



ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 8.4
IJAR 2023; 9(3): 34-39
www.allresearchjournal.com
Received: 15-01-2023
Accepted: 20-02-2023

Sneha Sharma
Department of Environmental
Sciences & Limnology,
Barkatullah University
Bhopal, Madhya Pradesh,
India

Rishabh Shukla
Department of Environmental
Sciences & Limnology,
Barkatullah University,
Bhopal, Madhya Pradesh,
India

Rajendra Chauhan
MVM College, Bhopal, Madhya
Pradesh, India

Abhilasha Bhawsar
Department of Environmental
sciences & Limnology,
Barkatullah University,
Bhopal, Madhya Pradesh,
India

Corresponding Author:
Abhilasha Bhawsar
Department of Environmental
sciences & Limnology,
Barkatullah University,
Bhopal, Madhya Pradesh,
India

Experimental analysis of particle size distribution using electromagnetic sieves shaker

Sneha Sharma, Rishabh Shukla, Rajendra Chauhan and Abhilasha Bhawsar

DOI: <https://doi.org/10.22271/allresearch.2023.v9.i3a.10662>

Abstract

The present study conducted the Kolar River basin, a tributary of the Narmada River in the Bhopal division of Sehore district, Madhya Pradesh, India, from May 2021 to June 2022 with the hope of better understanding the texture of sediment. The samples were collected from six stations using a grab sampler during the study. Using sieve analysis technique, passing percentage of soil grains is found to be 55% of Sand, 25% of silt and 20% of clay respectively. Grain size of soil types were measured to be in the range of 4.056 mm to 0.045 mm exhibiting the grain size gradation from coarse sand to clay. The main objective of this study is to determine the average particle size and find their distribution pattern for the given granules by sieve analysis method.

Keywords: Kolar River, Sediments, Particle size analysis, Sieve shaker machine and grain size distribution.

1. Introduction

Texture (grain size) is the most fundamental property of sediment particles, affecting their entrainment, transport and deposition [1]. It helps in determining depositional environment, besides others. Grain size analysis provides important clues to the sediment transportation history, depositional conditions and provenance [2-4]. The size of particles is directly dependent on the type of environmental setting, transporting agent, length and time during transport, and depositional conditions, and hence it possesses significant utility as an environmental change [5-6]. Understanding sediment's textural characteristics is relevant in sedimentological studies and has received valuable attention in recent years. One of the most important natural properties of sediments and regularly used parameter for sediments are grain size analysis [7]. The most fundamental natural properties of sediments that affecting their transport, entrainment as well the deposition is the distribution of grain size. The studies on the size of grains in the fluvial sediments will provide substantial information on the intrinsic properties within the sediments. The fundamental physical properties that controlling the hydraulics and the channel morphology of the stream will be exhibited by the sediments [8-9]. The present study conducted on the Kolar River at Sehore district, Madhya Pradesh. The current study aims to investigate the Kolar River's sediment texture and particle size analysis. The mechanical or sieve analysis is performed to determine the distribution of the courser, finer-sized particles. Sieve analysis was done in the laboratory of Department of Environmental Sciences & Limnology, during the study. Several authors have studied the textural characteristics of sediments from different rivers of the India as well as Arun *et al.*, (2019); Verma *et al.*, (2017); Marathe & Chawan (2021); Sujitha *et al.*, (2012); Shaniya, V. S., (2019); Bragadeeswaran (2007); shah *et al.*, (2019); Nagendra *et al.*, (2020); Ganesh *et al.*, (2013) [10-18].

2. Material & methods

2.1 Study area

The present study was carried out on Kolar River, the right bank tributary of the river Narmada and it is located on 35 kms south west away from the Bhopal city at the latitude and longitude of 21°14'N and 79°10'E respectively. It flows for a total length of 101 km, all of which is in the state of Madhya Pradesh. Kolar river arises in the Vindhya Range of Sehore district and flows in a south westerly direction to meet the Narmada River near Nasrullah

Ganj in the Sehore district of Madhya Pradesh. Its total drainage area is of 1,347 km². The river by all means acts as a main lifeline for all the activities related to irrigation,

domestic water supply, industrial water needs, and other minor activities.

Table 1: Geographical locations of different stations in Kolar River basin

S. No.	Station name	Station code	Latitude	Longitude
1	Lawakhadi	Station-1	22° 58' 30.9"N	77° 21' 38.4"E
2	Near bridge	Station-2	22° 59' 7.07"N	77° 22' 10.3"E
3	Veerpur	Station-3	22° 58' 24" N	77° 20' 56."E
4	Dana baba temple	Station-4	22° 57' 56" N	77° 20' 34."E
5	Amdoh	Station-5	22° 51' 46.5" N	77° 24' 34."E
6	Jholiyapur	Station-6	22° 51' 7.35"N	77° 23' 48"E

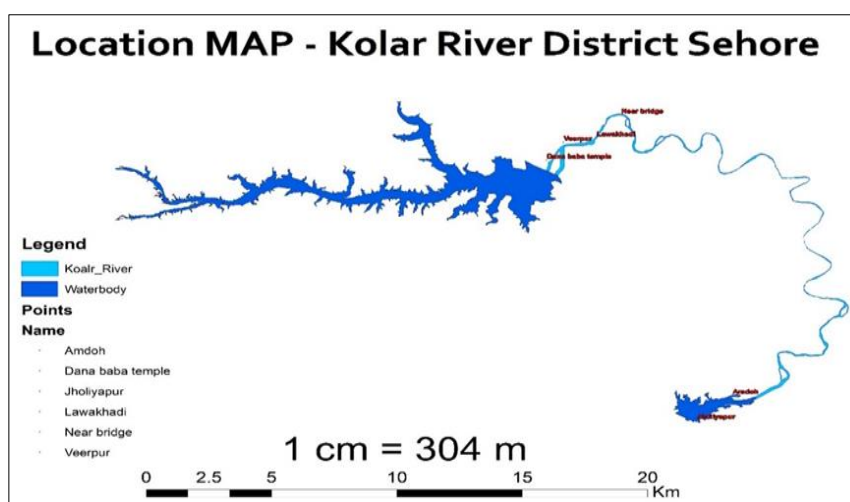
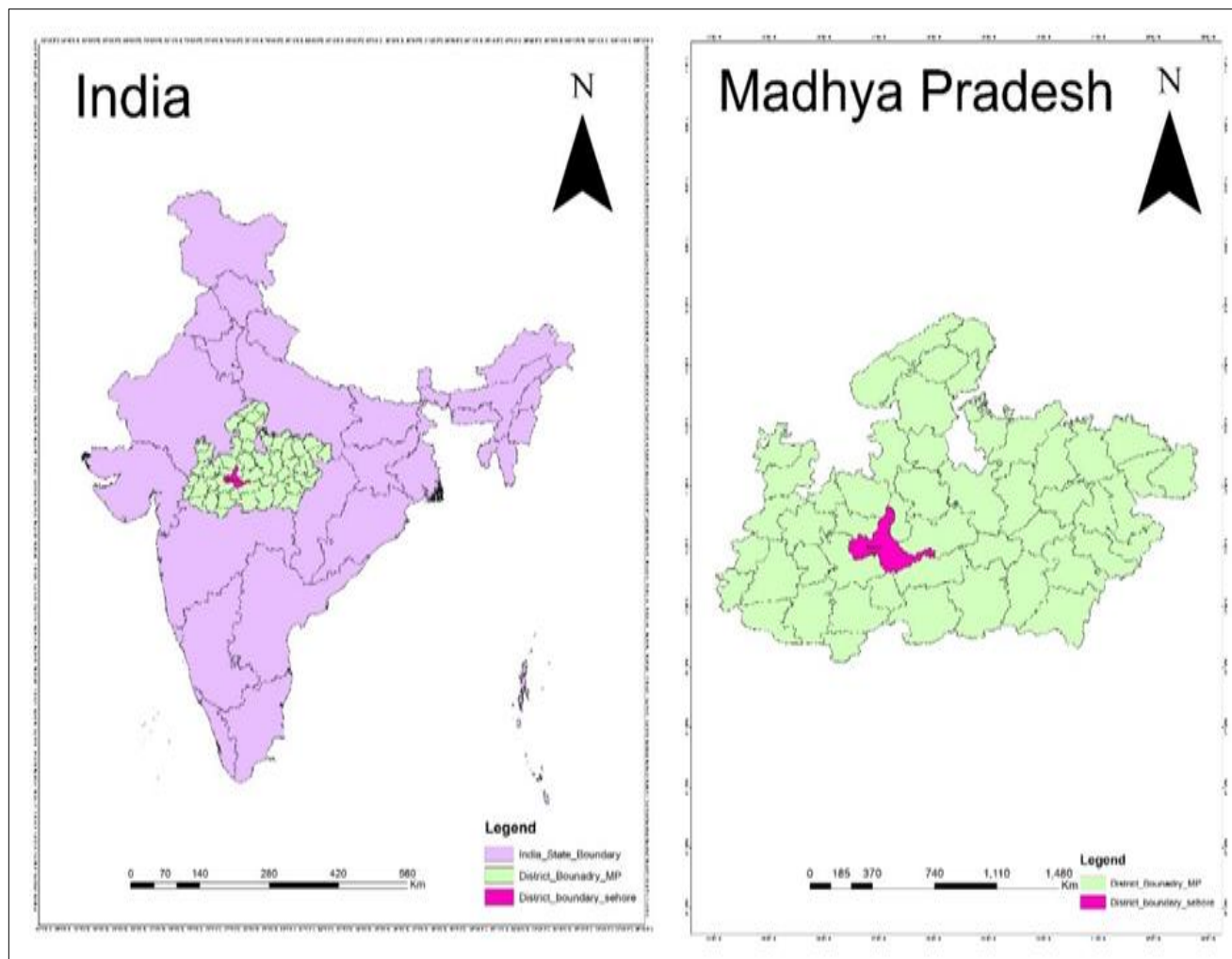


Fig 1: Showing location map of the study area (Kolar River)

2.2 Sample collection & preservation

Sediment samples were collected from six sampling stations along to Kolar River basin. Grab samplers were used to collect sediment samples from each sampling point, and the samples were packed in airtight polyethylene bags with proper levelling before being transported to the laboratory for further analysis. Sediment samples were air-dried to constant weight at room temperature in the laboratory. Samples of dry sediment were ground with a mortar and pestle and packed in polyethene bag for the sieve analysis.

2.3 Equipment's for Particle size analysis

Grab sampler, plastic tray, wide mouth jar, weighing balance, mortar & pestle, set of sieves different mass sizes, and mechanical Sieve shaker.

2.4 Sieve analysis

Sieve analysis (also known as gradation test) is a simple technique and possibly the most common procedure in use for assessing the particle size distribution of granular materials. It is used for determination of the relative proportions of different grain sizes that make up a given soil/material mass. The particle size distribution of coarse-grained soil is generally determined using a sieve analysis where a prepared dry soil sample is shaken thoroughly through a stack of sieves that consist of different apertures. The mass of particles retained on each sieve is calculated as a percentage of the total dry sample mass. The percentage

passing each sieve is generally treated cumulatively to determine the entire particle size distribution ^[17].

Percentage formula: retained sample of sieve / total sample x 100

For example, 121 / 200 x 100 = 60.5%

Table 2: Classification of soil/sediment as according to Indian soil classification (ISC) I.S. 1498 – 1970

S. No	Type of Soil / sediment	Size of grains
01.	Coarse sand	4.75-2 mm
02.	Medium sand	2.0-0.425 mm
03.	Fine sand	0.425-0.075 mm
04.	Silt	0.075-0.002 mm
05.	Clay	below 0.002 mm

2.5 Progression of determination of PSA

PSA was analyzed using Sieve Analysis, one of the foremost methods used to find out size distribution of soil / sediment samples. Collected samples were air-dried in the laboratory for 4 days to the constant weight of sediment. The dried sediment samples were grind using mortar and pestle Then, they were sieved in a sieve shaker. The sieves of the sieve shaker were cleaned using a brush to remove any particles stocked in the openings. Indian Standard Sieves of sieve sizes 4.450 mm, 2.057 mm, 0.075mm, 0.045 and pan were used for analysis, The sieves were arranged in order from larger to smaller opening. The sieve shaker was allowed to shake electrically for 15 minutes and the weight of each particle retained in sieve was recorded ^[19].



Fig 2: Showing the process of sieve analysis in the Department of Environmental Sciences & limnology laboratory

3. Results & discussion

The present study was conducted on the Kolar River to know the sediment texture. The current study found that Stations 1, 2, and 3 sediment samples had a sandy texture

with 50.5%, 47.5%, and 71.5%, respectively, while Stations 4 and 5 had a silt texture with 64% and 44.5%, respectively, and Station 6 had a clay texture with 64%. Indian Standard Sieves of sieve sizes 4.450 mm, 2.057 mm, 0.075mm, 0.045

and pan were used for analysis. Furthermore, rock exposures within the river channel may have a significant impact on changes in the overall dispersal pattern of sediments downstream of the Kolar River. Similar results were observed by Nagendra *et al.*, (2020) who investigate the percentage of soil grains found to be 54% of Sand, 30% of silt, and 17% of clay respectively during their study in the Mysore district in South India. And Verma *et al.*, (2017) also found similar results during their study in Jabalpur (MP). The detailed analysis of all the samples is as follows.

Station – 1

First of all, sample one was collected from Lawakhadi which was the first station of the Kolar River. According to the particle size analysis, 55.5% of the sediment samples had a sandy texture, 26% had a silt texture, and 18.5% had a clay texture, respectively. The results show that Station - 1 of the Kolar River was sandy, during the current study. (Table 2 & Fig.)

Table 3: Showing particle size analysis of Kolar River sediments at Station – 1 as per Indian soil classification (ISC) I.S. 1498 – 1970

IS sieve	Sieve no.	Mass retained	Retained %	Finer %	Soil classification%	Classification per grain size
4.450mm	4	10 gm	5%	95%	5%	Sand
2.057mm	8	101 gm	50.5%	49.5%	50.5%	Sand
0.075mm	200	52 m	26%	74%	26%	Silt
00.45mm	325	37 gm	18.5%	81.5%	18.5%	Clay
Total quantity of sample					200 gm	

Station – 2

Sample two was collected from Veerpur which was the second station of the Kolar River. According to the particle size analysis, 54% of the sediment samples had a sandy texture, 19.5% had a silt texture, and 26.5% had a clay texture, respectively. The results found the Station – 2 had sandy texture, during the current study. (Table & Fig.)

Table 4: Showing particle size analysis of Kolar River sediments at Station – 1 as per Indian soil classification (ISC) I.S. 1498 – 1970

IS sieve	Sieve no.	Mass retained	Retained %	Finer %	Soil classification%	Classification per grain size
4.450 mm	4	13 gm	6.5%	93.5%	6.5%	Sand
2.057 mm	8	95 gm	47.5%	52.5%	47.5%	Sand
0.075 mm	200	39 gm	19.5%	80.5%	19.5%	Silt
00.45 mm	325	53 gm	26.5%	73.5%	26.5%	Clay
Total quantity of sample					200 gm	

Station -3

Sample three was collected from the Near bridge, which was the third station of the Kolar River. According to the particle size analysis, 55.5% of the sediment samples had a sandy

texture, 26% had a silt texture, and 18.5% had a clay texture, respectively. The results show that the Station - 1 of the Kolar River was sandy, during the current study. (Table & Fig.)

Table 5: Showing particle size analysis of Kolar River sediments at Station – 1 as per Indian soil classification (ISC) I.S. 1498 – 1970

IS sieve	Sieve no.	Mass retained	Retained %	Finer %	Soil classification%	Classification per grain size
4.450mm	4	15 gm	7.5%	92.5%	7.5%	Sand
2.057mm	8	143 gm	71.5%	28.5%	71.5%	Sand
0.075mm	200	29 gm	14.5%	85.7%	14.5%	Silt
00.45mm	325	11 gm	5.5%	94.5%	5.5%	Clay
Total quantity of sample					200 gm	

Station – 4

Sample four was collected from the Dana baba temple which was the fourth station of the Kolar River. According to the particle size analysis, 17.5% of the sediment samples

had a sandy texture, 64% had a silt texture, and 8.5% had a clay texture, respectively. The results show that Station - 1 of the Kolar River had silt texture, during the current study. (Table & Fig.)

Table 6: Showing particle size analysis of Kolar River sediments at Station – 4 as per Indian soil classification (ISC) I.S. 1498 – 1970

IS sieve	Sieve no.	Mass retained	Retained %	Finer %	Soil classification%	Classification per grain size
4.450mm	4	21 gm	10.5%	89.5%	10.5%	Sand
2.057mm	8	34 gm	17%	83%	17%	Sand
0.075mm	200	128 gm	64%	36%	64%	Silt
00.45mm	325	17 gm	8.5%	91.5%	8.5%	Clay
Total quantity of sample					200 gm	

Station – 5

The sample – 5 was collected from the Amdoh which was the fifth station of the Kolar River. According to the particle size analysis, 33.5% of the sediment samples had a sandy texture, 44.5% had a silt texture, and 22% had a clay texture, respectively. This study clearly shows the Station - 1 of the Kolar River had a silt texture, during the study at Kolar River. (Table & Fig.)

Table 7: Showing particle size analysis of Kolar River sediments at Station – 5 as per Indian soil classification (ISC) I.S. 1498 – 1970

IS sieve	Sieve no.	Mass retained	Retained %	Finer %	Soil classification%	Classification per grain size
4.450mm	4	28 gm	14%	86%	14%	Sand
2.057mm	8	39 gm	19.5%	80.5%	19.5%	Sand
0.075mm	200	89 gm	44.5%	55.5%	44.5%	Silt
00.45mm	325	44 gm	22%	78%	22%	Clay
Total quantity of sample					200 gm	

Station – 6

Sample - 6 was collected from Jholiyapur which was the sixth station of the Kolar River. According to the particle size analysis, 11.5% of the sediment samples had a sandy

texture, 24.5% had a silt texture, and 64% had a clay texture, respectively. The results show that Station - 1 of the Kolar River had a clay texture, during the study. (Table & Fig.).

Table 8: Showing particle size analysis of Kolar River sediments at Station – 6 as per Indian soil classification (ISC) I.S. 1498 – 1970

IS sieve	Sieve no.	Mass retained	Retained %	Finer %	Soil classification%	Classification per grain size
4.450mm	4	10 gm	5%	95%	5%	Sand
2.057mm	8	13 gm	6.5%	93.5%	6.5%	Sand
0.075mm	200	49 gm	24.5%	75.5%	24.5%	Silt
00.45mm	325	128 gm	64%	36%	64%	Clay
Total quantity of sample						200 gm

Table 9: Showing the percentage of particle size analysis of Kolar River sediment

S. No.	Sieve size	S – 1	S – 2	S – 3	S – 4	S – 5	S – 6
1.	4.450mm	5%	6.5%	7.5%	10.5%	14%	5%
2.	2.057mm	50.5%	47.5%	71.5%	17%	19.5%	6.5%
3.	0.075mm	26%	19.5%	14.5%	64%	44.5%	24.5%
4.	00.45mm	18.5%	26.5%	5.5%	8.5%	22%	64%
	Results	Sand	Sand	Sand	Silt	Silt	Clay

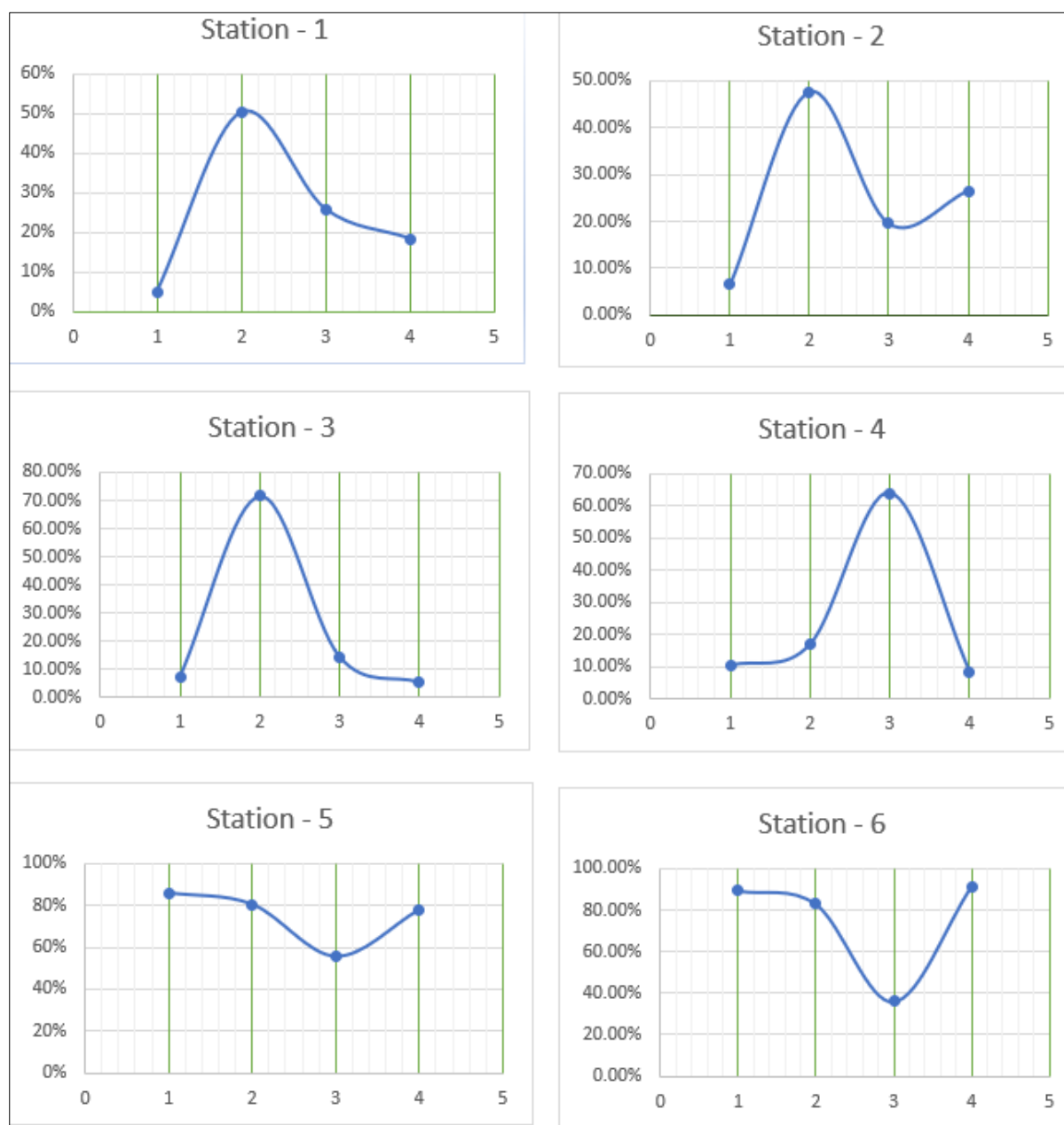


Fig 3: Showing grain size distribution

4. Conclusion

The present study was carried out to understand the nature of the distribution of grain size within the sediment samples collected at the Kolar River basin and suggested that the sediments are dominated by coarser particles. The textural parameters exhibited that the sediments were very coarse sand to clay. The particle size knowledge is very important for the proper management of soil and water quality. During the textural analysis of the soil of the river under study it was found that it contains 55% sand followed by 25% silt and 20% clay.

The current study will highlight the river environment, which will highlight nutrient recycling in this specific study area, and the current baseline information in sediments will serve as a useful tool for further ecological assessment and monitoring of the Kolar River in the Sehor district.

5. References

1. Flemming BW. The influence of grain-size analysis methods and sediment mixing on curve shapes and textural parameters: Implications for sediment trend analysis. *Sedi Geol.* 2007;202:425-35.
2. Folk RL, Ward WC. Brazos River bar: a study in the significance of grain size parameters. *J Sedi Petrol.* 1957;27:3-26.
<http://dx.doi.org/10.1306/74D70646-2B21-11D7-8648000102C1865D>
3. Friedman GM. Differences in size distributions of populations of particles among sands of various origins. *Sedimentology.* 1979;26:3-32.
<http://dx.doi.org/10.1111/j.1365-3091.1979.tb00336.x>
4. Bui EN, Mazullo J, Wilding LP. Using quartz grain size and shape analysis to distinguish between aeolian and fluvial deposits in the Dallol Bosso of Niger (West Africa). *E Sur Proc Lan.* 1990;14:157-66.
<http://dx.doi.org/10.1002/esp.3290140206>
5. McManus J. Grain size determination and interpretation. In Tucker, M. E. (ed.), *Techniques in Sedimentology*. Oxford: Blackwell Scientific. 1988. p. 63-85.
6. Stanley-Wood N, Lines RW. *Particle Size Analysis*. Cambridge, Royal Society of Chemistry, Special Publication. 1992.
7. Riyaz Ahmad Mir, Jeelani GH. Textural characteristics of sediments and weathering in the Jhelum River basin located in Kashmir valley, western Himalaya, *Journal of Geological Society of India.* 2015;86:445-458.
8. Di Steffano C, Ferro V. Brazosungai bar: A case study in the significance of grain size parameters, *J sedimentary petrology.* 2002;27(1):3-26.
9. Surian N. Downstream variation of grain size along an Alpine River: analysis of controls and processes', *Geomorphology.* 2002;43:137-149.
10. Arun TJ, Krishna RP, Aneesh TD, Limisha AT, Sreeraj MK, Reji S. Studies on the Textural Characteristics of Sediments from Periyar River Basin, Kerala, Southern India. *International Journal of Applied Environmental Sciences.* 2019;(4-5):495-526.
11. Verma SK, Akhtar S, Shrivastava S. Assessment of particles of varied soil by grain size analysis: A case study in Jabalpur (MP). *Int. Journal of engineering research and application.* 2017;7(7):2-37.
12. Marathe N, Chavan BP. Analysis of Physicochemical Parameters of Soil from Patalganga River, (Maharashtra, India). *IJSR.* 2021;10(9):1332-1337.
13. Sujitha PC, Mitra DD, Sowmya PK, Mini PR. Physico-chemical parameters of Karamana river water in Trivandrum district, Kerala, India. *International Journal of Environmental Sciences.* 2012;2(3):1417-1437.
14. Shaniya VS, Aslinsuji V, Packiaraj DD, JeyaSekar RR. Thamaraparani River and its Present Sediment Nutrient Status. *International Journal of Innovative Science and Research.* 2019;4(6):350-355.
15. Bragadeeswaran Rajasegar M, Srinivasan M, Rajan UK. Sediment texture and nutrients of Arasalar estuary, Karaikkal, south-east coast of India. *Journal of Environmental Biology.* 2007;28(2):237-240.
16. Shah RA, Achyuthan H, Veetil RPV, Derwaish U, Rafq MD. Sediment distribution pattern and environmental implications of physico-chemical characteristics of the Akkulam-Veli Lake, South India. *Applied Water Science.* 2019;9:188.
17. Nagendra P, Thanmaya BM, Samarth UM, Narasimha KN, Kumar SV. Grain size measurement of varied Soil particles by Sieve Analysis – A case study in Mysore District, South India. *Journal of Engineering Sciences.* 2020;11(2):686-691.
18. Ganesh B, Naidu AGSS, Rao MJ, Karudu TK, Avatharam P. 151 Studies on textural characteristics of sediments from Gosthani River Estuary - Bheemunipatnam, A.P., East Coast of India. *J. Ind. Geophys. Union.* 2013;17(2):139-151.
19. Shrestha S, Paudyal S. Particle Size Distribution of Fine Aggregate of Mahakali River, Nepal. *International Journal of Advanced Research in Engineering & Management.* 2019;5(6):46-52.