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IMPACT OF SAND MINING ON RIVER CHANNELS PHYSICAL CHANGES OF RIVER MORPHOLOGICAL CHARACTERISTICS

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Abstract

Sand mining cause havoc on the environment and society, with uncontrollable consequences. Because the rate of extraction exceeds the rate of deposition. Environmental. To assess the impact of sand mining on land and channel morphology along the River Channel, twenty-nine (29) core samples were collected between February and March utilizing distinct but similar field measurements. Between the two months, daily excavation activities in the mining zone were also recorded. Channel dimensions, sand particle size characteristics along the river channel, suspended and dissolved sediment transit in and out of the mining site, bulk density, sediment courses and sources, and the daily volume of sand collected from the channel bed are some of the variables taken into account. The data on channel depth collected in February and March 2017 was analyzed using inferential and descriptive statistics such as the t-test. According to channel morphology data, the River Channel has a sustainable threshold of 1.6 meters. The environmental problems may have started when the 1.6-meter limit for sand mining was breached. Sand accounts for 72.08 percent of the sediment in the channel, while silt and clay each account for 16.86 and 11.06 percent. The average daily sand transport into mining sites was 106.6 tons, with a daily transfer of 175.98 tons. The undisturbed area of the River Channel, on the other hand, became shallower and wider as a result of deposition, according to the study. As a result of considerable sand mining operations, the disturbed river became deep and narrow, causing erosion both upstream and downstream of the mining sites. The research recommended that mining businesses and people should comply with state and local government laws governing sand mining activities to avoid excessive excavation on the river channel's bed. The government should enforce strict compliance through monitoring to lessen our overall reliance on the River Channel.

Keywords: River Channels, Morphology, Sand Mining, Sediments, and measurements

1. Introduction

Although the sand is one of the world's most abundant resources, accounting for around 20% of the earth's surface, it is a finite resource. This suggests that sand may become scarce shortly since the rate at which it is consumed exceeds the natural rate of replenishment (Arsyad *et. al.*, 2020; Navya *et. al.*, 2021). Rapid urbanization is the primary driver of sand consumption and is responsible for the unsustainable extraction of sand from riverways. Sand extraction affects underground aquifers, affecting the quality and quantity of surface water accessible for human and animal consumption, as well as affecting the aquatic ecology and riparian flora. According to studies, unsustainable mining of sand and gravel from rivers has major consequences, both onsite and offsite, resulting in changes in channel structure, drying of river banks, and interference with both aquatic and terrestrial food networks (Phillips, 2016; Starnes *et. al.*, 1996). Park *et. al.* (2020) and Ashraf *et. al.* (2011) observed that instream mining can have far-reaching consequences beyond the immediate mine locations. Many hectares of agricultural land, as well as significant timber resources and wildlife habitats in riparian zones, are lost. Because all species require certain habitat conditions to maintain their long-term existence, degraded river habitats result in a loss of fish output and biodiversity. Other consequences include a decrease in recreational potential as well as the loss of land and scenic qualities. Evans *et. al.* (2019) and Matthias *et. al.* (2022), noted that the impact of sand harvesting on the physical environment may result in a riverbank undercutting and collapse; (ii) loss of adjacent land and or structures; (iii) upstream erosion as a result of an increase in channel slope and changes in flow velocity; and (iv) downstream erosion due to increased load-carrying capacity of the stream and downstream changes in patterns of deposition and changes in channel bed and habitat. They also discovered that stream sand mining destroys aquatic and riparian habitats by causing significant changes in channel morphology.

Goddard (2007), observed that decisions on where to mine, how much to mine, and how frequently to mine require a description of the reference state and sand budget. A reference state is the bare minimum of a channel's physical and biological conditions. Though determining the reference condition is challenging, a general understanding of fluvial processes is required to reduce the negative effects of mining. A sand budget for a specific extraction region, such as a stream or open area, should be created first to estimate how much sand may be extracted without causing degradation and erosion. However, when creating a sand budget, it is critical to examine the mining methods to be employed, particle size, sand properties, riparian vegetation and magnitude, as well as the frequency of hydrological events following the disturbance. As a result, minimizing the detrimental consequences of sand and gravel mining necessitates a thorough understanding of the site's reaction to these disturbances (Goddard, 2007). Apart from environmental consequences, sand harvesting has a wide range of social consequences. Because agriculture was unable to provide appropriate work prospects for the local landless laborers, the situation forced them to seek the assistance of illegal miners to secure their livelihood. As agricultural methods dwindle, farmers either sell their land to miners or allow them to excavate the valuable sand underlying their land (Manjunatha *et. al.*, 2022; Sathya *et. al.*, 2021). Dick-Sagoe *et. al.* (2016), Ekpo *et. al.* (2020) and (Nsimiire, 2009) observed the socioeconomic and ecological impacts of gravel mining in northern Ghana and discovered that the impacts of sand mining included pits, which served as breeding grounds for mosquitoes and the spread of other waterborne diseases, erosion and loss of vegetation, loss of economically important trees, and is a key route to conflicts. Mining's significant negative environmental impacts were erosion, landscape damage, biodiversity loss, loss of grazing land, sand and dust pollution, and sand and dust pollution. Mining's beneficial environmental impacts included improving infrastructure development such as highways. Despite this, sand mining continues at an alarming rate in the indicated location. Several studies on sand mining in Nigeria have been undertaken, including one by (Ako *et. al.*, 2014) who used field observation and laboratory research to investigate the environmental consequences of sand and gravel mining on land and soil in Luku, Minna Niger State, north-central Nigeria. They discovered a lot of farms, grazing land, landscape devastation, a lot of riverbank collapse, a lot of deforestation, and most of water and air pollution. It is also high in lead, arsenic, copper, nickel, cadmium, mercury, silver, and zircon. These values are higher than the upper continental crust's average standard concentrations of these elements. These greater concentrations may harm plants and animals in the vicinity, causing sicknesses such as brain and kidney damage, lung discomfort, cardiac abnormalities, and even death. Nabegu (2013) investigated the impact of sand mining on groundwater in the Kano River basin. According to an interview with users, the groundwater table at the mining site has dropped by up to 13 meters from 3 meters in the last twenty years. Groundwater levels in this area were likewise found to be stable at 4 meters during the rainy season (July–September) but plummeted to 7-9 meters during the dry season (November–June). The fact that all 26 boreholes within the mining site are bored to depths ranging from 35 to 55 meters, while the three on the Kano Sate University of Science and Technology (KUST) campus downstream are sunk to depths ranging from 20 to 30 meters, is further proof of the decreased water table.

Adetayo (2013) investigated the impact of rural people's sand mining operations on agricultural land in Ogun state. Sand mining adds to land degradation in rural communities by damaging the soil surface and structure and decreasing the nutritional quality of agrarian land, according to the findings. It is recommended that trees and bushes be planted to assist regenerate degraded land and avoid erosion, as well as educate rural people on alternative livelihood pursuits that are less damaging to agricultural land.

Abba and Andrew (2010) researched the effects of sand mining on agricultural activities on the Bama Ridge in North-Eastern Nigeria, and they discovered that sand mining has severely impacted agricultural activities on the ridge, with crops production reduced by more than half, grazing land destroyed, and animals migrating to areas with abundant food supply. Because of the Ngadda River's water scarcity, fish output has been substantially diminished. Lawan (2011) investigated the consequences of sand and gravel mining on stakeholders in Niger State's Minna emirate council. The primary goal of the research is to identify the issues that sand and gravel mining bring to stakeholders. According to the study's findings, while quarry owners and local governments get less than 8% of the entire profit generated by the firm, miners ferry more than 80% of the revenue. The perceived socioeconomic impact of sand extraction in Nigerian communities has been overserved. The findings showed that the current approach, which excludes communities from the planning process, may only lead to fear of the crisis that has bedeviled the country's producing region, and thus suggest an all-inclusive involvement of the affected communities in decision-making from the beginning of the mining cycle to the end (Chindo, 2011). On the Jos plateau in North Central Nigeria, researchers looked into the effects of mining on water quality and the environment. The results revealed that the manganese level in the mining pond was 0.9 mg/L, which was greater than the WHO's highest permissible level of 0.05

mg/L. The area's most serious problem is the devastated and de-vegetated ground. People are deprived of fertile agricultural land due to mining. However, the investigation revealed that the pond is still used for agricultural and other purposes (Gyang *et. al.*, 2009). Nabegu (2013) conducted a study, which examined the effects of sand mining on groundwater in the Kano River watershed. The results suggest that the groundwater table at the mining site has dropped by up to 13 meters in the last twenty years, from 3 meters. These studies converted on the impact of groundwater, socio-economic and other environmental issues. This research is therefore targeting the river channel morphological characteristics as a result of unsustainable sand mining.

2. Methodology

2.1 The Study Area

The Challawa River runs through Kano's southern region. It is around 70 kilometers long and has a confluence with the Kano River in Tamburawa. It travels in a south-westerly direction. It sits at a height of around 500 meters above sea level (Olofin, 1987). The Challawa River became permanent after receiving seasonal run-off from big streams such as the Kurma, Magaga, Kogin Dabga, River Raurau, Takwami (Gulu), Dawaza, Watari, and Natare. Tafashiya, Cijaki, and Tatsawarki, for example, carry water mixed with industrial waste from the Challawa and Sharada industrial regions. While the Kano River System originates in the Jos Plateau's slopes. It flows steeply to the north at first, until it reaches the Challawa River's confluence. The flood is moving eastward (Abdulhamid *et. al.*, 2014).

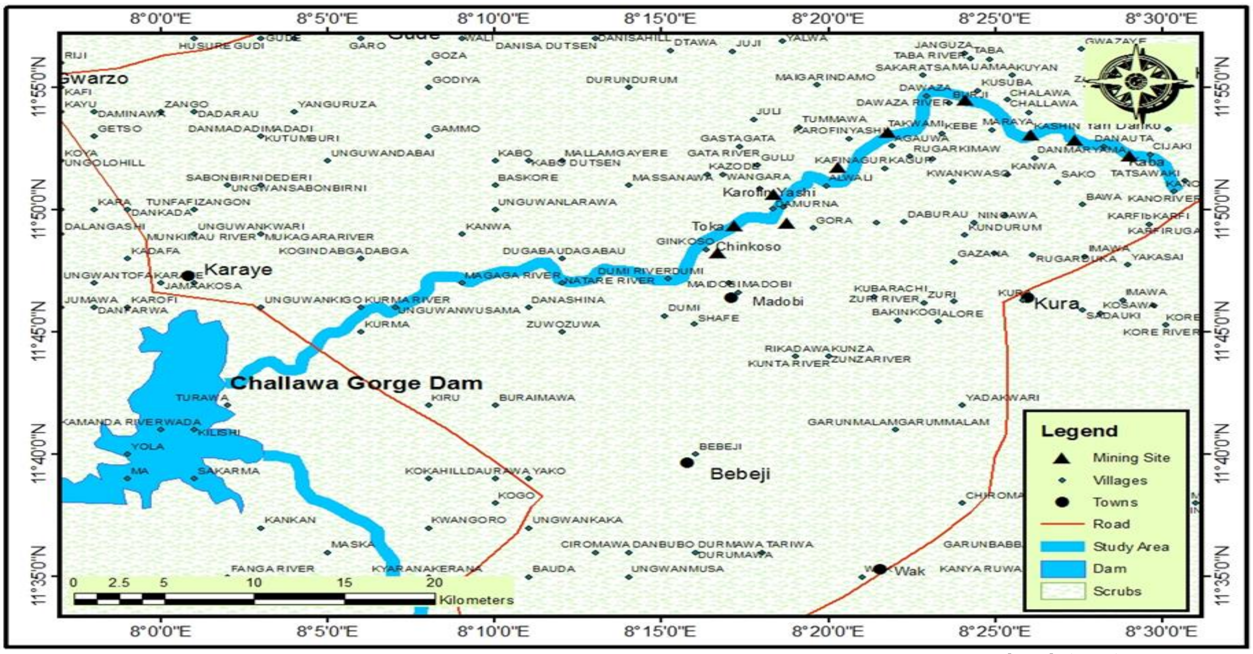


Figure 1 Map of Challawa River Showing the Study Area

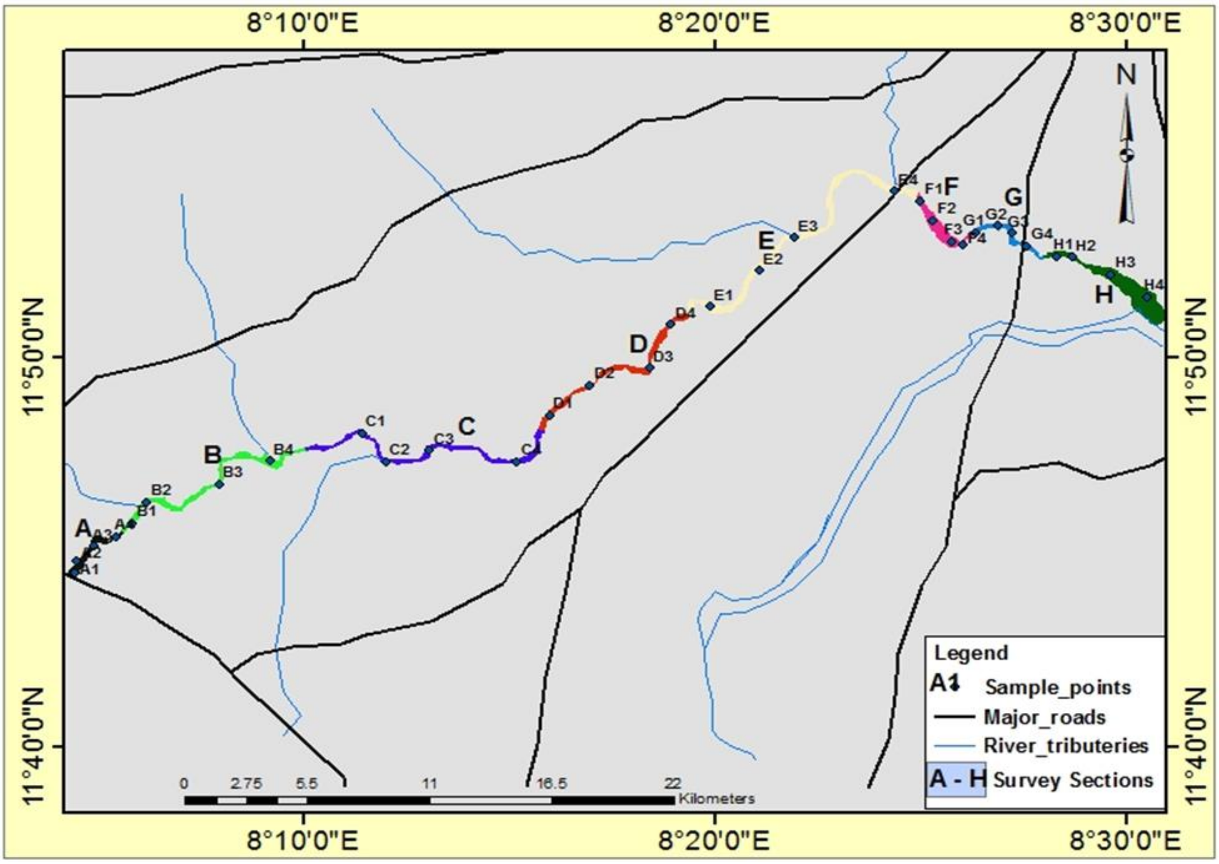
Source: Carto Lab Buk (2017)

3. Methodology

In the research region, mining activities were observed and sand budget was measured, analyzed in the lab, and sand volume calculations were made. The sand budget on the Challawa River channel, as well as information on mining activities, were gathered using bathymetric measurement and calculation on a comparatively undisturbed section of the Challawa River channel, which addressed the difficulties stated. Along the Channel, where sand mining and fadama agriculture activities take place in the research area, a soil survey and sample collection were done. Particle size distribution and bulk density were determined using samples collected for laboratory analysis.

Data on the estimated amount of sand excavated per day in the study area was obtained by recording the number of trucks evacuating sand daily at the sand loading sites in the area and the mining methods used, as well as a water sample for laboratory analysis and a daily discharge record of 20m3/sec of water from the Hadejia Jama'are River Basin Development Authority.

To determine total sediment transport in and out of the mining sites. A survey of 69.4 kilometers (69.4km) was done to assess the particle size characteristic of the sand in the research area, with the channel being separated into parts based on homogeneity in terms of width and depth. As with Andrew, (Sekellick *et. al.*, 2013). Soil samples and their coordinates were acquired in each segment to represent the complete portion. A daily inventory of the amount of sand being evacuated by the trucks was acquired daily for a month to determine the volume of sand being dug every day in the research region



. Figure 2 Sample Collection Points

Source: produced by A.H.Abdullahi (2017)

To determine the horizontal and vertical width at each selected position. a measuring tape was held from one end of the river bank to the other, like in (A. Tukur *et. al.*, 2013)Tukur, (2010). The channel depth was initially measured at the bank, and then the water level was obtained, and the Channel depth at the center was measured and compared with the original bank depth to determine the actual channel depth at a given place. On the range pole, a green marker was used to identify the corresponding depth. A measuring tape was then used to determine the depth of the equivalent depth on the ranging pole.

4. Results

Based on the bathymetric survey conducted on Challawa River from Kiru-Karaye Road Bridge to its confluence with Kano River. The study area covers about 69.4km long, with 694 environmental survey lines. Measurement and observations after the study showed some changes in the channel morphology. The channel was divided into eight portions numbered A through H. The Channel width was found to be increasing with an increase in the sediment deposit. But that was not the case in sections with mining activities, where the channel became deeper and narrow as shown in fig 1 and 2. The variations in dimension determine the rate of sediment deposition, yield and human interference. From the analysis in Table 1, it shows that the E section of the Channel was the largest, with a total length of 14.9 km and a total area of 2,305,030 square meters, a mean width of 154.7 meters, and an average depth of 2.6 meters, followed by C section with 13.8 km and a total area of 2,882,820 square meters, a mean width of 208.9 meters and an average depth of 1.6 meters. The smallest is the A section with 3.8 km, a total area of 167,860 square meters, a mean width of 44.7 meters, and an average depth of 1.4 meters. The channel depth and width increase eastward as the direction of its flow, except in the B section, where the channel became wider and shallow, except at the bank, due to large deposits by rivers that joined, such as Magaga, Kurma, Kogin Dabga and several other small tributaries joining at B section fig 2 below.

Table 1 Sectional Characteristics of the Challawa River Channel

Section	Coordinates (Latitude and Longitude)	Mean Width (m)	Mean Depth (m)	Length (km)	Area (m^2)
A	11.73968N 008.07323E 11.75839N 008.09436E	44.7	1.4	3.8	169,860
B	11.75839N 008.09436E 11.79332N 008.16924E	103.2	1.2	11.3	1,166,160
C	11.79332N 008.16924E 11.80268N 008.26479E	208.9	1.6	13.8	2,882,820
D	11.80268N 008.26479E 11.85267N 008.32283E	126.7	2.1	10.7	1,355,690
E	11.85267N 008.32283E 11.90205N 008.41489E	154.7	2.6	14.9	2,305,030
F	11.90205N 008.41489E 11,88889N 008.43697E	79.9	3.7	3.7	295,630
G	11,88889N 008.43697E 11.87842N 008.46701E	101.2	5.4	4.1	414,920
H	11.87842N 008.46701E 11.84782N 008.50964E	67.1	6.0	7.1	476,410

Source: Field Work, 2017

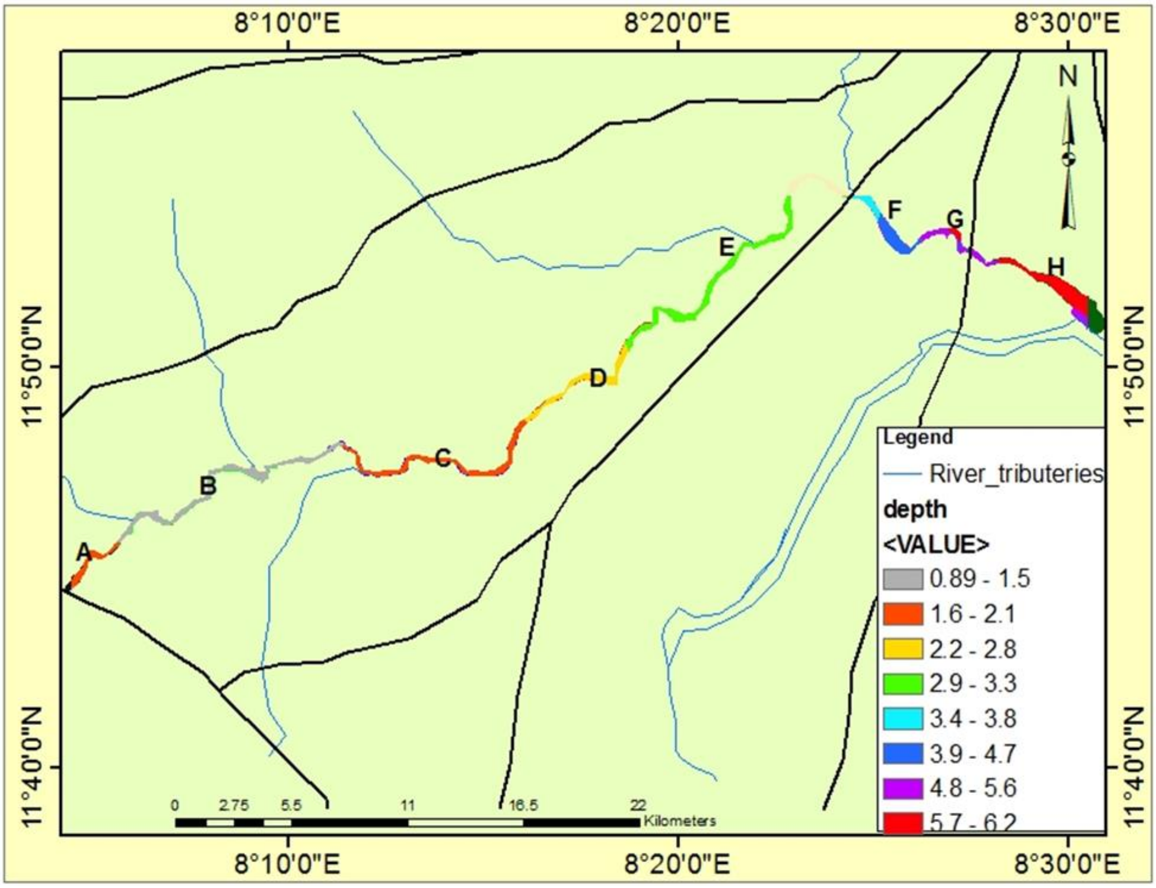


Figure 3 Sectional Depth of the Challawa River Channel Source: Produced by A.H Abdullahi (2017)

The Channel depth increases downward, because of the mining activities downstream, with section B having the lowest channel depth of 0.8 to 1.5, followed by A and C sections with 1.6 to 2.1 meters, section A falls into this category due to high Water velocity because of its proximity to Dam outlet, and D section has a depth range from 2.2 to 2.8 meters, while section E, F, G, and H have depth ranges from 3.4 to 3.8, 3.9 to 4.7, 4.8 to 5.6 and 5.7 to 6.2 meters respectively, this is due to the good road network and proximity of the River Channel section to the urban kano as shown in figure 2

4.1 Particle Size Distribution of the Challawa River Channel

Table 2 shows that the channel sediments were dominated by sand, with a small amount of silt and clay. Sand, silt, and clay made up 72.08 percent, 16.80 percent, and 11.06 percent of the texture, respectively. The extensive washout of particles by the running water may be the cause of the low clay and silt concentration. The lightness of the particles allows them to remain suspended for a long time. The deposit was determined to fall within the USDA textural triangle range of sandy loam, loamy sand, and loam soil. In agreement with the NADECO in (A. Tukur *et al.*, 2013) assessment, soil in the area was found to be within the range of loamy sand, sandy loam, and loamy soil. Silt content increases soil erosion, while the amount of sand and clay in the soil increases soil deposition at the same time. This is also recognized to be the case (Kandel, 2021). According to the soil's texture, it's safe to assume that the deposit came from farms upstream. In addition, because the construction is loose and less compact, erosion of the channel bed and sand excavation are both made simpler as a result of this.

Table 2: Particle Size Distribution of the Challawa River Channel Sediment

Section	Average Clay (%)	Average Silt (%)	Average Sand (%)	Total	Textural Class
A	10.05	22.43	67.52	100	Sandy loam
B	9.08	11.26	79.66	100	Loamy sand
C	10.2	10.2	79.6	100	Loamy sand
D	8.53	8.72	82.75	100	Loamy sand
E	8.2	11.2	80.6	100	Loamy sand
F	11.7	25.26	63.04	100	Sandy loam
G	16.2	9.74	74.04	100	Sandy loam
H	14.48	35.6	49.42	100	Loam
Average	11.06	16.86	72.08	100	

Source: Field Work, 2017

4.2 Bulk Density

It was possible to figure out the bulk density of sand by weighing 40 cm3 of the sample and then computing the mass per cubic centimeter. Calculation: The formula is grams divided by cubic meters, which is mg/m3 (mg/cubic meter). From table 3 the bulk density (BD) of sections C and E is 1.44 g/cm3, followed by section F at 1.41 g/cm3, section D at 1.39 g/cm3, while the BD of sections A, G, and H is 1.34 g/cm3 (g/cm3) on average (g/cm3). Phosphate-rich soil has lower bulk densities than dense, compacted soils, which have more solids. When soil is compacted, root growth, aeration, and water infiltration are hampered. As clay concentration increases, so does bulk density, which is a measure of soil compactness. Soil compaction increases linearly with bulk density. The passage of water is hindered by the limited permeability of compacted soils. As a result of compaction, infiltration is reduced, while runoff and erosion are accelerated (A. I. Tukur *et. al.*, 2018).

Table 3: the bulk density of the Challawa River Channel soil samples is shown.

Section	Sample Identification Number	Average Mass (g)	Volume (cm3)	Average Bulk Density (g/cm3)
A	A1,A2,A3	53.97	40	1.34
B	B1,B2,B3, B4	55.99	40	1.39
C	C1,C2,C3, C4	57.74	40	1.44
D	D1,D2,D3	58.83	40	1.39
E	E1,E2,E3, E4	57.74	40	1.44
F	F1,F2,F3,F4	56.65	40	1.41
G	G1,G2,G3,	53.62	40	1.33
H	H1,H2,H3, H4	50.42	40	1.25

Source: Field Work, 2017

4.3 Sediment Sources on Challawa River Channel

The sources and causes of sediment may be poor farming practice upstream, deforestation, sand mining, loosing of soil by hauling trucks, and tramping of animals across and within the channel and on upland farms along the Challawa River Channel. Apart from several tributaries that supply sediment upstream of the Challawa George Dam, from the Kiru-Karaye road bridge, the Channel has several seasonal streams that supply sediment into Challawa River, the major ones among them include; Kunkunta, Kamanda, Natare, Kurma, Magaga, Takwami (Gulu) Dawaza and Watari, others include; Raurau, Dabga, Zuwo, Yarkashin, Tafashiya and Chijaki among others. It is estimated that the mean annual denudation is between 400 to 800 tons per km2 due to the high percentage of easily erodible arable land in Challawa Catchments (Brabben, 1975).

4.4 Suspended and Dissolved Sediments

Table 4: shows that suspended sediments are higher than the dissolved sediments in all the mining sites. This is because the mining activities have raised the volume of the suspended sediment, however higher velocity and volume of water have increased the sediment trapping efficiency. The suspended sediment was therefore unstable and was further dispersed. Most of the water transported out of the mining site indicates a higher concentration of suspended sediments than the transport into the mining site.

Table 4 Total Suspended and Dissolved Sediment IN and OUT of the Mining Sites along Challawa River

Mining Site	TSS (mg/l)	TDS(mg/l)	Total(mg/l)
ChinkosoIn	1000	109.7	1109.7
Out	1000	42.1	1042.1
TokaIn	1500	31.4	1531.4
Out	2000	33.7	2033.7
Karofin YashiIn	1000	174.8	1174.5
Out	1500	45.5	1545.5
Kafin AgurIn	2000	35.7	3535.7
Out	2000	141.3	2141.3
BurjiIn	1000	30.8	1030.8
Out	500	31.3	531.3
KashinIn	500	29.7	529.7
Out	3000	73.1	3073.1
Hausawa In	1000	101.2	1101.2
Out	2000	32.3	2032.3
YandankoIn	1500	109	1609
Out	3000	72.5	3072.5
KabaIn	500	70	570
Out	2000	105	2105

Source: Fieldwork, 2017

4.5 Sustainable Threshold That May Be Excavated Along the Bed of Challawa River

Based on the long survey conducted on Challawa River from Kiru-Karaye Road Bridge to its confluence with Kano River at Tamburawa, the channel was divided into sections to facilitate more understanding of the relation between sediment accumulation, density and human intervention, as reported by Sekellick and Banks in (Sekellick *et al.*, 2013). The dimensions of the Channel resulted in sections that were not equal in area or volume. Section A to C has no mining activities, because of its proximity to the George Dam discharge outlet, due to high water velocity. 'A' section of the Channel has a mean depth of 1.4m and mean width of 44.7m with a water depth between 1 to 1.2 meters, with a total length of 3.8 km. Several large streams joined at the B section, which indicates a change in Channel dimension, because of the deposition from the upland farms upstream. The mean width in this section was 103.2m and the mean depth of 0.9 meters. The channel in the middle became silted but the depth increased at the banks which ranges between 0.8 to 1.7 meters. In most of the channel banks where the channel depth reaches up to 1.7m, erosion of 20-30 cm was recorded table 1. This indicates that if the sand can be excavated beyond 1-7m some ecological problems may be generated. Therefore, the excavation level advisably should not go above 1.6 meters. Usually, the bedload increases during the high flow, as observed by (Bartram *et. al.*, 1996), when they noted that most bed load movement occurs during the period of high discharge on a steep gradient when the water level is high and the flow is extremely turbulent. This indicates that the excavation portion of the channel will partly be recharged during high flow.

4.6 Excavation Level Beyond Which the Ecological Problems Began

Field measurements have shown that where the channel depth reaches up to 1.7 meters, a 30 cm erosion was recorded, and where it reaches up to 2 meters some erosion was seen here and there, unless the banks have dense vegetation cover. Section C of the Channel has no sand mining activities, but because of its proximity to the D section, which has active mining sites, with a mean depth of2.1 meters, as noticed by (Ojo-Ade, 2004) the large scale extraction of stream-bed material, mining and dredging below the existing streambed and alteration of channel-bed form and shape may lead to several impacts such as erosion of channel bed and banks, increase in channel slope, change in channel morphology. This impact may cause upstream erosion as a result of an increase in channel slope and changes in flow velocity.

4.7 The volume of Sand Being Excavated in the Mining Sites

To ascertain the volume of sand being excavated in the study area per day, eight mining site excavation activities have been recorded daily from February 12 to March 13, 2017. The mining sites include Chinkoso, Toka, Karofin yashi, Kafin Agur, Burji, Kashin, Hausawa, Yandanko, and Kaba. Presently Burji has higher average sand being excavated, with average daily tons of 1,118.7 and a total of 33,565.5 tons in 30 days. While Chinkoso has the least average daily tons of 9.7 and 290.6 tons in 30 days, as indicated in Table 4

4.8 Sand Budgeting on Challawa River

To calculate the sand budget on Challawa River a total discharge of 20m^3/sec received from the Challawa George Dam Authority was used in calculating the total sediment transport into and out of the mining site, in addition, to daily human activities with regards to sand mining were also recorded to get the total input and output on Challawa River during the study periods. Table 5 indicates that in most of the mining sites in the study area, the total output overweighs the total input, which indicates a narrowing of the channel in all the mining sites, except Chinkoso where the input overweighs output, which indicates that there is deposition and widening of the channel. (Ouillon, 2018) observed that the Sand budget is based on the sand removal, transportation, and the resulting excesses or deficiencies of material quantities. However, when the input of sand is greater than the output, the sand budget is positive and the river sand is thick and when the output of sand is greater than the input, the sand budget is negative and the river sand thins. However, the river may be at a steady state when the sand input will balance the sand output each year. More input of sand than output results in deposition and widening of the river, more output than input causes the river to erode.

Table 5: Sand Budget Analysis for each Mining Site Along Challawa River

Mining Site	Transport IN (tons)	Transport OUT (tons)	Average Daily Excavation(tons)	Remarks
Chinkoso	799.2	748.8	9.6	Deposition
Toka	1,101.6	1,460.6	20.3	Erosion
Karofin Yashi	756	842.4	26.5	Erosion
Kafin Agur	1,540.8	1,530	663.6	Erosion
Burji	381.6	7,416	1118.7	Erosion
Kashin	381.6	2,210.4	120.4	Erosion
Hausawa	792	1,461.6	158.7	Erosion
Yandanko	1,152	1,850.4	93.7	Erosion
Kaba	410.4	1,519.2	185.3	Erosion

Source: Field Work, 2017

Table 6 below illustrates the result of the t-test conducted between the mean depth of the Channel in February and March 2017, which were found to be 2.96 and 3.96 meters respectively. The calculated t-value is -0.43 and the critical t-value was 1.76 at a 5% level of significance. This indicates that sand mining has no significant impact on Fadama irrigation, along Challawa River Channel, at least at the moment.

5. Discussions

The influence of sand mining along the Challawa River Channel is investigated, with a focus on sand budgeting. The purpose of the survey was to identify the sustainable threshold that could be excavated along the Challawa River's bed, as well as the point at which the ecological crisis began. According to the findings, if the sand can be extracted beyond 1.7 meters, some ecological concerns may arise, and the sustainable threshold should not exceed 1.6 meters. The bulk density of the sand for different mining sites, the capacity of the truck used in evacuating sand were measured and calculated, and the 20m3 per sec. of water discharge were obtained from Hadejia Jama'are River Basin Development Authority, and the water sample collected in and out of the mining site were tested and analyzed, the bulk density of the sand for different mining sites, the capacity of the truck used in evacuating sand were measured and calculated, and the average daily excavation The findings show that in all of the mining sites, the total output (transport out + human intervention) exceeded the total input (transport in), indicating erosion (narrowing of the channel) except in Chinkoso, where the total input exceeded the total output, indicating deposition and channel widening. Soil samples were collected, tested, and analyzed to determine the particle sizes characteristic of the soil along the Challawa River Channel, which revealed that the sediments were characterized by a texture dominated by sand with a small fraction of silt and clay, accounting for 72.08 percent, 16.80 percent, and 11.06 percent, respectively. The deposit was discovered to be in the sandy loam, loamy sand, and loam soil range. Section C and E with an average bulk density of 1.44, followed by section F with an average bulk density of 1.41, section D and B with an average of 1.39, and sections A, G, and H with an average bulk density of 1.34, 1.33, and 1.25 (g/cm3), respectively. Due to mining activities that increased the volume of suspended sediment, the sediment concentration indicated that the total suspended sediment is more than the total dissolved sediment in all mining locations. Poor farming practices upstream, deforestation, sand mining, soil losing by hauling trucks, animal trampling across and within the River Channel and on upland farms along the channel, as well as several large and small tributaries upstream of the dam and within the study area, could all be sediment sources and causes.

6. Conclusion

The study has shown that the undisturbed part of the Channel became shallow and wider due to deposition, while the disturbed Channel, due to human intervention, became deep and narrow due to excessive excavation, without adherence to any specified threshold that can be fetched on the bed of the Challawa River Channel. This has triggered erosion upstream and downstream of the mining sites. The adjacent farms and upland farms along the river channel, because the total output overweighs the input thereby creating instability on the channel bed. However, the particle size characteristic of the soils indicated that the sediment is the product of poor farming practices upstream.

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