The European Research Journal 2019;5(3):440-448 **ORIGINAL ARTICLE**

Physio-chemical investigation and analyses of contaminants in groundwater flow. Case study - Papalanto, Ifo local government area, South - Western Nigeria, Ogun State

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ABSTRACT

Objectives: Groundwater is the primary source of drinking water for roughly, a third of the world's population, but highly vulnerable to pollution. A thorough research was carried out to investigate the extent of groundwater contamination on four active dumpsite and a control point at Papalanto, Abeokuta area, and South-Western Nigeria.

Methods: Domestic wells in the area facilitated the resources for water chemistry. A total of five groundwater samples were collected from wells located close to different dumpsite in the study area, to determine the extent of groundwater contamination. Physio-chemical analysis was carried out on the five water samples; the basic method adopted in the chemical analysis includes titrimetric method, atomic absorption spectroscopy and calometric method.

Results: The results showed that water quality parameter like temperature, pH, taste, odour, total solids, sulphate, copper, iron, zinc, cadmium and chromium are in appropriate standard prescribed by WHO and NSDWQ. Other physical parameters like color, turbidity, conductivity, total suspended solids, total dissolved solid, total hardness, total alkalinity, total acidity, calcium, magnesium, chloride, nitrite, manganese, lead, nickel, nitrate, have higher values than the authorized standard value, which directly or indirectly affect the water content found in the area for drinking purpose. These features could be attributed to the possible activities of contaminants facilitated by leachate plume from the dumpsite.

Conclusions: The study shows that the regolith aquifer in the area of study is highly vulnerable to pollution from the refuse dumps. From the geophysical and physio-chemical analysis carried out, the values of most parameters obtained in the water samples collected at locations close to the leachate have been confirmed to be higher than those collected at locations away from the leachate. Hence, the groundwater near the leachate is confirmed contaminated.

Keywords: Groundwater, contaminants, well, dumpsite, physio-chemical, pollution

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Waste disposal is one of the major problems in developing countries world over. Waste is any substance, solution, mixture or article for which no direct use is envisaged but which is transported for reprocessing, dumping, elimination by incineration or other methods of disposal [1]. Wastes are produced frequently on daily basis as a result of human activities. Individual efforts to control/eradicate waste have led to the emergence of waste disposed irresponsibly in bushes, river body and road side without much concern to the regions beneath the surface of the earth, geology of the study area and their closeness to the living quarters. This action is detrimental to human health further escalating environmental health risk [2]. In residential quarters, poor settlement structure and lack of septic facilities for domestic and human waste removal are factors to be greatly concerned about. Presence of prominent dumpsite in residential quarters is a major source of environmental pollution, air infectious disease, soil pollution, leachate and contaminants migration to water table. Different environmental degradation, activities and inconsiderate exploitation of water channel can be said to be responsible for this menace [3]. In addition, waste if not properly disposed could lead to contamination of surface and groundwater in its immediate environment [4, 5]. Sometimes, during the peak of the raining season, the dumpsite is usually covered with flood. It is this contaminated liquid that spread through the soil and ground water system. This results in pollutant loads on the environment which depends on the quality and quantity of the water that percolates through the dumpsite and penetrates down to the ground water. Generally, leachate from dumpsite consists of different organism, microbes, chemicals and other harmful substance, this is because water in its natural state is not pure coupled with introduction of leachate plume from dumpsite, this pose great danger to the composition, constituent and relevance of water in that area [6].

In Papalanto area, which is a rural community in Nigeria, the primary source of drinking water is from hand dug well. This is due to lack of pipe borne water occasioned by lack of functional water treatment facilities. Hence, the community is exposed to polluted water for its domestic and agricultural purposes thereby increasing the risk of contracting water related health hazards [7]. Leachate plume and other pollutants pose a high risk to groundwater resource if not adequately managed. To overcome this, there is need to assess some of the important parameters of the leachate with a view to providing solution to water pollution occasioned by indiscriminate waste disposal. Consequently this study aims to examine the physio-chemical composition and level of contaminants in the water samples from hand dug wells in the study area while comparing the results obtained with the standards for drinking water of World Health Organization (WHO) and Nigerian Standard of Drinking Water Quality (NSDWQ).

Papalanto metropolis is a semi urban area in Ifo local government area, in Ogun state, South-Western Nigeria. Papalanto has a latitude of 6.8821, latitude (DMS) 6°52’56N and longitude of 3.1931, longitude (DMS) 3°11”35E, altitude (feet dimension) 236, altitude (meters dimension) 71 m above sea level [8]. The physiography of the study area is that of extensive lowland that is gently undulating with a gentle sloping dissected escarpment known as southern uplands [9], it lies in the tropical climate belt, where the climate condition is friendly, while the monthly temperature varies between 25°C and 30°C.

Papalanto is a major town situated along the Lagos-Abeokuta Road. It has an intersection with the Sagamu/Ilaro Road in the Ewekoro local government area of Ogun State. It stands as a vantage point for trade, transportation and communication. The construction of New Lagos-Abeokuta express road led to the migration of different tribes to Papalanto which brought about physical development to places like Ori-Ogbo, Araromi, Ajegunle, Fowowawo (now called Sawmill) and many other areas after places like Oju-Oja Isale Alfa, Alagbede compound, Ago-Ika and Ago-Ijaiye compound [10].

One of the major source of revenue was generated through sugar cane plantation and sale, which was very predominant in Papalanto till date. The area is characterized by different activities as a result of the cement factory, schools and other facilities located in the vicinity.

As a result of commercial activities in the area, huge masses of waste are generated and its management could be cumbersome despite the presence of few licensed refuse government agencies. In the area, refuse are mostly dumped on road side, farm lands, water bodies, bushes and roadside,

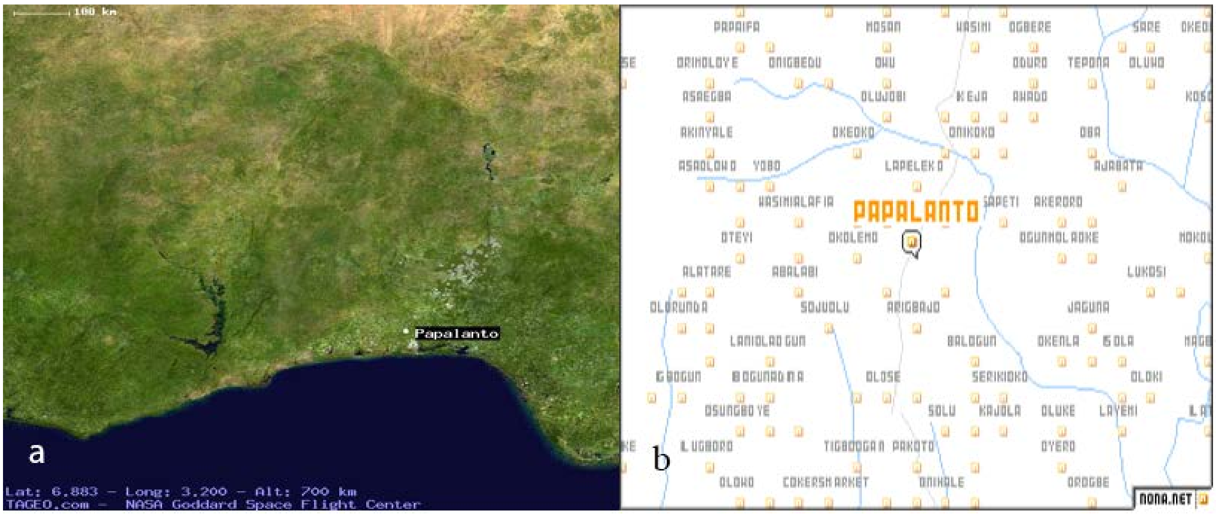

Figure 1. The research area for this study (a and b).

constituting serious environmental and health nuisance. The study area (Figures 1a and 1b) (Papalanto) belongs to the eastern part of Dahomey basin, extending from the Volta Delta (Southern Ghana) to the Western border of Niger Delta region in Nigeria [11]. However, the general succession of the rock unit is that of concealed rock which encompasses Abeokuta group, followed by Ewekoro, Akimbo, Oshosun, and Ilaro formations respectively. On the uppermost surface of Ilaro formation is the coastal plain sands. The Ewekoro formation is the local geology in the study area. It comprises of non-crystalline and highly non-fossiliferous limestone and thinly laminated fossile and probably non-fossiliferous shale [12].

This is necessitated by the influence of properties of underlying permeable strata on the subsurface movement of potentially polluting substances deposited on the ground surface.

The sediments here consist of diverse layer of sands and mud with a varying proportion of vegetal matter (from sugar cane plantation). Occasional beds of sandstone and sediments were clearly deposited under littoral and lagoonal conditions. Due to high amount of compost, animal/plant material waste, clay, manure and silt above the gruss zone, water residence times are high in this section. Accompanied by spacious reactions surface, there are the best conditions for water-rock interactions and hydro-chemical changes. Regarding the hydro-chemical situation, acidification process are other important factors. Groundwater recharge and storage is limited to the weathering zone and zonal soil. The good capabilities and the capacity in the covering layers are lowered in parts with local kaolinite bearing sections areas and muddy-loamy interculations. Areas of the highest total permeability were found in vicinity of faults system. In this part, there are possible electric contact between fissured aquifers and shallow pore aquifers.

METHODS

There are four active dumpsite and one control point in the study area. These dumpsites are located close to residential quarters and developing layout, such that waste disposal activity is still prominent in the areas till the date of collection of the samples (November 2013). The first dumpsite is located along the New Palace road, approximately 20 m to the west of Papalanto high school. It is delineated between latitude 4°52.36’N to 4°52.75’N and longitude 6°57.17’E to 6°57.43’E. The second sampling point is the control point, located at the backyard of Papalanto high school. The third dumpsite is located along Tipper /Ilaro road, the fourth dumpsite is located along Agbede /Ago-Ijaiye compound and the fifth dumpsite is located along Sawmill road.

2D Electrical resistivity method, (using the ABEM Terrameter system ES10-64C electrode selector) was used to investigate the subsurface potential of different dumpsites. A total of eight wells within the region were sampled, of which five wells where taken as case study. Each water sample was collected in a chemically clean double sealed plastic bottle. Distilled water was first used to rinse the bottle to nullify pollution in any form [13]. The samples were collected in the afternoon and toward evening after the well have been put to use. The water samples were taken to the laboratory for physio-chemical investigation and analysis. The recommended standard put in place by NSDWQ and WHO were appropriately followed to investigate the water quality of the water samples from the study area.

Physical and chemical parameters that were tested for includes the followings: temperature, pH, colour, taste, odour, turbidity, conductivity, total solids, total suspended solids, total dissolved solid, total hardness, total alkalinity, total acidity, calcium, magnesium, chloride, nitrate, nitrite, sulphate, copper, manganese, zinc, lead, cadmium, nickel, and chromium. All the results obtained were compared with NSDWQ and WHO standards.The temperature value of the water samples were measured using a thermometer. The terrameter system electrodes were immersed in buffer 7 solution, the temperature was selected to 25°C. The display was set to read the correct value of buffer using buffer control knob. The electrode was rinsed using distilled water and Immersed in buffer 4 or 10 depending on the available buffer and given sufficient time to stabilize. Then reading was set using the slope control. The electrode was rinsed in deionized water and Immersed in an unknown solution. The electrode was allowed to stabilize for 2-3 minutes and the reading was taken. The electrode was rinsed with deionized/distilled water and blotted with clean tissue before immersing in another sample to avoid contamination. After the chemical analysis, the electrode was rinsed properly with de-ionized /distilled water and then immerse in buffer 4 (pH:4) for storage. (Visual comparison method) the water sample's color was observed by filling a matched Nessler tube to 50 ml mark with sample and comparing it with standard. Look vertically downward through the tubes towards a white or specular surface placed at such an angle that light is reflected upward through the column of the liquid. These procedure helps determines if turbidity is present and has not been removed, it is reported as `apparent color'. If color exceeds 70 units, the sample is diluted with distilled water in known proportions until the color is within the range of the standards. The pH of each sample was then measured. The water samples was taken into the mouth and tasted orally. The taste sampling is only carried out on samples that are safe for ingestion i.e. samples that do not contain bacteria, viruses, parasites and hazardous chemicals. The odour was determined orally by perceiving the water samples using the nose. Presence of odour signified negative inference and absence of odour signified positive interference. The turbidity was measured using turbidimeter, the samples were thoroughly shaked and observed until air bubbles disappeared, then the sample were poured into the turbidimeter tube and immersed in an ultrasonic bath for 1 to 2 seconds. This caused complete bubble release which shows the turbidity direct from instrument scale. The conductivity was measured using aconductimeter. It was switched on to stabilize for 15 minutes. The conductivity electrode was rinsed using the sample to be determined. The knob to conductivity menu (point) was turned up and the temperature was set to 25°C within an appropriate range. When the reading did not appear, the conductimeter was switched to the next lower range for greater sensitivity. The reading was taken and the electrode was mixed with distilled water. If the conductivity of the sample exceeds that of the instrument, known volume of the sample should be mixed accordingly to 100 ml with diluted/deionized water of little or no conductivity. For total solids (T.S)- the dish was cleaned heated between 103 to 105°C. It was stored and cooled in a desiccator until needed (the weight was measured immediately before use). About 100 ml of water sample was pipetted into the evaporating dish. The dish was evaporated to dryness on a steam bath. The water sample was stirred with a magnetic stirrer during transfer. Optionally, successive water sample portion was added to the same dish after evaporation. The evaporating sample was dried for at least 1 hour in an oven at 103 to 105°C. The dish was cooled in desiccator to balance temperature. The cycle of drying, cooling, desiccating and weighing was repeated until a constant weight is obtained. When evaporating in a drying oven, the temperature is usually lowered to approximately 2°C below boiling point to prevent splattering. Total suspended solid is obtained when the result of total solid is subtracted from dissolved solid (D.S), the output is suspended solid i.e. Suspended solid mg/l = T.S – D.S. Total dissolved solids (TDS)-the conductimeter was switched on, the electrode was rinsed using the water sample to be determined, the knob was set to TDS menu and the temperature was set to 25°C, the value was displayed on the meter screen, the electrode was rinsed with distilled water. Total hardness-50 ml of water sample was pipetted into 250 ml conical flask. 1 ml or 25 drops of buffer 10 (ammonium chloride buffer) was added. 3 drops of Erichrome black T indicator was added and swirled to mix. The mixture was titrated using standardized E.D.T.A to blue end point. Total alkalinity-50 ml of the water sample was taken. 6 drops of phenolphthalein indicator + 6 drops of bromophenol blue was added. The mixture was titrated with 0.02 M hydrochloric acid to green end point, if phenolphthalein is added to the sample and pink color observed, it means there is carbonate in the sample. The mixture was titrated till the pink color turned to colorless and the titre value was noted before bromophenol blue indicator was added, to calculate the total alkalinity add the titre value of phenolphthalein and bromophenol blue indicator. Total acidity-50 ml of the water sample was added into 250 ml conical flask. Chlorine residue was removed by adding a drop of 0.1 M sodium thiosulfate. 6 drops of bromophenol blue indicator was added and swirled to mix thoroughly. The mixture was titrated with standardized 0.02 M sodium hydroxide until the color changes from yellow to purple green. Calcium-20 ml of the water sample was pipetted out, a pinch of ammonium purpurate was added, the burette was filled with EDTA. The mixture was titrated against EDTA solution. The titration was continued till the colour changes to purple. The calcium hardness was calculated., i.e. volume of EDTA × Normality × 50 × 1000/volume of sample taken. Dissolved oxygen-an oxygen bottle of known capacity was filled to overflow with water sample, avoiding the inclusion of air bubbles. 0.5 ml each of manganese II chloride solution and sodium hydroxide solution containing potassium iodide was added. The bottle was closed without any air bubble inclusion and shaked vigorously. After the precipitate had settled, the clear supernatant liquid was carefully decanted. The precipitate was dissolved in 2 ml conc. phosphoric acid. The liberated iodide was titrated against 0.01 M Na2S2O3 until colorless using starch solution as indicator (add towards the end of titration) the end color is pale yellow. Chloride-50 ml of the sample. 1 ml of potassium chromate was added and titrated with standardized 0.01 M silver nitrate to a red-pinkish yellow. If the conductivity of the sample is expected to be high, a measurement of 0.1 M standardized silver nitrate is used. Nitrite-two 25 ml flat bottom flask was used, one for sample, the other for blank. One of the 25 ml flask was filled with water sample and the other was filled with distilled water (the blank). 1 ml sulfanilamide reagent was added to each mixture. 1 ml naphthalene solution was also added to each mixture. The content was placed in the dark for 30 minutes. The absorbance was measured at 540 nm. Nitrate-10 ml of water sample was transferred into a large test tube. The test tube was placed in cold-water bath and 2 ml of sodium chloride solution was added. The content was mixed thoroughly by hand and 10 ml H2SO4 acid solution was added, Mixed by swirling and allowed to cool. 0.5 ml bruline sulfanilic acid reagent was added to the mixture. The tubes were swirled to mix thoroughly and the tubes were placed in a well-stirred boiling water bath that maintains a temperature of not less than 95°C. After exactly 20 mins, the sample was removed and immersed in a cool water bath and allowed to cool to room temperature. Absorbance was measured at 410 mn using distilled water treated in the manner as blank. Sulphate-100 ml of water sample was taken. Spatula level of barium chloride was added to the sample and allowed to stand for 5 minutes. The sulphate content was measured by using turbidimeter. The instrument was set using turbidimeter standard that has 10 NTU. When that was carried out, the turbidimeter was taken out of the sample. Zinc-50 ml of sample was acidified with few drops of 0.5 M hydrochloric acid, about 5 ml of sodium acetate solution was added to the solution to bring the pH to about 5.3 ml of sodium thiosulphate solution and 10 ml of dithizone solution was added and shaked thoroughly. The absorbance value is checked at 540 nm against a blank of distilled water treated in the way. Cadmium-50 ml or smaller volume of water was pipetted into glass beaker and heated for 10 minutes with 5 ml of 2 M hydrochloric acid (for turbid sample, filter). The mixture was cooled and 5 ml potassium tartrate solution was added. 1 drop of methyl orange indicator and 2 M NaOH, was added drop wise until color changes from red to yellowish orange. The solution was transferred to a 100 ml separating funnel.

Titrate with 5 ml NaOH-KCN solution (a), 2 ml hydroxyl ammonium chloride solution and 15 ml dithizone solution (a) in that order mixing thoroughly on each addition. The mixture was shaked for 1 minute and allowed the layers to separate. The solvent phase was transferred to a second 100 ml separating funnel containing 25 ml cold tartaric acid solution. 10 ml chloroform was pipetted into the first separating funnel. It was shaked again for 1 minute, allowed the chloroform to separate and transferred to the second separating funnel taking care that none of the strongly alkaline aqueous phase is entrained. The second separating funnel is shaked for 2 minutes. The chloroform phase is drained and discarded. 5 ml chloroform was added and shaked for 1 minute again and discarded.

RESULTS

The results of the physio-chemical analysis of the five water samples are shown in Table 1. The results showed that water quality parameter like temperature, pH, taste, odour, total solids, sulphate, copper, iron, zinc, cadmium and chromium are in appropriate standard prescribed by WHO and NSDWQ. Other physical parameters like color, turbidity, conductivity, total suspended solids, total dissolved solid, total hardness, total alkalinity, total acidity, calcium, magnesium, chloride, nitrite, manganese, lead, nickel, nitrate, have higher values than the authorized standard value, which directly or indirectly affect the water content found in the area for drinking purpose. These features could be attributed to the possible activities of contaminants

DISCUSSION

The conductivity of the study area falls within appropriate range (120-220 µs/cm) except for S3 and S5 (2270-2280 µs/cm) which are high and above WHO standard. The increased conductivity could be attributed to the geology of the area and migration of leachate plume. Proximity of the well to the dumpsite could also be responsible factor. This is in line with the findings of Oyelami *et al*. [4] .The study area (S3-Tipper/Ilaro road, S5-Sawmill road) has a history of swampy foundation. Over time, due to development and commercial activities in the area, the swampy area was filled with decomposed waste and clay sand materials. With consistent activity of land filling the area, the swampy water body combined with the decomposed waste material have sunk down to the ground at a depth of 4.0 metres. This results for the underlying presence of layers of leachate plume and chemical waste. It is a zone with extremely low resistivity, presence of decomposed contaminants prominent over past years. This fluid has delineated deep into the soil. Other reasons are due to the poor septic drainage system for domestic and human waste disposal. This contaminated fluid called effluent has percolated the region and also contributes to the level of contamination in the study area [14-17].

The well situated inside Papalanto high school has the highest color concentration (slightly turbid), while other locations has a clear colour of water (places like Palace road, Agbede Compound, Sawmill road and Papalanto/Ilaro road). Although water is naturally colorless, but the location of the well and soil composition of the study area brings about the change in color of the water. Other factor that could account for the turbid look of the water is the high level of limestone sediment, due to the local geology of the study area. This sediment consists of indissoluble inorganic mineral matter. These sediments are scattered unevenly all through the fluid content and this helps the particles to easily absorb light. This is the brain discovery behind the dusty or foggy turbid look of the well water in study area S2.

From the data in the Table 1, the highest concentration of total dissolved solid is 1140 mg/l at Sawmill road and the least value of 60 mg/l at Papalanto high school. This high value is due to leachate plume, chemical waste contaminants, decomposed landfill and soil content, found at the study area at sSwmill road. This area shows undissolved materials that are present in the groundwater.

From Table 1, the total suspended solid values ranges between 0.30 and 30 mg/l. Water samples from Palace road, Tipper/Ilaro road and Sawmill road have the highest values. This could be caused by the constituents of leachate plume accumulated over the years, other probable factors could be industrial/chemical waste, sediments, silts and organic particles

Table 1. Physio-chemical analysis of water

S/N	PARAMETERS Physical, chemical & microbiological	RESULTS					NSDWQ
		S1	**S2**	**S3**	**S4**	**S5**	
1	**Temperature (°C)**	24.8	25.2	25.6	25.9	25.0	22-30
2	**PH**	6.74	6.93	7.64	7.68	7.28	6.8-8.5
3	**Colour**	Clear	Slightly turbid	Clear	Clear	Clear	Clear/Colorless
4	**Taste**	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.
5	**Odour**	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.
6	**Turbidity (NTU)**	2.09	15.7	1.31	5.21	0.78	5
7	**Conductivity S/cm)**	220	120	2270	220	2280	1,500
8	**Total solids (mg/l)**	120	60.30	1185	112	1170	1,200
9	**Total suspended solids (mg/l)**	10	0.30	50	2	30	-
10	**Total dissolved solids (mg/l)**	110	60	1135	110	1140	-
11	**Total hardness (mg/l)**	112.0	100.0	616.0	60.0	580.0	400
12	**Total alkalinity (mg/l)**	60	60	540	440	100	-
13	**Total acidity (mg/l)**	20	20	140	40	100	-
14	**Calcium (mg/l)**	44.89	40.08	246.89	24.01	232.46	50 (WHO)
15	**Magnesium (mg/l)**	16.31	14.56	85.32	8.74	84.45	50(WHO)
16	**BOD (mg/l)**						-
17	**Dissolved oxygen (mg/l)**						-
18	**Chloride (mg/l)**	56.72	70.90	340.32	212.7	368.68	250
19	**Nitrate (mg/l)**	19.00	24.66	20.00	29.00	70.00	50
20	**Nitrite (mg/l)**	1.8	1.95	2.0	1.99	2.51	-
21	**Sulphate (mg/)**	75.60	79.07	120.9	132.0	98.6	200
22	**Copper (mg/l)**	0.437	0.552	0.327	0.428	0.298	2
23	**Manganese (mg/l)**	0.932	0.732	0.559	0.687	0.429	0.5
24	**Iron (mg/l)**						0.3 (WHO)
25	**Zinc (mg/l)**	1.332	2.080	1.009	0.649	1.129	5 (WHO)
26	**Lead (mg/l)**	0.023	0.020	0.079	0.019	0.087	0.05
27	**Cadmium (mg/l)**	-0.034	-0.077	0.003	-0.132	0.001	0.003
28	**Nickel (mg/l)**	0.011	0.014	0.035	0.065	0.029	-
29	**Chromium (mg/l)**	0.021	0.029	0.027	0.031	0.053	0.05
30	**Total bacterial count (cfu/ml)**						-
31	**Total coliform (cfu/100ml)**						-
32	**Total fungi/yeast counts**						-

ND = Not detected, cfu = colony forming unit, WHO = World Health Organization, NSDWQ = Nigerian Standard for Drinking Water Quality, unobj. = unobjectionable that are less than visible macroscopic view, that float in the water body of the area of study. The minimum values were recorded in Papalanto high school and Agbede compound.

The total hardness of water ranges from 60 to 616 mg/l, showing that areas like Tipper/Ilaro road (S3) and Sawmill road (S5) have very high hard water content (580-616 mg/l), which will make the water less consumable for human use. The hardness of water had being characterized by two major chemical elements namely calcium and magnesium. This is buttressed by the increased values (246.89 mg/l and 232.46 mg/l) of calcium for S3 and S5 respectively when compared to WHO and NSDWQ standards. Though calcium and magnesium are basically two components that the body needs for growth, development and regular metabolism. With a view into the study area, S3 (Tipper/Ilaro road) and S5 (Sawmill road) have the highest level of total water hardness which can also be confirmed by the result of the physio-chemical analysis. S3 (Tipper/Ilaro road) has a recorded data of 85.32 mg/l and S5 (Sawmill road) has a recorded data of 84.45 mg/l respectively of magnesium content. S3 and S5 also have calcium content recorded data of 246.89 mg/l and 232.46 mg/l, respectively. The two major chemical components that contribute to hardness of water (i.e. calcium and magnesium) are found dominant in S3 and S5 with high value against the NSWDQ and WHO standard. This could be a result of dissolution of divalent mineral substance, magnesium and calcium components bombarded in the area as a result of landfill and accumulated swamp leachate plume over a long period of time.

The study area shows a high level of alkalinity from the water samples. Ranging from 60-540 mg/l, S3 (Tipper Park) and S4 (Agbede compound) have the highest level of alkalinity, 540 mg/l and 440 mg/l, respectively. Alkalinity is associated with hardness in water, and the major compound which might account for this is calcium, carbon and oxygen components which are predominantly elements for limestone formation and calcite. The basic element in the study area is within 8.74 to 85.32 mg/l. The range of chloride deposit in the study area is within 56.72 to 368.68 mg/l. In the study area, the local geology comprises of non- crystalline and highly non-fossiliferous limestone and thinly laminated fissile and probably non-fossiliferous shale (these materials listed above are basically carbonate and calcium based compounds which are predominant in the study area [12, 18-21]. The predominant present of calcite, carbon and calcium component also facilitated the presence of a cement producing industry located in the environs of Papalanto. The sediments here consists of diverse layer of sands and mud with a varying proportion of vegetal matter (from sugar cane plantation). Occasional beds of sandstone and sediments were clearly deposited under littoral and lagoonal conditions. Accompanied by spacious reactions surface there are the best conditions for water-rock interactions and hydro-chemical changes. The generality/totality of this research study has vividly evaluated the physio-chemical measurable constituents of the research area. [19-25].

The following parameters have higher value which exceeds the recommended NSDQW and WHO standard. The physical parameters include nickel (S1-S5), lead (S3, S5), manganese (S1-S4), nitrite (S1-S5), nitrate (S5), chloride (S3, S5), magnesium (S3, S5), calcium (S3, S5), total acidity (S1-S5), total alkalinity (S1-S5), total hardness (S3,S5), total dissolved solid (S1-S5), total suspended solid (S1-S5), conductivity (S3-S5), and turbidity (S2).

CONCLUSION

With a comprehensive research carried out in the study area to investigate the extent of leachate contaminant in the water table, the water samples from different strategic areas of Papalanto have been assessed and the physio-chemical analysis carried out. Evidently, contaminants are characterized by high level of toxic, organic and inorganic waste materials. The water samples obtained from well situated in the area of the prominent dumpsite area are not terribly contaminated but certain physio-chemical parameters have exceeded the WHO and NSDWQ standard for quality drinking water. Thus physio-chemical analysis is a useful technique for monitoring groundwater contamination due to leachate at the refuse disposal sites.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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