Multivariate Analysis Of Ground Water Characteristics Of Geological Formations Of Enugu State Of Nigeria.

Orakwe, LC, Chukwuma, EC

Abstract: The chemometric data mining techniques using principal factor analysis (PFA), and hierarchical cluster analysis (CA), was employed to evaluate, and to examine the borehole characteristics of geological formations of Enugu State of Nigeria to determine the latent structure of the borehole characteristics and to classify 9 borehole parameters from 49 locations into borehole groups of similar characteristics. PFA extracted three factors which accounted for a large proportion of the variation in the data (77.305% of the variance). Out of nine parameters examined, the first PFA had the highest number of variables loading on a single factor where four borehole parameters (borehole depth, borehole casing, static water level and dynamic water level) loaded on it with positive coefficient as the most significant parameters responsible for variation in borehole characteristics in the study. The CA employed in this study to identified three clusters. The first cluster delineated stations that characterise Awgu sandstone geological formation, while the second cluster delineated Agbani sandstone geological formation. The third cluster delineated Ajali sandstone formation. The CA grouping of the borehole parameters showed similar trend with PFA hence validating the efficiency of chemometric data mining techniques in grouping of variations in the borehole characteristics in the geological zone of the study area.

Keywords: Borehole Characteristics, Multivariate Analysis, Cluster Analysis, Principal Factor Analysis, Geological Formations, Enugu state.

1. INTRODUCTION

Water is our most valuable natural resource. It is essential to all basic human needs, including food, drinking water, sanitation, health, energy and shelter. Its proper management is the most pressing natural resource challenge of all. Without water we have no society, no economy, no culture, and no life. By its very nature and multiple uses, water is a complex subject. Although water is a global issue, the problems and solutions are often highly localized [1]. Generally, the major water-consumptive uses in Africa are for agriculture activities and human settlements. However, there has been an increasing use of water in the industrial sectors which is affecting water quality. It is predicted that by the year 2025 several African countries will experience water scarcity. As at now, 11 countries are experiencing water stress and 15 countries suffer water scarcity conditions [2]. Water resource management is a vital important resource whose availability is often taken for granted until there is a scarcity or significant flooding.To appropriately site and design water sources, the groundwater resources of an area need first to be investigated to understand how water occurs in the ground [3]. The broad objectives of water management cover the utilisation and development of water resources in an efficient, environmentally sound, equitable and reasonable manner in order to satisfy society's demand for water, water-related goods and services, as well as to safeguard the ecological functions of water resources. Distribution of water in major parts of Africa is characterised by complex patterns and striking paradoxes which exhibit an abundance of rainfall over the equatorial zone contrasted by extensive and extreme aridity of the Sahara desert in the north and the Kalahari desert in the south [2]. Groundwater exploration is gaining greater attention due to increasing demand for water supply. The occurrence, storage, and distribution of groundwater are influenced by different geological factors. Test drilling and stratigraphy analysis are some reliable ways in determining the location of an aquifer and its characteristics. The failure in most groundwater development projects has been linked to inadequate knowledge in groundwater characteristics of any given area; hence the use of geophysical surveys as a pre-requisite to any successful groundwater resources development has been reiterated. The spatially variability of groundwater characteristics is known; groundwater data of at state of region is usually large complex dataset and needs simplification for water resource management. Several researches with large complex data have been simplified and hidden data structure identified with multivariate statistical technique. One of these data mining technique is PFA, it is a multivariate technique for transforming a set of related (correlated) variables into a set of unrelated (uncorrelated) variables that account for decreasing proportions of the variation of the original observations [4]. [5] used multivariate statistical analysis such as CA and PFA/factor analysis to evaluate temporal/spatial variations in water quality and identify latent sources of water pollution in the Songhua River Harbin region, China. The quality of harvested rainwater used for toilet flushing in a private house in the southwest of France was assessed over a one-year period by [6] using multivariate techniques. To elucidate factors affecting the rainwater composition, PFA and CA were applied to the complete data set of 50 observations. Knowledge on the subsurface geophysical conditions in many parts of Nigeria is needed for water resource management and planning. Hence the aim of this study is to determine the natural groupings of borehole characteristics in Enugu state of Nigeria, and to characterise associations present in the complete data set.

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1.1 Environmental setting of study Area

The study area Enugu state of is situated at the Southern Eastern part of Nigeria. It is located between Latitude 6^0 20' - 6^0 50'N and Longitudes 7^0 20' - 7^0 30'E. The climate is characterized by a tropical wet and dry climate. The rainy season lasts approximately seven months from April to October and the dry season lasts from November to March. There is a two month spell of dry dust-laden wind blowing North-South from the Sahara causing what is known as Harmattan haze. The climate is of subequatorial type with rainfall varying from 1,860 mm – 2,000 mm. Temperature range and Sunshine have little variations throughout the year, with mean values of temperature at 29^o C and mean values of Sunshine is 6 hours. General physiographic features within the study area comprise the Enugu and Udi Plateau escarpment. The Udi Plateau is a larger physiographic unit extending through the area with highest points rising to about 500m above sea level. It slopes westwards from Enugu escarpment to the lowlands of Niger and Imo rivers. The boreholes within the study area penetrate the Ajali Formation and related rocks and are mainly unconfined. This aquifer is highly transmissive sandstone which underlies the Udi – Nsukka Plateau (where the water table is deep) and the lower grounds west of the Plateau where the water may be confined. Borehole depths range from 50 m to 240 m.

2. Materials and Methods

2.1 Sampling Stations

Enugu State is a mainland state in south-eastern Nigeria. Its capital is Enugu, from which the state - created in 1991 from the old Anambra State - derives its name. The principal cities in the state are Enugu, Agbani, Awgu, Udi, Oji-River, and Nsukka. A total of 49 locations were analysed in these major cities. Borehole parameters considered include Borehole diameters (mm), borehole depths (m), borehole casing (m), screen length (m), static water level (m), dynamic water level (m), drawdown (m), borehole yield (l/s), and specific capacity (l/s/m).

2.2 Multivariate Chemometric Analysis

In this study, multivariate chemometric classification of borehole characteristics was carried out using a non-supervised hierarchical clustering approach. Squared Euclidean distance was used as the similarity index for clustering, using the average linkage and centroid method. Multivariate chemometric techniques were performed using SPSS version 17 statistical package.

2.2.1 Principal Factor Analysis

Principal Factor Analysis (PFA) is one of the most applied approaches in the environmetrics to study data structures. It is aimed at finding and interpreting hidden complex and casually determined relationships between dataset features. This is accomplished by studying the data structure in a reduced dimension while retaining the maximum amount of variability present in the data. To do this, it is necessary to estimate the number of significant factors present in the data. More precisely, a matrix of pair-wise correlations among parameters is decomposed into eigenvectors, which, in turn, are sorted in descending order of their corresponding eigenvalues [6]. The analysis was based on the correlation matrix, which is the covariance matrix of the standardized variables, to remove the scaling effect. The variances have been computed as the sums of squares of deviations divided by N-1 (where N is the valid number of cases). Significant principal factors (PCs) with eigenvalues greater than unity (i.e., PCs explaining more than the variance of one parameter) were extracted. The principal component (PC) can be expressed as:

$$Z_{ij} = a_{i1}x_{1j} + a_{i2}x_{2j} + a_{i3}x_{3j} + \cdots + a_{im}x_{mj} \qquad (1)$$

where *Z* is the component score, *a* is the component loading, *x* the measured value of variable, *i* is the component number, *j* the sample number and m the total number of variables [7].

2.2.2 Cluster Analysis

Classification is an important component of virtually all scientific research. Cluster analysis is an unsupervised pattern recognition technique that defines the underlying behavior or intrinsic structure of data sets, without making prior assumptions about the potential structure, in order to ultimately classify the data samples into clusters or classes with similar characteristics [7]. Several hierarchical clustering methods are already known, but the hierarchical agglomerative clustering analysis (HACA) is the most common linear clustering approach [8]. This method is based on similarity between two clusters or objects and can be expressed as:

$$s_{ij} = 1/({}^{d_{ij}}/_{d_{max}}) \qquad (2)$$

where d_{ij} is the distance between the two clusters or objects and d_{max} is the maximum d_{ij} [9].

3.0 Result and Discussion

3.1 Preliminary Analysis

Prior to multivariate analysis, univariate descriptive statistics were used to compare the measured variables. Minimum, maximum, mean, and standard deviation were used to describe the data (Table 1).

Table 1: *Descriptive Statistics*

Bore Parameters	N	Minimum	Maximum	Mean	Std. Deviation
Borehole Diameter	49	150.00	300.00	238.2653	48.70779
Borehole Depth	49	39.33	272.71	166.1953	53.47817
Borehole Casing	49	27.33	260.71	152.4788	52.63542
Screen Length	49	5.01	20.45	13.7165	2.93770
Static Water Level	49	.60	162.00	93.3943	46.60348
Dynamic Water Level	49	14.36	180.02	104.1720	47.34426
Drawdown	49	1.35	38.22	10.7778	7.54859
Borehole yield	49	1.38	93.33	21.1500	16.31634
Specific Capacity	49	.37	8.44	2.5587	1.97183
Valid N (listwise)	49				

The statistical univariate analysis shows that the borehole diameter from the study area ranged from 200mm to 300mm, the borehole depth ranged from 166.19m to 272.71m, with an average value of 166m. The screen lengths were from 5.01 to 20.45m, while the static water level ranged from 0.6 to 162m, with an average value of 93.39m. The standard deviation of static water level is about 46.60m. The dynamic water level ranged from 14.36m to 180.02m with average value of 104.172m. The water drawdown and yield ranged from 1.35m and 38.22m while borehole yield ranged from 1.38l/s to 93.33 l/s. The specific capacity of the boreholes ranged from 0.37 l/s/m to 8.44l/s/m.

3.2 Principal Factor Analysis

Table 2 shows the common degrees of factor analysis. Among them, the initial common degrees of the factor are all equal to 1. The extraction column is the communality of the variables after the factor is extracted. Water drawdown, specific capacity, dynamic water level, static water level, borehole depth, borehole casing, and borehole yield all have relative high common degree ranging from extraction value of 0.8 and above with comprehensive information, while borehole diameter and screen length is relatively low with extraction value of ≤ 0.6, with information lacking.

Table 2: *Communalities*

Borehole parameters	Initial	Extraction
Borehole Diameter	1.000	.600
Borehole Depth	1.000	.849
Casing	1.000	.841
Screen length	1.000	.161
Static Water Level	1.000	.897
Dynamic Water Level	1.000	.899
Water Drawdown	1.000	.952
Borehole yield	1.000	.819
Specific Capacity	1.000	.938

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Extraction Method: *Principal Component Analysis.*

From table 3 it can be seen that the characteristic roots of the first three common factors were larger than 1, in addition, only the first three factors are extracted and spinning. Statistical analysis showed that out of the 9 factors loaded, the first factor (F1) accounted for about 46.315% of the total variance, the second factor (F2) accounted for about 16.156% of the total variance and the third factor (F3) accounted for about 14.835% of the total variance of the dataset indicating rapid decline from F1 to F2 and gradual level-off towards F5 to F7. The cumulative loading of the first factor is 46.315% while cumulative loading of the first and second factor is 62.470%. The first to the third factors had a cumulative loading of 77.305%. The fourth, fifth, sixth to the ninth cumulative loadings were considered less important, because of their minimal variation and cumulative loadings' contribution to the factors. Therefore, we will restrict or consider only the first three factors, which accounted for a large proportion of the variation in the data (77.305% of the variance).

Table 3: *Total Variance Explained*

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.168	46.315	46.315	4.168	46.315	46.315	3.371	37.452	37.452
2	1.454	16.156	62.470	1.454	16.156	62.470	2.141	23.790	61.242
3	1.335	14.835	77.305	1.335	14.835	77.305	1.446	16.063	77.305
4	.918	10.195	87.500						
5	.585	6.502	94.002						
6	.440	4.887	98.889						
7	.100	1.111	100.000						
8	3.262E-16	3.625E-15	100.000						
9	-4.322E-16	-4.803E-15	100.000						

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	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.168	46.315	46.315	4.168	46.315	46.315	3.371	37.452	37.452
2	1.454	16.156	62.470	1.454	16.156	62.470	2.141	23.790	61.242
3	1.335	14.835	77.305	1.335	14.835	77.305	1.446	16.063	77.305
4	.918	10.195	87.500						
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7	.100	1.111	100.000						
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9	-4.322E-16	-4.803E-15	100.000						

Extraction Method: *Principal Component Analysis.*

According to the principles in selecting factor of principal factor analysis, it is helpful to determine the optimal number of principal component factor. The scree plot (figure 1) demonstrates the distribution of variance among the components graphically. For each principal component, the corresponding eigenvalue is plotted on the *y*-axis. Three principal factors accounting for about 77.305% of the total variation are retained on the basis of the eigenvalue-greater-than-one rule. Also from figure 1 we can see the difference in the eigenvalues between factor 1, 2, and 3 which showed rapid decline. This suggests that the first three factors have stronger general information. The difference between factors 4 to 9 is shown to be relatively small. This ascertains that the first three factors serves as the main composition factor to represent the nine variables.

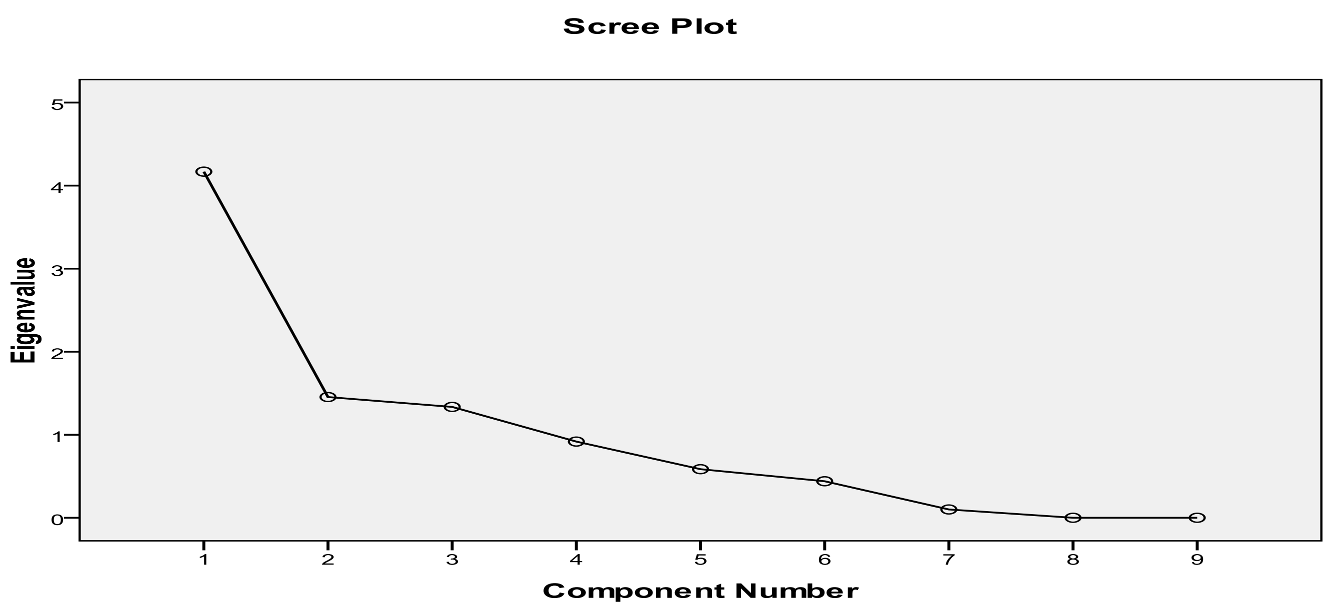

Figure 1: *The scree plot*

Table 4: *Component Matrix*

	Component		
	1	2	3
Borehole Diameter	.622	-.104	.450
Borehole Depth	**.915**	.036	-.108
Borehole Casing	**.909**	.028	-.115
Screen Length	.356	.161	.094
Static Water	**.820**	.048	-.472
Dynamic Water	**.846**	.178	-.389
Drawdown	.245	**.819**	.471
Borehole yield	.587	-.121	.678
Specific Capacity	.445	-.835	.208

Table 5: *Rotated Component Matrix*

	Component		
	1	2	3
Borehole Diameter	.281	**.718**	.070
Borehole Depth	**.835**	.388	.035
Borehole Casing	**.833**	.382	.024
Screen Length	.276	.216	.196
Static Water	**.943**	.045	-.075
Dynamic Water	**.941**	.087	.075
Drawdown	.081	.267	**.935**
Borehole yield	.133	**.886**	.126
Specific Capacity	.154	.644	**-.706**

Extraction Method: *Principal Component Analysis.*
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 4 iterations.

Table 4 and 5 shows the factor loading matrix before and after rotation respectively. To confirm the component composition, a varimax rotation was applied to these components, resulting in the three factor model. The three factors rotated using varimax rotation procedure and the results are presented in Table 5. According to [10], factor loadings are classified as 'strong', 'moderate' and 'weak', corresponding to absolute loading values of > 0.75, 0.75–0.50 and 0.50–0.30, respectively. The variables that contributed to PFA1 in Table 4 were borehole depth, borehole casing, dynamic water level and static water level. Thus there was strong positive loading of borehole depth, borehole capacity, dynamic water level and static water level on PFA1. Similarly, the PFA1 (Table 5) is characterized by the highest number of variables loading on a single factor where four borehole parameters loaded on it with positive coefficient. The second PFA had strong positive loading with borehole yield and borehole diameter. While water drawdown and specific capacity loaded with strong positive loading on PFA3. The rotated loadings of table 5 enhanced the composition of the static water level and dynamic water level in the first factor, the second factor was simplified by reducing the loading of water drawdown and specific capacity and enhancing the loading of borehole diameter and borehole yield. In the third factor, the reduced loadings in the second factor of water drawdown and specific capacity were enhanced.

3.3 Cluster Analysis

The CA was employed in this study to identify broad-scale variations in the borehole characteristics of Enugu geological formation, to classify borehole characteristics into zones of similar characteristics, and to investigate the relative importance of the nine borehole parameters. The horizontal lines in the dendrogram point to the links between objects or clusters while the vertical axis represents the height as a measure of distance [11]. Clustering of the borehole characteristics based on the ninetieth percentile values of the 9 borehole parameters produced a dendrogram with groups separated at $(d_{Link}/d_{max}) \times 100 < 20$ (Fig. 2 and 3). The dendrogram of figure 2 shows that the 49 locations were group into three clusters. The first cluster delineated stations that characterise Awgu sandstone geological formation, while the second cluster delineated Agbani sandstone geological formation. The third cluster delineated Ajali sandstone formation. The second dendrogram as a confirmation of the first indicates that the borehole parameters are grouped into three clusters also. The first cluster delineated consists of four borehole parameters which include screen length, water drawdown, specific capacity and specific yield. The second cluster delineated consists of three borehole parameters which include static water level, dynamic water level, and borehole depth. The third cluster delineated includes of two borehole parameters these are borehole casing and borehole diameter. This indicates similarity of a group of borehole parameters (clusters) in the same geological formation. Thus is can be inferred that the borehole parameters is largely affected by the geological formation. It follows that knowledge of geological formation in the study area is essential in water resources management. CA was therefore able to provide good results as an exploratory evaluation of the borehole characteristic differences of the studied systems.

($D_{link}/D_{max} < 20$)

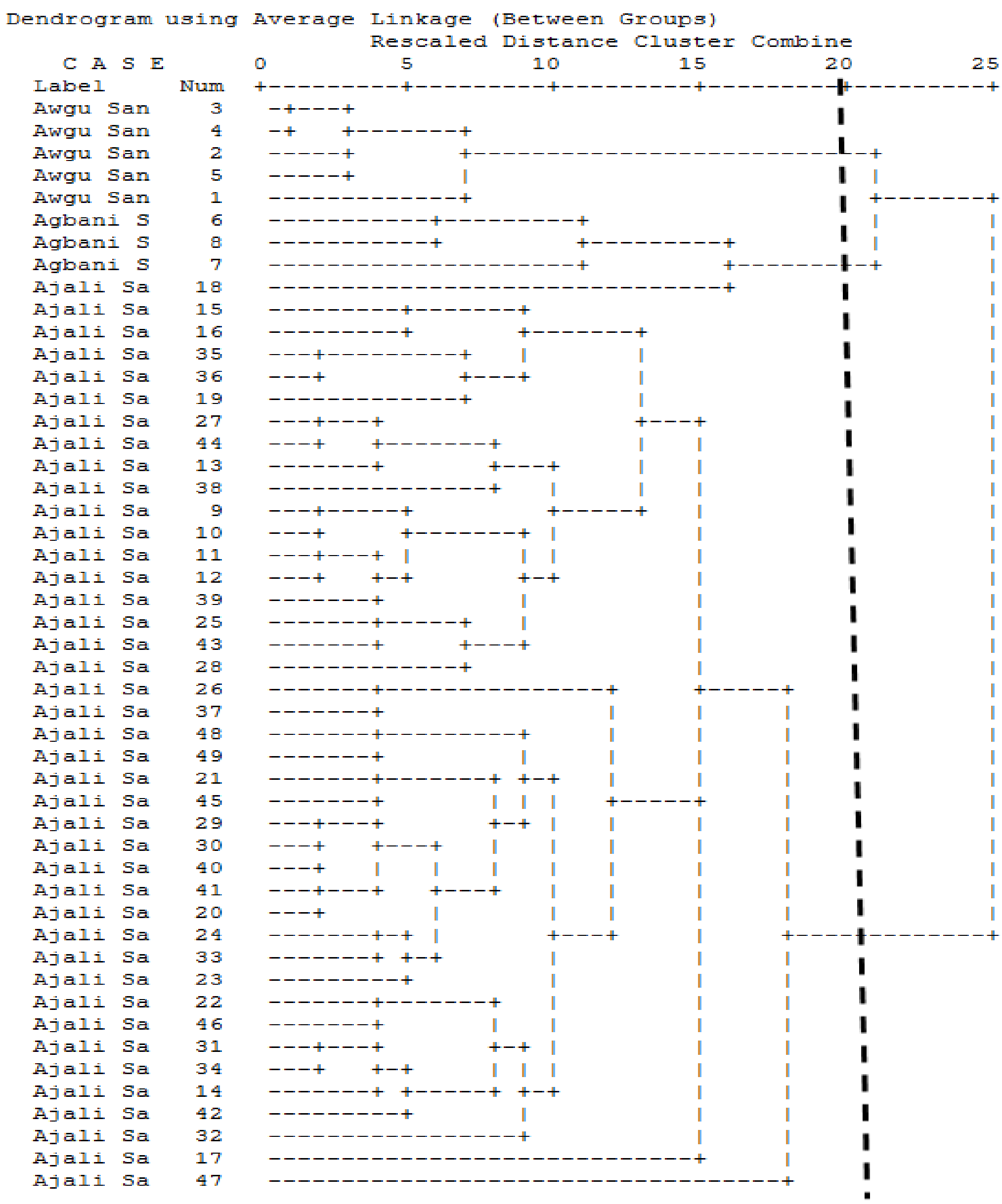

Figure 2: *Dendrogram of the borehole geological formation clusters*

Boreho_d: Borehole diameter, Boreho_d: Borehole Depth, Dynamic_w: Dynamic water level, Screen_l: Screen length, Specific: Specific Capacity, Static_W: Static Water level.

($D_{link}/D_{max} < 20$)

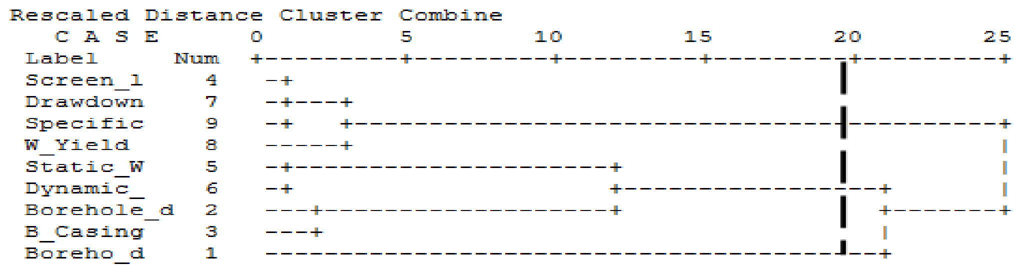

Figure 3: *Dendrogram of the borehole parameters*

3. Conclusion

PFA and CA were used in classification of borehole data in this study. The PFA statistical analysis shows that out of the 9 factors loaded, the first factor (F1) accounted for about 46.315% of the total variance, the second factor (F2) accounted for about 16.156% of the total variance and the third factor (F3) accounted for about 14.835% of the total variance of the dataset The first three factors, accounted for a large proportion of the variation in the data (77.305% of the variance). To classify borehole characteristics into zones of similar characteristics, and to investigate the relative importance of the nine borehole parameters, CA was employed. The CA produced a dendrogram with groups separated at $(d_{Link}/d_{max}) \times 100 < 20$, grouping the 9 borehole parameters for the 49 stations into three statistically distinctive clusters. Adequate agreement between PFA and CA were observed, hence validating the grouping in variation in the borehole characteristics in the geological zone. The results of this study reinforces the fact that multivariate statistical methods using PFA and CA can be applied to interpret complex datasets and were useful in offering reliable classification of the borehole characteristic of the study area.

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Appendix

Towns	LGA	Formation	Borehole Diameter	Borehole Depth	Borehole Casing	Screen length	Static Water Level	Dynamic Water Level	Drawdown	Yield	Sp. Cap
Awgu	Awgu	Awgu	150	39.33	27.33	12.00	33.34	35.22	1.88	2.20	1.17
Ogugu II	Awgu	Awgu	200	51.83	39.83	12.00	19.21	24.60	5.39	17.69	3.28
Ogugu II	Awgu	Awgu	200	51.98	39.98	12.00	3.05	14.39	11.34	5.81	0.51
Ogugu I	Awgu	Awgu	200	51.82	39.82	12.00	3.12	14.36	11.24	5.52	0.49
Ogugu	Awgu	Awgu	200	42.68	30.68	12.00	14.30	27.60	13.30	5.69	0.50
Obinagu	Nkanu	Agbani	150	117.38	105.38	12.00	19.40	32.90	13.50	11.60	0.86
Akpugo	Nkanu	Agbani	150	198.00	183.00	15.00	18.30	33.70	15.40	12.50	0.81
Agbani	Nkanu	Agbani	150	152.00	140.00	12.00	29.00	35.37	6.37	10.88	1.71
Iwollo	Ezeagu	Ajali	250	167.68	149.39	18.29	123.48	127.14	3.66	15.50	4.23
Iwollo O	Ezeagu	Ajali	250	161.89	145.89	16.00	122.00	132.31	10.31	10.11	0.98
Obeleagu	Ezeagu	Ajali	250	152.74	140.74	12.00	96.04	117.08	21.04	17.05	0.81
Obeleagu	Ezeagu	Ajali	250	153.05	140.85	12.20	99.09	123.48	24.39	12.05	0.49
Akamaogh	Ezeagu	Ajali	200	113.41	105.79	7.62	87.50	93.60	6.10	10.00	1.64
Akamaogh	Ezeagu	Ajali	300	211.50	191.50	20.00	91.00	123.00	32.00	34.22	1.07
Aguobu O	Ezeagu	Ajali	300	152.04	140.04	12.00	68.80	78.20	9.40	50.51	5.37
Aguobu O	Ezeagu	Ajali	300	137.16	125.16	12.00	48.70	57.20	8.50	51.33	6.04
Awha Ime	Ezeagu	Ajali	300	272.71	260.71	12.00	136.00	141.05	5.05	37.78	7.48
Akpugoez	Oji River	Ajali	250	213.04	196.84	16.20	0.60	20.90	20.30	7.56	0.37
Okpuje	Nsukka	Ajali	250	192.02	176.78	15.24	68.90	70.25	1.35	11.39	8.44
Opi	Nsukka	Ajali	250	184.15	174.09	10.06	146.96	153.36	6.40	12.50	1.95
Eha-Alum	Nsukka	Ajali	200	188.52	168.70	19.82	148.48	155.08	6.60	7.08	1.07
Nsukka U	Nsukka	Ajali	300	190.85	171.41	19.44	135.37	150.30	14.93	34.69	2.32
Edem	Nsukka	Ajali	250	220.00	208.00	12.00	118.59	126.59	8.00	20.00	2.50
Nkalagu	Igboeze	Ajali	250	189.55	177.55	12.00	120.22	128.22	8.00	28.33	3.54
Ibeagwa	Igboeze	Ajali	250	140.24	128.24	12.00	76.64	82.10	5.46	12.20	2.23
Ovoko I	Igboeze	Ajali	200	196.65	180.53	16.12	100.61	107.91	7.30	35.08	4.81
Ovoko II	Igboeze	Ajali	200	137.20	121.08	16.12	99.39	105.49	6.10	18.75	3.07
Umuagam	Igboez	Ajali	250	101.05	96.04	5.01	66.16	68.60	2.44	1.38	0.5

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Umuagama	Igboeze	Ajali	250	205.50	193.50	12.00	144.10	150.00	5.90	34.61	5.87
Umuagama	Igboeze	Ajali	250	200.80	188.80	12.00	142.00	148.40	6.40	26.00	4.06
Ugbaike	Igboeze	Ajali	300	202.08	187.08	15.00	113.00	121.24	8.24	34.17	4.15
Ugbaike	Igboeze	Ajali	300	201.30	186.30	15.00	108.00	146.22	38.22	93.33	2.44
Amachall	Igboeze	Ajali	250	205.79	190.79	15.00	108.00	117.00	9.00	38.77	4.31
Amachall	Igboeze	Ajali	300	209.76	194.76	15.00	109.10	116.00	6.90	37.85	5.49
Ete I	Igboeze	Ajali	300	179.88	164.88	15.00	76.22	82.31	6.09	21.88	3.59
Ete II	Igboeze	Ajali	300	181.66	166.66	15.00	71.30	83.70	12.40	25.26	2.04
Umachi	Igboeze	Ajali	175	198.18	186.18	12.00	88.90	99.95	11.05	31.25	2.83
Aji I	Igboeze	Ajali	150	125.91	110.91	15.00	70.73	77.44	6.71	4.38	0.65
Ikpamodo	Igboeze	Ajali	250	143.29	128.29	15.00	109.76	113.11	3.35	10.00	2.99
Obollo A	Udenu	Ajali	250	199.90	185.88	14.02	151.22	157.62	6.40	15.63	2.44
Obollo A	Udenu	Ajali	250	192.07	179.27	12.80	153.66	160.06	6.40	15.00	2.34
Ukehe I	Igboetit	Ajali	300	183.79	171.79	12.00	97.27	111.81	14.54	38.83	2.67
Ukehe II	Igboetit	Ajali	250	125.30	110.06	15.24	91.46	101.22	9.76	15.00	1.54
Ukehe II	Igboetit	Ajali	200	131.40	116.16	15.24	91.46	101.21	9.75	15.17	1.56
Ohodo I	Igboetit	Ajali	200	205.49	185.04	20.45	138.41	142.68	4.27	20.75	4.86
Ohodo II	Igboetit	Ajali	300	189.02	173.78	15.24	140.70	165.09	24.39	9.10	0.37
Ekwegbe	Igboetit	Ajali	150	212.14	200.14	12.00	162.00	180.02	18.02	17.33	0.96
Ekwegbe	Igboetit	Ajali	250	243.84	231.84	12.00	154.78	171.32	16.54	15.97	0.97
Ekwegbe	Igboetit	Ajali	250	226.00	214.00	12.00	160.00	178.03	18.03	16.67	0.92
Awgu	Awgu	Awgu	150	39.33	27.33	12.00	33.34	35.22	1.88	2.20	1.17