundred meters (100 m). Soil samples from the near surface ( $\sim 0-15$  cm) were carefully collected using stainless steel core-samplers at regular intervals. After collection, the samples were initially stored in sealed polythene bags,

labelled and transported to the laboratory for analysis. In the laboratory, samples from each profile of sample location (site) were divided into two sub-samples (at natural water content), of which, each sub-sample was used for the electrical resistivity measurements while the remaining sub-sample used to determine physical properties such as Bulk density, Porosity, and Moisture content. Similar to the *in-situ* method where soil resistivity meters are taken onto the field for direct measurements, this technique adopts the soil-box method (*ex-situ* method), where soil samples are collected from the field and analyzed in the laboratory.

### 2.3. DC Electrical Resistivity Measurements

The soil samples were placed in a piece of plastic cylinder (PVC pipe) of measured length,  $L$  connected in a simple circuit shown in the set-up (figure 1). A 10 V voltage was supplied through the circuit. A known current,  $I$  was introduced into each sample,  $C$ . The milliammeter,  $mA$  connected in series with the sample measured the amount of current through the soil sample whereas, the voltmeter  $V$ , connected across the sample measured the corresponding potential difference (p.d) across the sample. The cross-sectional area of the plastic cylinder was also measured and recorded.



**Figure 1.** Experimental Set-Up to Determine Soil Resistivity

Before readings were taken from both milliammeter and the voltmeter, it was ensured that the conducting plate,  $A$  soldered onto a piece of wooden cork at the ends of the plastic cylinder had a good contact with the sample so that current could be conducted through the sample,  $C$ . This wooden seal with the conducting plate at the ends served as a conductor at both ends of the cylinder. The methodology was therefore an active one which employed measurements of electrical potential associated with subsurface electrical current-flow generated by a DC or slowly varying AC source. This technique measured the ability of the soil to resist an

electrical current passing through it. According to Vendl, 2001 the differences in resistance may be due to the nature or the physical properties of the soil. More conveniently however, electrode arrays (e.g. Wenner, Schlumberger or Dipole-dipole) could be moved along profiles on the field (*in-situ* method) to determine the apparent resistivity of the soil under the profiles. In addition to these listed geophysical models or arrays, the vertical electrical or resistivity soundings and resistivity profiling (Chaker, 1981) are also considered as the most common electrical methods used in hydro-geologic and environmental investigations.

### 2.3.1 Basic theory of electrical resistivity survey

All the electrical resistivity methods applied in soil surveys are based on the standard four-electrode principle (according to the Wenner four-electrode principle since 1915) needed to obtain the apparent resistivity are variants of this four-electrode scheme. Considering resistivity survey measured using an array of electrodes that measure the bulk resistivity of the soil around and between the electrodes as arranged in Lowrie, 1997, current flows from the outside electrodes into the earth and spreads out vertically and horizontally. This theoretical direction of current flow results from the assumption that the soil is a uniform half-space (homogeneous) and by convention, the free positive charge moves radially outward from a point source and radially inward toward a negative point source (Chaker, 1981). The current lines represent a sampling of the infinitely many paths followed by the current, paths that are defined by the condition that they must be everywhere normal to the equipotential surfaces (US EPA, 2011; Wightman *et al.*, 2003).

The purpose of a DC electrical survey is to determine the subsurface resistivity distribution of the ground, which can then be related to physical conditions or properties of interest such as bulk density, porosity, and moisture content. The basic parameter of a DC electrical measurement is resistivity (Johnson, 2003). The resistance (R), measured in ohms, is the result of an electrical measurement, where according to Ohm's Law;

$$R = \frac{V}{I}$$

where, V is the voltage (measured in volts), and I is the current (measured in amperes). Considering a conductor as a small portion of soil of length L, resistance R and cross-sectional area A, the soil resistivity  $\rho$  [ $\Omega\text{m}$ ] is defined by;

$$\rho = \frac{RA}{L}$$

### 2.3.2. Determination of Soil Physical Properties

So far as this paper is concerned, the soil physical properties become an imperative tool for evaluating the suitability of soil subsurface for a particular purpose. These significant properties seek to answer questions as to whether the soil can support trees or plants, are loosely bound or are compact, whether or not it is too anaerobic or prone to drought. Besides, the question as to whether the soil can withstand vehicular traffic or will fail under stress, require thorough knowledge of the physical properties of the surface and subsurface soil (Brady, *et al.*, 1999). This paper therefore considers bulk density, moisture content, and porosity as physical properties whose effect on the soil resistivity is evaluated and analyzed.

#### 2.3.2.1 Bulk Density ( $\rho_d$ )

Soil bulk density is considered a ratio of the weight of a given volume of soil (solid) to the total volume. It certainly depends upon the amount of pore spaces, texture, arrangement of soil particles (structure), and organic matter content of the soil. It is therefore considered the weight (oven-dry) of a volume of the bulk soil. This is determined in the laboratory from the ratio of the mass of dry soil to the bulk (total) volume of the soil. The bulk volume includes the volume of the solids (soil) and the volume of the pore space. The mass is determined after drying in an oven to a constant weight at 105 °C temperature to ensure that soil is completely dry and from the expression

$$\rho_d = \frac{\text{oven-dry weight of total soil}}{\text{volume of the air-dry soil}}$$

the bulk density  $\rho_d$  of the sample is determined.

#### 2.3.2.2 Moisture Content (MC)

Moisture content value is based on the weight of the water in the soil, and not necessarily, the volume of water present. Therefore in the laboratory, the method used consists of weighing the sample, drying it in the oven (between temperatures of 105 - 110 °C), and re-weighing the sample. The difference between the wet and dry weights reflects the weight of the water driven from the sample. The moisture content (MC) is then calculated using the relation below;

$$\text{MC \%} = \frac{\text{container and wet soil} - \text{container and dry soil}}{\text{container and dry soil} - \text{empty container}} \times 100$$

#### 2.3.2.3 Porosity, $S_v$

The way soil behaves depends not only on the kind and size of individual particles but also on how these are arranged and bonded together or interconnected. The porosity therefore measures the pore spaces in the soil which influences how much

water and air a soil can hold. Therefore, on a volume basis:

- Percentage (%) pore space + Percentage (%) solid space = 100 %
- Percentage (%) pore space = 100% - Percentage (%) solid space

- But, Percentage (%) solid space = (bulk density / particle density) x 100%,
- % pore space = porosity = 100% - (bulk density / particle density) X 100%

**Table 1.** Resistivity and physical properties of investigated soils

Profile 1	V [v]	I [mA]	R [ $\Omega$ ]	Distance[m]	$\rho$ [ $\Omega$ m]	Moisture Content[%]	Bulk Density [gcm <sup>-3</sup> ]	Porosity[%]
S <sub>1</sub>	13.72	1.00	13720.00	0.00	89.04	11.07	2.47	49.54
S <sub>2</sub>	13.66	0.98	13938.78	10.00	90.46	11.02	2.57	48.47
S <sub>3</sub>	15.07	4.00	3767.50	20.00	24.45	19.44	1.72	80.40
S <sub>4</sub>	15.09	1.00	15090.00	30.00	97.93	10.23	2.51	46.59
S <sub>5</sub>	15.22	0.96	15854.17	40.00	102.89	7.09	2.62	42.17
S <sub>6</sub>	15.10	1.00	15100.00	50.00	97.99	9.66	2.55	46.17
S <sub>7</sub>	15.19	2.20	6904.55	60.00	44.81	15.38	2.11	72.46
S <sub>8</sub>	14.21	3.00	4736.67	70.00	30.74	16.59	2.03	75.13
S <sub>9</sub>	15.08	1.00	15080.00	80.00	97.86	10.43	2.54	46.87
S <sub>10</sub>	15.13	1.00	15130.00	90.00	98.19	9.22	2.56	44.03
Profile 2	V [v]	I [mA]	R [ $\Omega$ ]	Distance[m]	$\rho$ [ $\Omega$ m]	Moisture Content[%]	Bulk Density [gcm-3]	Porosity[%]
S1	15.44	1.10	14036.36	0.00	91.09	20.92	2.18	54.57
S2	15.40	1.00	15400.00	10.00	99.94	15.61	2.22	42.34
S3	15.50	1.20	12916.67	20.00	83.82	21.80	2.17	55.18
S4	15.41	1.40	11007.14	30.00	71.43	34.68	1.99	79.35
S5	15.39	1.00	15390.00	40.00	99.87	18.60	2.20	43.34
S6	15.42	1.30	11861.54	50.00	76.98	26.25	2.08	69.96
S7	15.49	1.10	14081.82	60.00	91.38	20.65	2.18	53.26
S8	15.43	1.20	12858.33	70.00	83.44	25.56	2.17	57.66
S9	15.47	1.40	11050.00	80.00	71.71	30.44	2.04	76.35
S10	15.36	1.20	12800.00	90.00	83.07	26.07	2.15	58.04
Profile 3	V [v]	I [mA]	R [ $\Omega$ ]	Distance[m]	$\rho$ [ $\Omega$ m]	Moisture Content[%]	Bulk Density [gcm-3]	Porosity[%]
S1	15.43	2.00	7715.00	0.00	50.07	18.87	2.12	54.90
S2	15.48	2.00	7740.00	10.00	50.23	18.76	2.17	53.25
S3	15.37	1.20	12808.33	20.00	83.12	13.05	2.20	47.13
S4	15.47	1.00	15470.00	30.00	100.39	11.32	2.22	36.44
S5	15.64	1.30	12030.77	40.00	78.07	14.90	2.19	48.09
S6	15.53	1.10	14118.18	50.00	91.62	12.36	2.21	46.43
S7	15.49	1.00	15490.00	60.00	100.52	10.70	2.23	36.34
S8	15.43	2.20	7013.64	70.00	45.51	20.35	2.03	66.12
S9	15.42	2.00	7710.00	80.00	50.03	19.43	2.07	58.47
S10	15.41	1.40	11007.14	90.00	71.43	17.85	2.19	51.67
Profile 4	V [v]	I [mA]	R [ $\Omega$ ]	Distance[m]	$\rho$ [ $\Omega$ m]	Moisture Content[%]	Bulk Density [gcm-3]	Porosity[%]
S1	15.52	2.0	7760.00	0.00	50.36	20.49	2.21	56.61
S2	15.55	2.2	7068.18	10.00	45.87	23.52	2.20	58.09

S3	15.62	1.3	12015.38	20.00	77.97	13.74	2.22	50.17
S4	15.57	1.8	8650.00	30.00	56.13	15.56	2.21	56.45
S5	15.37	3.0	5123.33	40.00	33.25	46.21	2.14	73.87
S6	15.62	2.7	5785.19	50.00	37.54	29.32	2.16	70.34
S7	15.39	3.6	4275.00	60.00	27.74	53.64	2.08	79.45
S8	15.56	2.9	5365.52	70.00	34.82	36.22	2.14	73.43
S9	15.6	2.4	6500.00	80.00	42.18	29.16	2.19	69.57
S10	15.44	3.4	4541.18	90.00	29.47	46.35	2.11	74.69
Profile 5	V [v]	I [mA]	R [ $\Omega$ ]	Distance[m]	$\rho$ [ $\Omega$ m]	Moisture Content[%]	Bulk Density [gcm-3]	Porosity[%]
S1	14.99	1.2	12491.67	0.00	81.06	23.43	2.19	55.23
S2	14.97	1.4	10692.86	10.00	69.39	32.65	2.17	56.76
S3	14.78	1.6	9237.50	20.00	59.95	54.24	2.12	72.54
S4	15.01	1.7	8829.41	30.00	57.30	76.43	2.09	77.76
S5	14.82	1.3	11400.00	40.00	73.98	32.14	2.18	56.25
S6	14.94	1.5	9960.00	50.00	64.64	34.87	2.16	67.48
S7	15.03	1.0	15030.00	60.00	97.54	9.90	2.34	39.24
S8	15.14	1.9	7968.42	70.00	51.71	100.14	1.96	79.90
S9	14.92	1.0	14920.00	80.00	96.82	10.86	2.24	49.62
S10	14.87	1.0	14870.00	90.00	96.50	22.56	2.22	53.90
Profile 6	V [v]	I [mA]	R [ $\Omega$ ]	Distance[m]	$\rho$ [ $\Omega$ m]	Moisture Content[%]	Bulk Density [gcm-3]	Porosity[%]
S1	15.87	0.8	19837.50	0.00	128.73	19.76	2.18	55.30
S2	16.02	0.7	22885.71	10.00	148.52	19.70	2.23	39.52
S3	15.79	0.9	17544.44	20.00	113.85	20.23	2.17	56.54
S4	15.92	0.5	31840.00	30.00	206.62	15.84	2.34	38.43
S5	15.97	1.4	11407.14	40.00	74.03	23.56	2.15	57.55
S6	15.88	1.8	8822.22	50.00	57.25	34.09	2.10	69.67
S7	15.94	1.9	8389.47	60.00	54.44	43.32	2.09	70.13
S8	16.08	1.7	9458.82	70.00	61.38	30.14	2.15	57.72
S9	15.72	2.5	6288.00	80.00	40.81	98.65	1.99	76.73
S10	15.88	2.4	6616.67	90.00	42.94	45.32	2.03	75.93

**S = sample R = resistance  $\rho$  = apparent resistivity V = Voltage I = current**

Profile 1 = (KNUST-Gate 1) Profile 2 = (KNUST-Gate 2) Profile 3 = (Oduom) Profile 4 = (Ejisu) Profile 5 = (Onwi)

Profile 6 = (Asienimpong)

Therefore;

$$\text{Porosity, } S_t = \left(1 - \frac{\rho_d}{\rho_p}\right) \times 100\%$$

Where,  $\rho_d$  = Bulk density;  $\rho_p$  = Particle density.

But,

$$\text{Particle density, } \rho_p = \frac{M_d}{V_p}$$

where,

$M_d$  = Oven-dry weight of total soil;

$V_p$  = Volume of the oven-dry soil.

### 3. Results and Discussions

The results according to table 1 represent physical variations and relationship between the soil resistivity and the physical properties (bulk density, moisture content, and porosity) for investigated soils. The resistivity values of the various soil samples obtained were plotted against each of the physical properties to verify how they are interrelated, so as to prompt further geophysical tests needed for foundation studies, which normally may be conducted before right choices are made on the soil usage for a particular purpose.

The results obtained from the resistivity measurements (*ex-situ*), together with the physical properties, are displayed in graphs which indicate

how soil resistivity is affected by the physical properties. Figure 2 therefore shows the results of the variation of the measured resistivity with separation distance of the selected sites of each of the ten (10) sample locations from the six (6) different profiles and that of the physical properties.

### 3.1 Soil Apparent Resistivity with Distance

From the resistivity-distance relationship according to figure 2, the measured soil resistivities vary significantly with distance for all profiles. This is contrary to the expectation that, soil resistivity normally do not vary extensively with short distances. This might be due to the fact that, the surface soils are highly inhomogeneous. This therefore makes the measured soil resistivities vary between 27.74  $\Omega\text{m}$  (minimum) and 206.62  $\Omega\text{m}$  (maximum), specifically at respective locations of profile 4 (Ejisu) and profile 6 (Asienimpong) as shown in figure 3 considering all the six (6) profiles.

### 3.2 Measured Soil Resistivity and Physical Properties

The results obtained from the measured soil resistivity showed a very strong correlation with all the measured physical properties (figure 3.1-3.6). Specifically, the apparent resistivity showed strong positive correlation with bulk density (BD), whereas it displayed strong negative correlation with the MC and porosity.

The measured resistivity plot of the various soil samples against the physical properties (according to figure 3.1-3.6) also showed very consistent outcome throughout the analysis, and from the regression coefficient ( $R^2$ ) model, significant values for all locations were determined. For all sample locations, it is clear from figure 3.1-3.6 that, as the measured soil resistivity increases, the MC decreases and vice versa. Therefore, sites that recorded low resistivity also recorded high MC since favourable conditions exist to accumulate and retain soil moisture. Profile 3 (Oduom) produced a very strong negative correlation between the resistivity and MC thereby recorded higher  $R^2$  value of 0.954, while the least correlation was recorded at profile 5 (Onwi) with 0.3358 value for  $R^2$ . The moisture content in soils influence the mobility of electrical charges and this makes the amount of water present in the soil an imperative factor so far as its correlation with soil resistivity is concerned.

The measured resistivity compared with the soil porosity showed similar linear relationship as with

that of the MC discussed above. Figure 3.1-3.6 showed porosity variation with resistivity of the soil from all sampled locations which also showed a very strong negative correlation. The results indicated that soils with fine texture or least particle-size distribution recorded highest mean porosity values (table 1 and figure 3.1-3.6) giving a clear relationship that, the measured resistivity decreases with increasing porosity. These confirm the fact that, soil porosity increases when soils are loosely bound and in effect, decreases soil resistivity in general.

With regards to the BD, results from figure 3.1-3.6 also showed linear relationship with the measured soil resistivity. As the measured BD increases, the resistivity also increases and vice versa, showing a very high positive correlation. The highest and lowest value of  $R^2$  determined were respectively 0.9467 and 0.7009, and at respective locations of profile 1 (KNUST-Gate 1) and profile 4 (Ejisu). According to the research, the minimum and maximum BD values were respectively 1.72  $\text{gcm}^{-3}$  and 2.62  $\text{gcm}^{-3}$  (Table 1), and both values were recorded at specific location of profile 1 (KNUST-Gate 1). These recorded values of BD correspond with conclusions of Brady *et al.*, 1999 that; soil bulk density values generally range from 0.5 to 3.0 even though, most values are between 0.8 and 1.8  $\text{gcm}^{-3}$ . However, majority of the recorded values from the research are beyond the 1.8  $\text{gcm}^{-3}$  and since BD values denser than about 1.8 are root limiting and according to Brady *et al.*, 1999 not considered conducive for plant growth, agricultural practices cannot therefore be encouraged on such locations.

## 4. Conclusions

From the research, all the measured soil resistivity varies significantly spatially (Table 1 and figures 2 and 3) due to the inhomogeneous nature of the sampled locations. There also exist some correlation between measured resistivity and the soil physical properties (MC, BD and porosity). The measured soil resistivity linearly increases with decreasing soil MC as well as porosity, agreeing with findings of Omunguye and Akpila, 2013 and Ozcep *et al.*, 2010. However, since the soil is a reflection of the amount of pore spaces (porosity), the resistivity measured directly affects the BD of the soil. The findings therefore agree to the fact that; increasing the soil resistivity also increases BD of the soil and vice-versa.

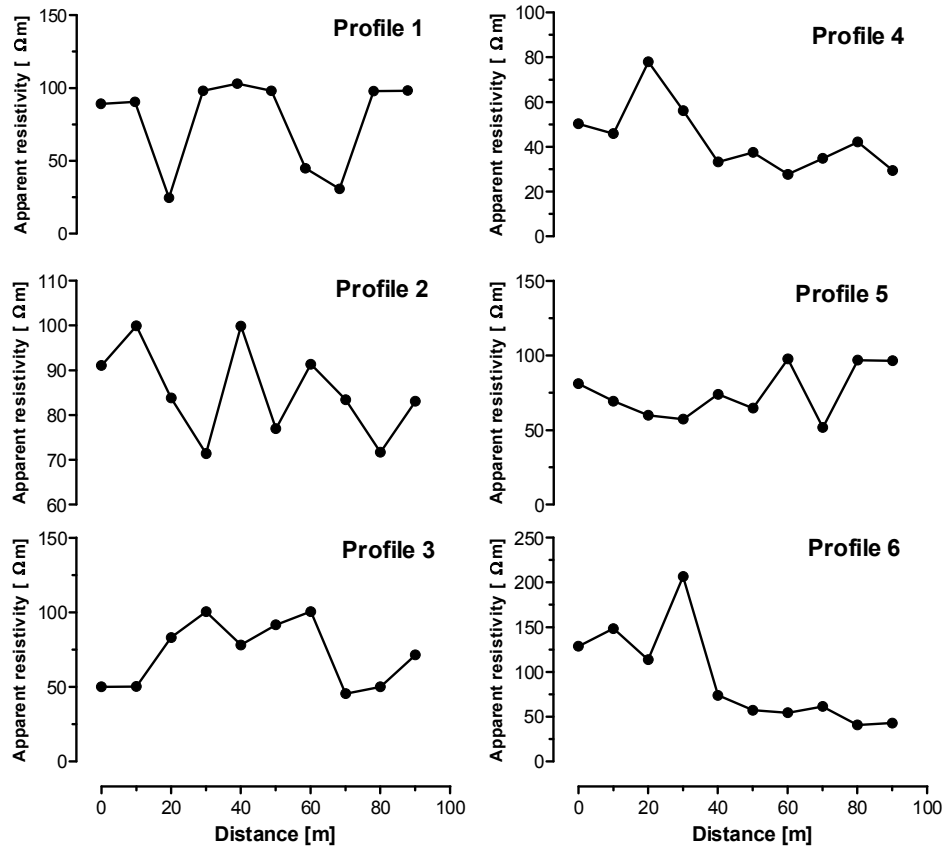


Figure 2. Soil resistivity variations as a function of distance for profiles 1-6

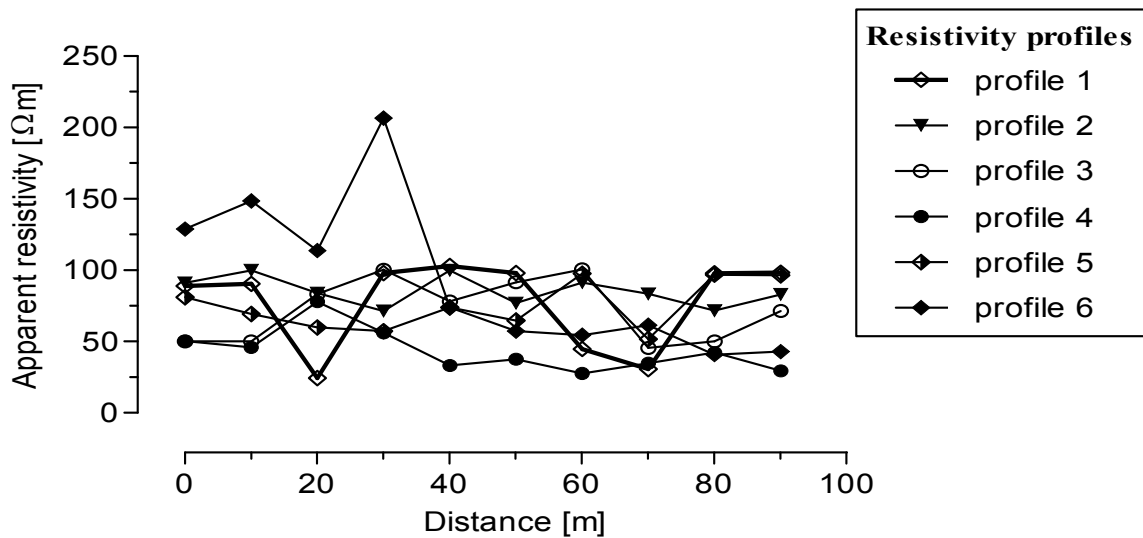
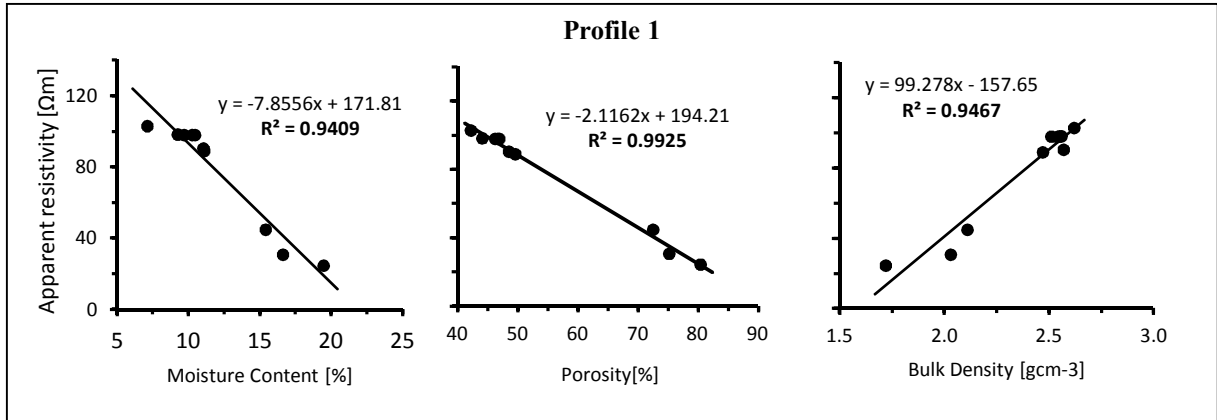
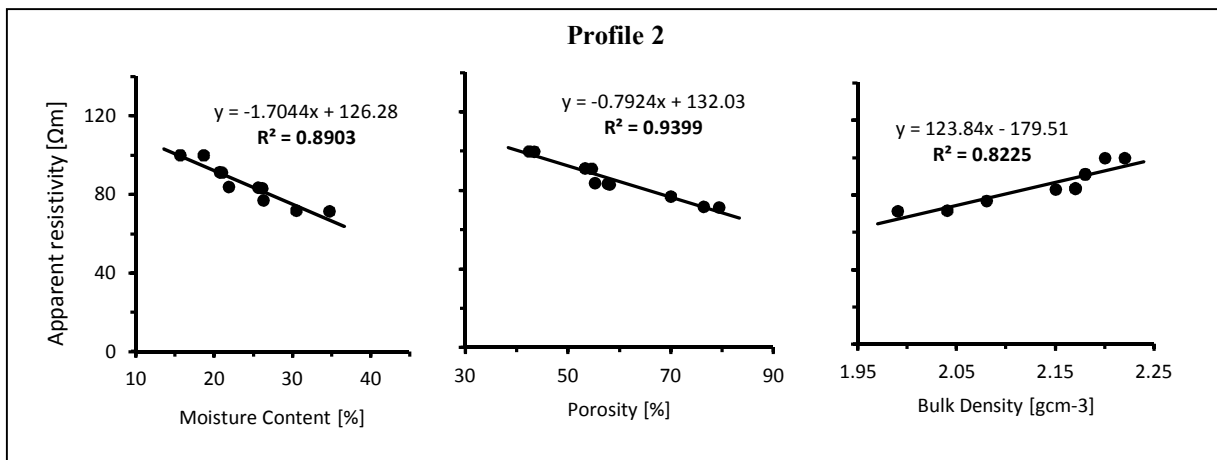


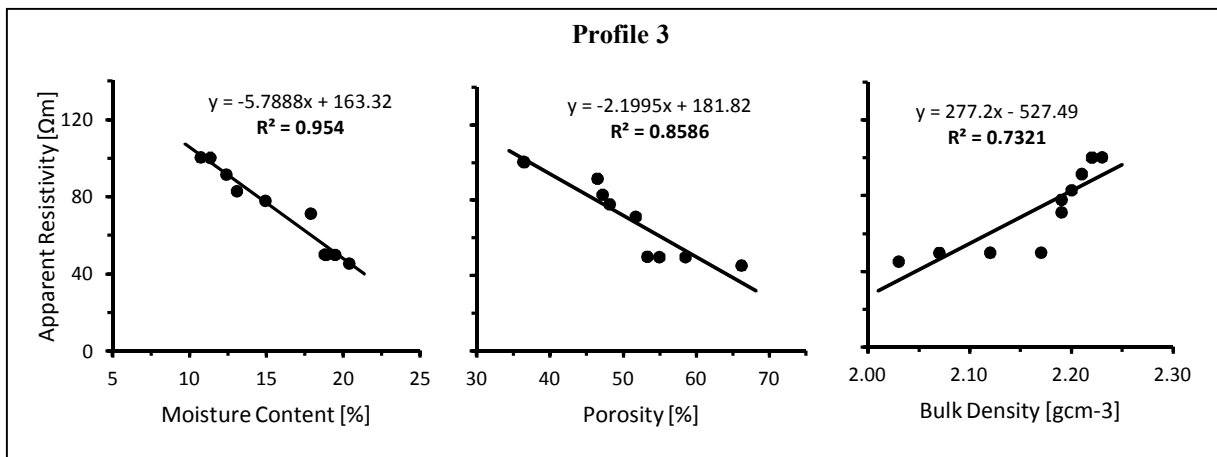
Figure 3. Soil resistivity variations for all 6 profiles on the field



**Figure 3.1** Variation of soil resistivity as a function of physical properties for Profile 1

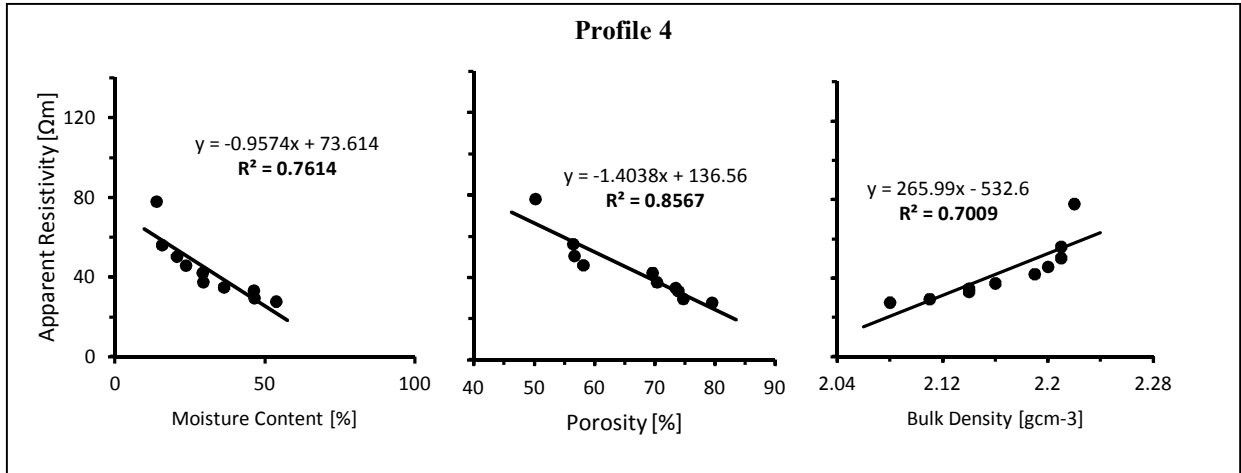


**Figure 3.2** Variation of soil resistivity as a function of physical properties for Profile 2

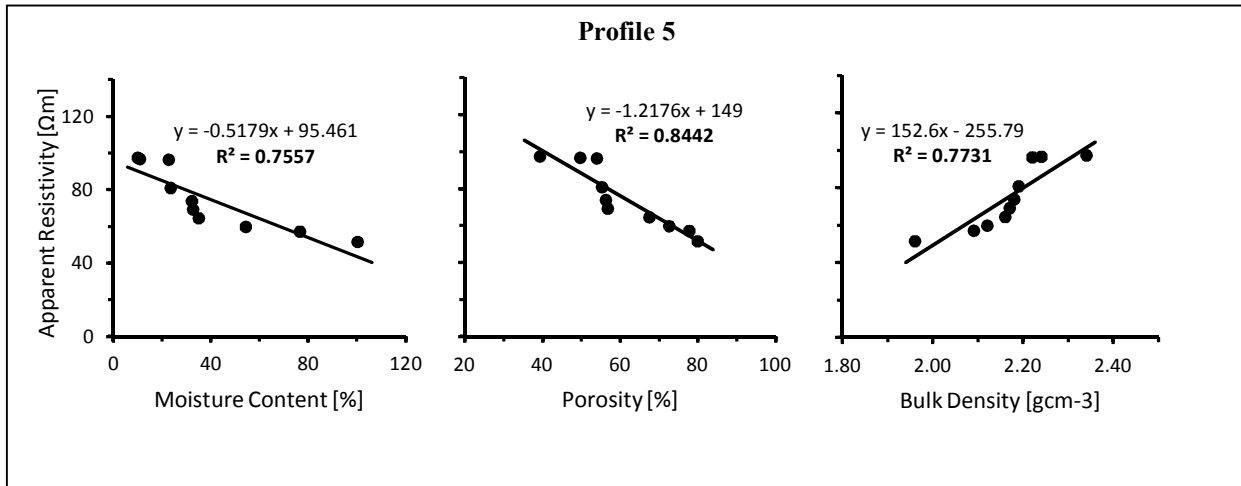


**Figure 3.3** Variation of soil resistivity as a function of physical properties for Profile 3

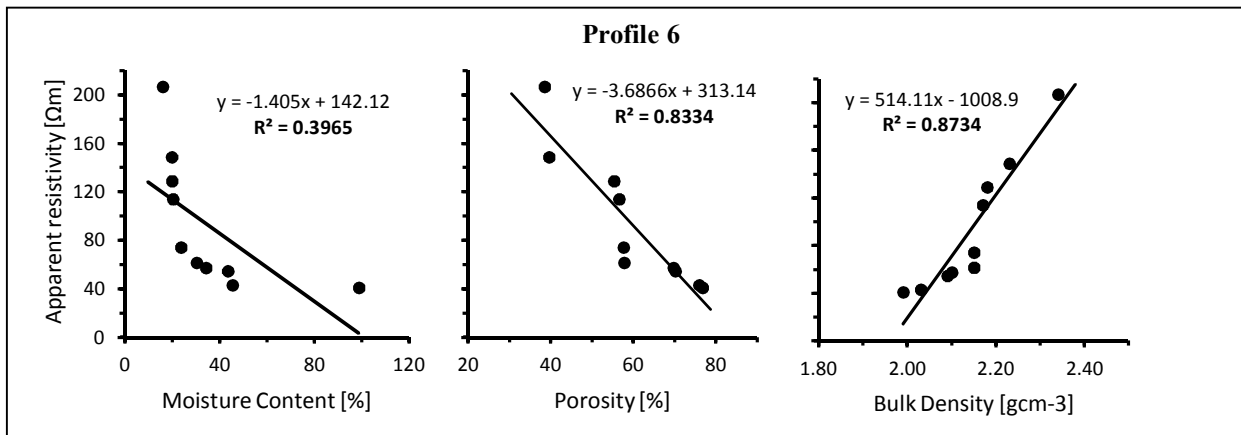




**Figure 3.4** Variation of soil resistivity as a function of physical properties for Profile 4



**Figure 3.5** Variation of soil resistivity as a function of physical properties for Profile 5



**Figure 3.6** Variation of soil resistivity as a function of physical properties for Profile 6

This method of survey (resistivity survey) is necessary to aid civil engineers, geophysicists and soil scientists to estimate for the mechanical properties of the soil and also aid in fundamental or

foundation studies, especially locating sites for refuse dump, fuel station and septic tank. Soil resistivity survey have strong correlation with other soil physical properties such as corrosivity (Ibitoye *et al.*,

2013), and it is a vital tool for predicting corrosion in buried metallic structure (Preko *et al.*, 2006).

In conclusion, all the measured soil physical properties according to the study, showed significant correlation with the measured soil resistivity therefore influencing the mobility of electrical charges in soils. Again, the paper reveals that, soil samples with bigger grain size (loosely bound) also recorded high resistivity as well as the soil bulk density. However, the porosity and moisture content values were low. On a whole, the results can be used to improve the soil characterization for soil genesis studies in Ghana, and map soils for precise agricultural practices, construction (roads and buildings) and other foundation studies. The soil resistivity survey can be considered as a proxy for the spatial and temporal variability of many other soil physical properties therefore, the results obtained for future studied can be used to evaluate soil pollution, environmental applications and engineering applications.

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