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# Environmental Effect of River Sand and Gravel Mining in Dagiri Gwagwalada Area Council of the FCT

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***Abstract***
*Rivers are the most important life supporting systems of nature. Environmental problems occur when the rate of extraction of sand, gravel and other materials exceeds the rate at which natural processes generate these materials. This paper examined the environmental effect of river sand and gravel mining in Dagiri, Gwagwalada Area Council of the FCT. Both primary and secondary data were used in the study. Convenience sampling technique was used in the administration of questionnaire. The study revealed that majority of the respondents were traders with 138 representing 39.0% of the people sampled. This could be attributed to Dagiri being a satellite town in Gwagwalada with places like WAZOBIA Park and other parks within the area. However, 69 respondents representing 19.5% were civil servants, 52 (14.7%) of the respondents were farmers, 49 (13.8%) engaged in sand mining activities while others were involved with one activity or the other. The study revealed that river sand and gravel mining has resulted to the destruction of the landscape, vegetation and deforestation in the study area as noted by 59.0% of the total respondents sampled. In addition, 60.4% of the population sampled agreed that river sand and gravel mining causes water, air and land pollution in the study area. More so, 68.1% of the total respondents opined that river sand and gravel mining causes erosion, flooding and collapse of and expansion of river banks in the study area. The result also showed that there is loss of biodiversity, soil nutrients and fertility loss as stated by 72.8% of the total respondents sampled. The hypothesis which stated that river sand mining has no significant effect on the environment of Dagiri, Gwagwalada Area Council of the FCT was tested using multivariate analysis. From the result, $F(12, 918.367) = 112.981$, $p < 0.05$ shows a highly significant effect. This implies that river sand and gravel mining have significant effect (such as water pollution, vegetal loss, degradation of the landscape, loss of biodiversity and others) on the environment of Dagiri Gwagwalada Area Council, FCT. It was recommended that there should be river sand mining environmental assessment, management and monitoring programmes to mitigate the environmental effects of river sand mining.*

**Keywords:** *River Sand, Gravel Mining, Natural Processes, Water Pollution, Landscape Degradation*

## 1.0 INTRODUCTION

Sadeghi et al., (2018) opined that monitoring the sediment transport behaviour induced by different interventions particularly sand mining from rivers is needed to adaptively manage the watersheds. The particle size distribution of the suspended sediment in up and downstream of rivers is one of the main indicators to know about fate of sediments, which may be varied in different conditions. Riverine sediments are a key component of the watersheds which determines a watershed health (Adhami and Sadeghi, 2016). Sand mining is a practice that is used to extract sand, mainly through an open pit. However, sand is also mined from beaches, inland dunes and dredged from ocean beds and river beds (Aigbedon and Iyayi, 2007). It is often used in manufacturing as an abrasive, for example, and it is used to make concrete. It is also used in cold regions to put on the roads by municipal plow trucks to help icy and snowy driving conditions, usually mixed with salt or another mixture to lower the freezing temperature of the road surface (have the precipitations freeze at a lower temperature). Sand dredged from the mouths of rivers can also be used to replace eroded coastline (Aigbedon and Iyayi, 2007). Increasing of human activities in watersheds and particularly sand and gravel mining from gravel-bed rivers to secure their structural needs influence suspended sediments behaviour in rivers. Suspended sediments behaviour and characteristics in rivers may be varied by different factors consisting of climatic, temporal and hydrological, geomorphologic conditions and human intervention (Oi and Liu, 2017; Kheirfam and Sadeghi, 2017; Li et al., 2016, Sadeghi and Singh, 2017). Another reason for sand mining is the extraction of minerals such as retiles, limonite and zircon, which contain the industrially useful elements titanium and zirconium. These minerals typically occur combined with ordinary sand, which is dug up, the valuable minerals being separated in water by virtue of their different densities, and the remaining ordinary sand re-deposited (Idiake, 2006).

Sand mining is a direct cause of erosion, and also impacts the local wildlife. For example, sea turtles depend on sandy beaches for their nesting, and sand mining has led to the near extinction of gavials (a species of crocodiles) in India. Disturbance of underwater and coastal sand causes turbidity in the water, which is harmful for such organisms as corals that need sunlight. It also destroys fisheries, causing problems for people who rely on fishing for their livelihoods (Jacobson, 2004).Removal of physical coastal barriers such as dunes leads to flooding of beachside communities, and the destruction of picturesque beaches causes tourism to dissipate. Sand mining is regulated by law in many places, but is still often done illegally (Martin, 2003).

Sadeghi and Zakeri (2015) noted that river gravel and sand are desired resources of river materials since their fine particles are carried by water flow and durable sediments with suitable granulometry are deposited. Sand and gravel are used extensively in construction. In the preparation of concrete, for each tonne of cement, the building industry needs about six to seven times more tonnes of sand and gravel (USGS, 2013). Thus, the world's use of aggregates for concrete can be estimated at 25.9 billion to 29.6 billion tonnes a year for 2012 alone. This production represents enough concrete to build a wall 27 metres high by 27 metres wide around the equator (Miller, 2013). Aggregates also contribute to 90% of asphalt pavements and 80% of concrete roads and the demand for aggregates stems from a wide range of other sectors, including production of glass, electronics and aeronautics. These sands and gravels are mined world-wide and account for the largest volume of solid material extracted globally and the highest volume of raw material used on earth after water (about 70-80% of the 50 billion tons material mined/year) (USGS, 2013). Formed by erosive processes over thousands of years, they are now being extracted at a rate far greater than their renewal (Swenson, 2011).

One of the major occupations in Gwagwalada Area Council is river sand mining. Although of recent there has been a decline in the business due to the seasonality of the river. Most of the miner makes their living from this venture as they see it as a very lucrative business. Technically the river deposit fine silt at the river mouth during the rainy season and due to the seasonality of such rivers the business seems to be seasonally inclined. Sadeghi et.al., (2018) assessed the effects of type, level and time of sand and gravel mining on particle size distributions of suspended sediment. Negative effects of river sand mining on the environment are unequivocal and are occurring around the world. The volume being extracted is having a major impact on rivers, deltas, coastal and marine ecosystems (Ali, 2003).Sand mining results in loss of land through river or coastal erosion, lowering of the water table and decreases in the amount of sediment supply(Saleem, 2003).Sand mining is a direct cause of erosion, and also impacts the local wildlife. While this effect cannot be disconnected from the ever-increasing population within the Area Council and especially the study area, anthropogenic activities within the area have recently become pronounced thereby increasing the demand for river sand and gravel mining which are used for building and other purposes. The fluvial behaviour of the rivers is differently influenced by sand and gravel mining as one of the common human interferences (Abarca et al., 2017; Karimnia and Bagloo, 2015; Papenmeier, et al., 2014). In view of all these, the research seeks to address the environmental effects of sand and gravel mining in Dagiri, Gwagwalada Area Council, Abuja FCT and to suggest accurate temporal and spatial management of sand and gravel mining and other human interference in and around river Usma for appropriate utilization of its resources.

## 2.0 MATERIALS AND METHODS

### The Study Area

Gwagwalada is located in the Federal Capital Territory of Nigeria, it lies within $8^0$ 05’ North and $9^0$ 15’ North of equator and longitude $6^0$ 50’ east and $7^0$ 05’ east in the FCT (Adeeko and Ojo, 2015). Gwagwalada town is strategically located close to the heartland of the FCT and exist as a nodal within the nation regional and local road network is located along Kaduna Lokoja express way and it is about 60 kilometres West of the Abuja and about 25 minutes’ drive to the city gate from the heart of Gwagwalada by road. The town has a boundary with Kuje in the East, Kwali to the South, Suleja to the North and border town of 170 metre in the North eastern part (Balogun, 2001).The study area is the second largest town in the F.C.T after the federal capital city Abuja with a total land mass of about 65 square km it is located at the centre of a very fertile agriculture area with abundant clay deposit to its north-east and south west (Adakayi, 2000).

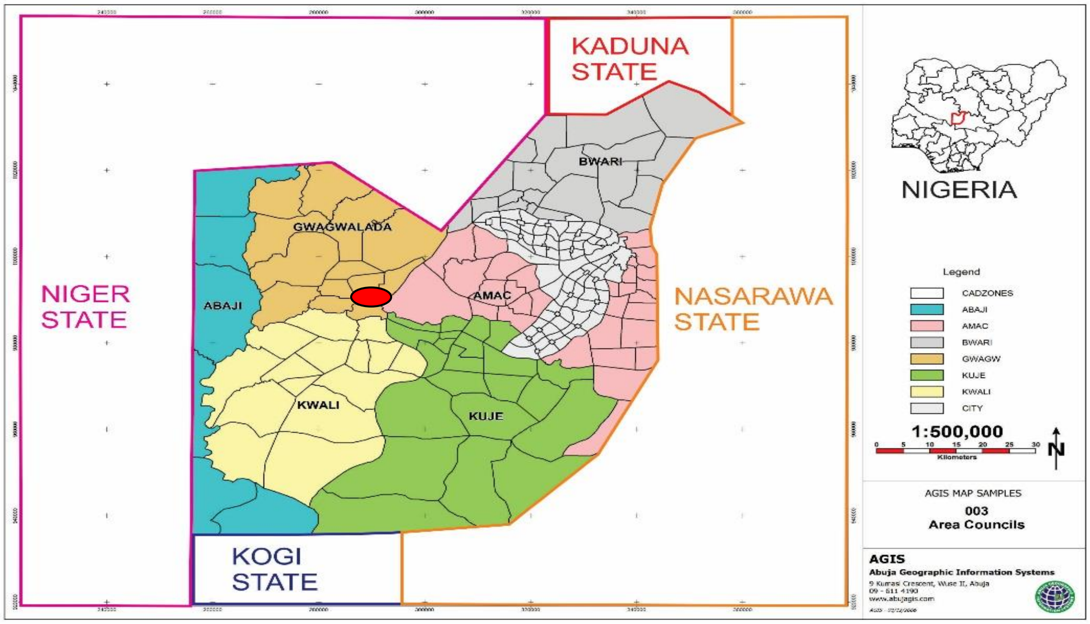


Fig 1: Map of FCT showing Gwagwalada Area Council
Source: Author's design, 2021

The population of Gwagwalada Area Council was 79,306 (NPC, 1991). The amount of rainfall in the area is moderate between the months of April and October and is characterised by the dry and wet hazy weather commences from October – November and last until March – April, although there could be some scanty flashes of rain during this period. The mean maximum temperature remains high throughout the year, hovering about $31^0$C, particularly in March and June. The lowest minimum temperature however, occur usually between December and January when most part of the area come under the influence of the tropical continental air mass that blows from the North. The relative humidity of the area ranges from 27% - 87%. The relative humidity is high during the rainy season. The area lies in the tropical savannah vegetation zone where there is complete soil and vegetation cover. It has a fairly plain topography with sparsely distributed medium size hills and highlands that may have been formed by outcropping basement rocks. It is underlain by the Nigerian basement complex rock of the Precambrian age. The basement areas of Gwagwalada have good weathered zones that are great aquifer formations and well-decomposed basement rocks under lie the top soil that is mostly laterite (Adeeko and Ojo, 2015).

**Types and Sources of Data**

Both primary and secondary types of data were employed in this study. The primary data types of the study include data on the mining method used in the study area, data on the daily income generated from mining, data on the effects of river sand and gravel mining on the environment, etc. These data were gotten with the use of questionnaire, interview and on-site observations.

**Population of the study**

The study area is Dagiri. Dagiri is one of the localities in Gwagwalada Area Council. It has a total population of 1,974 people (NPC, 1991). The economic activities of the people in the study area are trading, fishing, mining, business and workers (both government and private workers). The population was projected to 2018 based on 3% growth rate and the projected population is 4,385.

**Sample size and sampling procedure**

The sample size for this research was determined using Yamen's formula. The sample size technique is given as;

$$n = \frac{N}{1+N\,(e)^2}$$

where n = sample size

N = population of study

e = tolerable error

Therefor,

$$n = \frac{4{,}385}{1 + 4{,}385\,(0.05)^2}$$

$= 367$

This implies that 367 persons were sampled during the study.

**Questionnaire administration**

The research used the questionnaire method to obtain relevant data from the respondents which were majorly river sand miners, fishermen, truck and canoe drivers and residents living close to the river side. In all, three hundred and sixty-seven questionnaires were administered, out of which 354 were properly filled and returned. Convenience sampling technique was employed during the administration of the questionnaires. This technique was used because it involves the sample being drawn from that part of the population which is close at hand.

The questionnaire was divided into two sections; section A and section B. Section A comprised of personal information of the respondents like age, sex, occupation, etc. while section B had questions on the effect of river sand and gravel mining in Dagiri, Gwagwalada Area Council.

**Hypothesis testing**

Ho: River sand and gravel mining has no significant effect on the environment of Dagiri, Gwagwalada Area Council of the FCT.

**Method of Data Analysis**

Descriptive and inferential statistics were employed in this study to analyse the data collected. The data were analysed using simple percentage, tables, flow charts and multivariate analysis. For parametric test to be ran, the data measured in nominal and ordinal scales were recorded into dummies of 1 and 0. The hypothesis which stated that river sand and grave mining has no significant effect on the environment of Dagiri, Gwagwalada Area Council, FCT was tested using multivariate analysis.

## 3.0 RESULTS AND DISCUSSION

**Demographic and socioeconomic characteristics of respondents**

The demographic and socioeconomic characteristics of the respondents are shown in Table 1. The study revealed that 75 representing 21.2% of the respondents were between the age of 46 – 55 years, 69 (19.5%) were between the ages of 26 – 35 years, 64 respondents representing 18.1% were between 36 – 45 years, 56 respondents representing 15.8% were between 16 – 25 years, 50 respondents (14.1%) were between 56 – 65 years while 40 respondents (11.3%) were between 66 years and above. The result implies that majority of the respondents were of age and knowledgeable on the environmental effects of sand and gravel mining in Dagiri. In terms of marital status, 146 respondents representing 41.2% were single, 119 respondents representing 33.6% were married, 48 (13.6%) of the respondents were widow while 41 (11.6%) of the respondents were divorced. Furthermore, 95 respondents representing 26.8% had secondary school education, 82 (23.2%) of the respondents had HND/BSc level of education, 69 (19.5%) of the respondents had primary education, 65 (18.4%) of the respondents had no formal education while 43 respondents representing 12.1% had NCE/OND. The result shows that majority of the respondents were educated enough to proffer answers to the questions on the questionnaire. As regards to income level, majority of the respondents representing 206 (58.2%) earn between ₦1,000 – ₦100,000, 86 (24.3%) of the respondents earn between ₦101,000 – ₦200,000, 46 (13.0%) of the respondents earn between ₦201,000 – ₦300,000, 6 (1.7%) of the respondents earn between ₦301,000 – ₦400,000 while 10 (2.8%) of the respondents earn between ₦400,000 and above. The analysis also revealed that males responded more (181 that is, 51.1%) than female respondents (173 that is, 48.9%).

Table 1: Demographic characteristics of the respondents

| Variables | Category | Total Frequency | Total Percent |
|---|---|---|---|
| Age | 16 – 25 | 56 | 15.8 |
| | 26 – 35 | 69 | 19.5 |
| | 36 – 45 | 64 | 18.1 |
| | 46 – 55 | 75 | 21.2 |
| | 56 – 65 | 50 | 14.1 |
| | 66 and above | 40 | 11.3 |
| **Marital status** | Single | 146 | 41.2 |

| | | | |
|---|---|---|---|
| | Married | 119 | 33.6 |
| | Widowed | 48 | 13.6 |
| | Divorced | 41 | 11.6 |
| **Education level** | No formal | 65 | 18.4 |
| | Primary | 69 | 19.5 |
| | Secondary | 95 | 26.8 |
| | NCE/OND | 43 | 12.1 |
| | HND/BSc | 82 | 23.2 |
| | ₦1,000 – ₦100,000 | 206 | 58.2 |
| | ₦101,000 – ₦200,000 | 86 | 24.3 |
| **Income level** | ₦201,000 – ₦300,000 | 46 | 13.0 |
| | ₦301,000 – ₦400,000 | 6 | 1.7 |
| | ₦401,000 and above | 10 | 2.8 |
| **Sex** | Female | 173 | 48.9 |
| | Male | 181 | 51.1 |
| | Farming | 52 | 14.7 |
| | Trading | 138 | 39.0 |
| **Occupation** | Sand mining | 49 | 13.8 |
| | Fishing | 29 | 8.2 |
| | Civil servant | 69 | 19.5 |
| | Others | 17 | 4.8 |

Source: Author's computation, 2021

In the case of occupation, majority of the respondents were traders with 138 representing 39.0% of the people sampled. This could be attributed to Dagiri being a satellite in Gwagwalada with places like WAZOBIA park and other parks within the area. However, 69 respondents representing 19.5% were civil servants, 52 (14.7%) of the respondents were farmers, 49 (13.8%) engaged in sand mining activities while others were involved with one activity or the other.

## Environmental effects of sand and gravel mining in Dagiri

**Table 2: River sand and gravel mining has resulted to the destruction of the landscape, vegetation and deforestation**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagreed | 43 | 12.1 | 12.1 | 12.1 |
| | Disagreed | 102 | 28.8 | 28.8 | 41.0 |
| | Agreed | 89 | 25.1 | 25.1 | 66.1 |
| | Strongly Agreed | 120 | 33.9 | 33.9 | 100.0 |
| | Total | 354 | 100.0 | 100.0 | |

The result also revealed that river sand and gravel mining has resulted to the destruction of the landscape, vegetation and deforestation as agreed by 59.0% of the total respondents while 41.0%

of the population sampled were of the opinion that river sand and gravel mining has not resulted to the destruction of the landscape, vegetation and deforestation in the study area as shown on Table 2.

**Table 3: River sand and gravel mining causes water pollution, air pollution and land pollution**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagreed | 41 | 11.6 | 11.6 | 11.6 |
| | Disagreed | 99 | 28.0 | 28.0 | 39.5 |
| | Agreed | 90 | 25.4 | 25.4 | 65.0 |
| | Strongly Agreed | 124 | 35.0 | 35.0 | 100.0 |
| | Total | 354 | 100.0 | 100.0 | |

Similarly, 60.4% of the total respondents sampled noted that river sand and gravel mining causes water, air and land pollution in the study area while 39.6% disagreed by stating that river sand and gravel mining do not cause water, air and land pollution in the study area as shown on Table 3.

**Table 4: River sand and gravel mining causes erosion, flooding and collapse of and expansion of river banks**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagreed | 33 | 9.3 | 9.3 | 9.3 |
| | Disagreed | 80 | 22.6 | 22.6 | 31.9 |
| | Agreed | 99 | 28.0 | 28.0 | 59.9 |
| | Strongly Agreed | 142 | 40.1 | 40.1 | 100.0 |
| | Total | 354 | 100.0 | 100.0 | |

From Table 4, 68.1% of the total population sampled opined that river sand and gravel mining causes erosion, flooding and collapse of and expansion of river banks while 31.9% disagreed that river sand and gravel mining causes erosion, flooding and collapse of and expansion of river banks.

**Table 5: There is loss of biodiversity, soil nutrients and fertility loss as a result of river sand and gravel mining**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Strongly Disagreed | 25 | 7.1 | 7.1 | 7.1 |
| | Disagreed | 71 | 20.1 | 20.1 | 27.1 |
| | Agreed | 95 | 26.8 | 26.8 | 54.0 |
| | Strongly Agreed | 163 | 46.0 | 46.0 | 100.0 |
| | Total | 354 | 100.0 | 100.0 | |

The result on Table 5 showed that 258 representing 72.8% of the total respondents believed that there is loss of biodiversity, soil nutrients and fertility loss as a result of river sand and gravel mining while 96 persons representing 27.2% of the total population sampled were of the opinion that there is no loss of biodiversity, soil nutrients and fertility loss as a result of river sand and gravel mining in the study area.

**Testing of hypothesis**

River sand and gravel mining has no significant effect on the environment of Dagiri, Gwagwalada Area Council, FCT. This was tested using multivariate analysis.

**Table 6: Descriptive Statistics**

| | N | Mean | Std. Deviation |
|---|---|---|---|
| River sand and gravel mining has resulted to the destruction of the landscape, vegetation and deforestation | 354 | 2.8079 | 1.03882 |
| River sand and gravel mining causes water pollution, air pollution and land pollution | 354 | 2.8390 | 1.03456 |
| River sand and gravel mining has caused erosion, flooding and collapse of and expansion of river banks | 354 | 2.9887 | 1.00135 |
| There is loss of biodiversity, soil nutrients and fertility loss as a result of river sand and gravel mining | 354 | 3.1186 | .96543 |
| Valid N (listwise) | 354 | | |

**Table 7: Multivariate Tests[c]**

| Effect | | Value | F | Hypothesis df | Error df | Sig. |
|---|---|---|---|---|---|---|
| Intercept | Pillai's Trace | .993 | 1.219E4[a] | 4.000 | 347.000 | .000 |
| | Wilks' Lambda | .007 | 1.219E4[a] | 4.000 | 347.000 | .000 |
| | Hotelling's Trace | 140.487 | 1.219E4[a] | 4.000 | 347.000 | .000 |
| | Roy's Largest Root | 140.487 | 1.219E4[a] | 4.000 | 347.000 | .000 |
| VAR00001 | Pillai's Trace | 1.544 | 92.557 | 12.000 | 1.047E3 | .000 |
| | Wilks' Lambda | .091 | 112.981 | 12.000 | 918.367 | .000 |
| | Hotelling's Trace | 4.302 | 123.923 | 12.000 | 1.037E3 | .000 |
| | Roy's Largest Root | 2.948 | 2.572E2[b] | 4.000 | 349.000 | .000 |

a. Exact statistic

b. The statistic is an upper bound on F that yields a lower bound on the significance level.

c. Design: Intercept + VAR00001

**Table 8: Tests of Between-Subjects Effects**

| Source | Dependent Variable | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Corrected Model | River sand and gravel mining has resulted to the destruction of the landscape, vegetation and deforestation | 270.796[a] | 3 | 270.796 | 865.436 | .000 |
| | River sand and gravel mining causes water pollution, air pollution and land pollution | 265.142[b] | 3 | 265.142 | 828.277 | .000 |
| | River sand and gravel mining has caused erosion, flooding and collapse of and expansion of river banks | 234.572[c] | 3 | 234.572 | 691.635 | .000 |
| | There is loss of biodiversity, soil nutrients and fertility loss as a result of river sand and gravel mining | 226.437[d] | 3 | 226.437 | 777.012 | .000 |
| Intercept | River sand and gravel mining has resulted to the destruction of the landscape, vegetation and deforestation | 2750.491 | 1 | 2750.491 | 8790.272 | .000 |
| | River sand and gravel mining causes water pollution, air pollution and land pollution | 2812.555 | 1 | 2812.555 | 8786.130 | .000 |
| | River sand and gravel mining has caused erosion, flooding and collapse of and expansion of river banks | 3121.634 | 1 | 3121.634 | 9204.132 | .000 |
| | There is loss of biodiversity, soil nutrients and fertility loss as a result of river sand and gravel mining | 3401.443 | 1 | 3401.443 | 11671.955 | .000 |
| VAR00001 | River sand and gravel mining has resulted to the destruction of the landscape, vegetation and deforestation | 270.796 | 1 | 270.796 | 865.436 | .000 |
| | River sand and gravel mining causes water pollution, air pollution and land pollution | 265.142 | 1 | 265.142 | 828.277 | .000 |
| | River sand and gravel mining has caused erosion, flooding and collapse of and expansion of river banks | 234.572 | 1 | 234.572 | 691.635 | .000 |
| | There is loss of biodiversity, soil nutrients and fertility loss as a result of river sand and gravel mining | 226.437 | 1 | 226.437 | 777.012 | .000 |
| Error | River sand and gravel mining has resulted to the destruction of the landscape, vegetation and deforestation | 110.141 | 352 | .313 | | |
| | River sand and gravel mining causes water pollution, air pollution and land pollution | 112.680 | 352 | .320 | | |
| | River sand and gravel mining has caused erosion, flooding and collapse of and expansion of river banks | 119.383 | 352 | .339 | | |
| | There is loss of biodiversity, soil nutrients and fertility loss as a result of river sand and gravel mining | 102.580 | 352 | .291 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Total | River sand and gravel mining has resulted to the destruction of the landscape, vegetation and deforestation | 3172.000 | 354 | | | |
| | River sand and gravel mining causes water pollution, air pollution and land pollution | 3231.000 | 354 | | | |
| | River sand and gravel mining has caused erosion, flooding and collapse of and expansion of river banks | 3516.000 | 354 | | | |
| | There is loss of biodiversity, soil nutrients and fertility loss as a result of river sand and gravel mining | 3772.000 | 354 | | | |
| Corrected Total | River sand and gravel mining has resulted to the destruction of the landscape, vegetation and deforestation | 380.938 | 353 | | | |
| | River sand and gravel mining causes water pollution, air pollution and land pollution | 377.822 | 353 | | | |
| | River sand and gravel mining has caused erosion, flooding and collapse of and expansion of river banks | 353.955 | 353 | | | |
| | There is loss of biodiversity, soil nutrients and fertility loss as a result of river sand and gravel mining | 329.017 | 353 | | | |

a. R Squared = .711 (Adjusted R Squared = .710)
b. R Squared = .702 (Adjusted R Squared = .701)
c. R Squared = .663 (Adjusted R Squared = .662)
d. R Squared = .688 (Adjusted R Squared = .687)

From the result in Table 3, $F(12, 918.367) = 112.981$, $p < 0.05$ shows a highly significant effect. It can be deduced that river sand and gravel mining have significant effect on the environment of Dagiri Gwagwalada Area Council, FCT. The analysis also revealed that sand mining causes environmental problems such as water pollution, air pollution and land pollution in the study area ($p < 0.05$). Pollution of the environment was so glaring at river sand mining Dagiri. Pollution of downstream water for the community and other communities within who use the water for domestic and other purposes is a threat to the inhabitants of the area. Instream sand mining activities will have an impact upon the river's water quality. Impacts include increased short-term turbidity at the mining site due to resuspension of sediment, sedimentation due to stockpiling and dumping of excess mining materials and organic particulate matter and oil spills or leakages from excavation machinery and transportation vehicles (Ashraf et al., 2011). The mining also has effects on the adjoining groundwater system and the uses local people make of the river. In addition, the sand business owners use lorries to move this product from the stream banks to their final end where they are needed most of the time this lorries releases carbon monoxide (Co) from their exhaust which in turn constitute a major polluting agent in the area. One of the respondents interviewed complained that most at times being a food vendor to people who work at the mining site that her food being exposed during sales are often laced with particulate dust especially when dry sand is moved nearby her food stand. Most of the dust particles can cause respiratory problem to those that inhale or eat them while making food sale unsafe in the axis close to the mining site.

**Plate 1: Showing the extent of land and air pollution in the study area as a result of river sand mining**

Similarly, it leads to destruction of the vegetation, deforestation and destruction of the landscape. The result shows that sand mining has effect on the landscape. From mere observation of the study area, the landscape has been destroyed without real time control over the way sand and gravel mining are being carried out in the area. Most of the area has been converted from agrarian lands where fadama rice plantation was once carried out to an area where refuse dump is now sighted due to the way the mining activities are being carried out over the years. Vegetation is also being destroyed in the study area as well as a result of easy movement of lorries and vehicles conveying the mined sand. Ako et al. (2014) also established that destruction of the landscape, reduction of farm and grazing land, collapsing of river banks, deforestation and water pollution are the environmental effects that result due to sand and gravel mining. Syah and Hartuti (2017) noted that sand and gravel mining is aimed at providing materials for infrastructure development as well as providing economical source to the miners. However, the impacts of sand and gravel mining could also cause disturbances to ecological balance, since it is closely related to land use change and river degradation, besides causing conflicts in the miners, the government and the private relationship. Sand mining involves a high degree of environmental degradation in every stage of mine's life (Gavriletea, 2017).

**Plate 2: Showing evidence of the destruction of the landscape of the study area as a result of river sand mining**

It also has effect on biodiversity, soil nutrients and fertility of the study area. Destruction of the vegetation within the study area has effect on the biodiversity of the area. During the interview, it was noted that at a time there were water alligators which were amphibious in nature around the area some years back due to vegetation and aquatic stability within and around the river but today the reverse is the case as there are no more fishes to catch or even the slightest sight of these water alligators. Adeoti and Peter ((2018) noted that increasing sand mining activities which promote development and income revenue generally continue to reduce the vegetation of most of the mining communities to levels that are destructive to biological diversity. The complete removal of vegetation and destruction of the soil profile destroys habitats above and below the ground as well as within the aquatic ecosystem, resulting in the reduction in faunal populations (Lawal, 2011). Sand mining of the bed, banks, riparian zone and floodplains of rivers are known to cause major morphological and hydrological changes that impact both on their functioning and on riverine habitats and biota (Pillay et al., 2014). It is known fact that loss of soil nutrients and fertility are aftermath effect of sand mining in any area around the world. In the study area, farmlands have been reduced or converted to bad lands as a result of sand mining activities.

More so, river sand mining has a very significant effect or leads to erosion, flooding and collapse of and expansion of river bank (p = 0.000). As a result of sand mining, river width seems to have expanded closely to even residential buildings which are seriously causing erosion and flooding in the study area. This supported the work by Montoi et al. (2017) which asserts that river sand extraction is one of the main factors that induces the significant changes on river platform. Khan and Sugie (2015) noted that for people whose homestead or land was located in the riverbank, the risk of the loss of their property for further erosion was increased by sand mining.

## 4.0 CONCLUSION

This paper examined the environmental effects of river sand and gravel mining in Dagiri, Gwagwalada Area Council of the FCT. Data used for this study were obtained through interviews, field observations and questionnaire administration. Three hundred and sixty-seven (367) questionnaire copies were administered out of which 354 were properly filled and returned. Convenience sampling technique was employed during the administration of the questionnaire. Both descriptive and inferential statistics were employed in the course the study. The study revealed that majority of the respondents were traders with 138 representing 39.0% of the people sampled. This could be attributed to Dagiri being a satellite town in Gwagwalada with places like WAZOBIA Park and other parks within the area. However, 69 respondents representing 19.5% were civil servants, 52 (14.7%) of the respondents were farmers, 49 (13.8%) engaged in sand mining activities while others were involved with one activity or the other. The study revealed that river sand and gravel mining has resulted to the destruction of the landscape, vegetation and deforestation in the study area as noted by 59.0% of the total respondents sampled. In addition, 60.4% of the population sampled agreed that river sand and gravel mining causes water, air and land pollution in the study area. More so, 68.1% of the total respondents opined that river sand and gravel mining causes erosion, flooding and collapse of and expansion of river banks in the study area. The result also showed that there is loss of biodiversity, soil nutrients and fertility loss as stated by 72.8% of the total respondents sampled.

The hypothesis was tested using multivariate analysis. From the result, $F(12, 918.367) = 112.981$, $p < 0.05$ shows a highly significant effect. This implies that river sand and gravel mining have significant effect on the environment of Dagiri Gwagwalada Area Council, FCT. Further analysis revealed that sand mining causes environmental problems such as water pollution, air pollution and land pollution in the study area ($p < 0.05$). Pollution of the environment was so glaring at river sand mining Dagiri. Pollution of downstream water for the community and other communities within who use the water for domestic and other purposes is a threat to the inhabitants of the area. The mining also has effects on the adjoining groundwater system and the uses local people make of the river. It also leads to destruction of the vegetation, deforestation and destruction of the landscape. Vegetation is also being destroyed in the study area as well as a result of easy movement of lorries and vehicles conveying the mined sand. More so, river sand mining has a very significant effect or leads to erosion, flooding and collapse of and expansion of river bank

### Recommendations

River sand and gravel mining has serious environmental effects in Dagiri, Gwagwalada Area Council. Based on the findings, it is recommended that;

I. Awareness should be created to enlighten the general public especially river sand miners on the environmental effects of river sand and gravel mining.

II. There should be sand mining environmental assessment, management and monitoring programmes to mitigate the environmental effects of river sand mining.

III. There should be alternative supply of construction materials (sand and gravel) to reduce river sand mining especially in Gwagwalada Area Council and FCT on the whole.

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