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Comparative Grain Size Analysis on Sediments of Bhagirathi & Alaknanda River

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ABSTRACT

Grain size analysis of clastic sediments refers to a set of logical approach conducted in the laboratory to determine the size of diverse range of collected sediments of a particular region or area. The main objective of this approach is to classify sedimentary environments. The above mentioned objective can be achieved by many standard techniques like sieving, laser granulometry and various statistical tools which employ arithmetic, geometric and logarithmic calculations.

In this study, twenty two recently deposited channel sediments were collected from the Bhagirathi and Alaknanda River. Gradation test was performed on the nine samples (SD 11 to SD 19) to get individual class wise sieve weight to assess the grain-size distribution. After that, raw sieve weights were converted to individual weight percents & cumulative weight percent to plot two types of curves i.e. Frequency Curve and Cumulative Curve on log probability scale, for each sample. Both graphical and mathematical data-reduction methods were applied on the obtained data to determine Mean, Standard Deviation, Skewness and Kurtosis. A comparative study was being made on the results obtained by both the methods.

Keywords: Granulometry, Statistical, Grain-Size, Frequency Curve, Cumulative Curve

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1. INTRODUCTION

There are number of techniques used for the analysis of grain size like X-Ray, Laser, Sieving, Pipette Analysis etc. depending on the size of sediments (Table 1). Among all dry sieving technique is well used for the sediments ranging from size 40 µm and 125 mm. Grain size analysis refers to the methodology used in the field of sedimentology for determining the various depositional aspects & flow regimes present at the time of deposition of sediments. Grain size analysis therefore provides important clues to the sediment provenance, transport history and depositional conditions (e.g. Folk and Ward, 1957; Friedman, 1979; Bui et al., 1990). A lot of well defined standard techniques are available for the interpretation of fluvial grain size data. Among them two of the most extensively used approaches are graphical & mathematical data reduction technique both of which involves the assessment of the graded fluvial sediments by sieve analysis. Present study aimed at assessing the collected fluvial sediments of Alaknanda & Bhagirathi Rivers as Alaknanda is the major contributor of river Ganga's sediments (Chakrapani and Saini, 2009; Yadav and Chakrapani, 2011) and the discrepancies that may arise during interpretation of obtained results by applying the above mentioned approaches.

Table 1: Methods of Measuring Grain Size (Boggs, Sam. Principles of Sedimentology and Stratigraphy. Pearson Education, 2014)

Type of Sample	Sample grade	Method of Analysis
Unconsolidated sediments and disaggregated sedimentary rock.	Boulders Cobbles Pebbles	Manual measurement of individual clasts.
	Granules Sand	Sieving, settling – tube analysis, image analysis.
	Silt Clay	Pipette analysis, sedimentation balances, photohydrometer, sedigraph, laser-diffractometer, electroresistance.
Lithified Sedimentary rock.	Boulders Cobbles Pebbles	Manual measurement of individual clasts.
	Granules Sand	Sieving, settling – tube analysis, image analysis.
	Silt Clay	Electron microscope.

The most widely used for fluvial sediments is the Wentworth Scale (Miall, 2006). Analysis of the grain size distribution of fluvial sediments along with the sedimentary structures and grain morphology will allow us to precisely understand and construct the depositional environment (Leopold et al., 1964; Moss, 1972; Miall, 2006). Many sedimentologists have applied geochemical methods using major, trace, rare earth elements (REEs) and isotopes composition of river load to find out the source of River sediments (Tripathy et al., 2010; Singh, 2010).

2. LITERATURE REVIEW

Grain size is a primary characteristic of siliciclastic sedimentary rocks. It is also an important descriptive property of such rocks. The weathering & erosion processes can be interpreted from the sizes of particles in a particular deposit. Grain sizes of sedimentary rocks cover a vast range of dimensions-form microscopic clay particles to boulders tens of meters in diameter. Sedimentologists are primarily concerned with the following aspects of grain size- 1) Measurement of the grain size and expressing it in terms of a grain size scale 2) Summarizing such data in a large amount and presenting them in a graphical or statistical form, and 3) Using such data to interpret the genetic history of the rock Therefore the first step of grain size analysis of any sedimentary rock sample would be to fix a universally accepted scale to which the measured sizes may be referred. Universally used scale for grain size estimation by sedimentologists is the Udden-Wentworth scale. This scale is a geometric representation where each value is twice as large or one-half as large as the previous value, depending on the direction one is going. This geometric scale ranges from >1/256 mm to <256 mm. Grain-size data can also be expressed in units of equal value for the purpose of statistical calculations and graphical plotting by using the logarithmic phi scale given by Krumbein in 1934.

$$\emptyset = -\log_2 d \qquad \text{(Eq. 1)}$$

Where, is the phi grain size; d is diameter in mm. The negative logarithm of the grain diameter is used as most of the sedimentary rocks consist of sand-sized or smaller grains so one can get larger values corresponding to smaller sizes in millimeter which can make our calculations easy & handy.

2.1 Measurement of Grains

The most widely used for fluvial sediments is the Wentworth Scale (Miall, 2006). Analysis of the grain size distribution of fluvial sediments along with the sedimentary structures and grain morphology will allow us to precisely understand and construct the depositional environment (Leopold et al., 1964; Moss, 1972; Miall, 2006).

- Manual measurements of individual clasts can be done using Verniercallipers or tape, and the size is expressed in terms of the long or intermediate dimension of the grain.
- Sieving involves separation of granule to silt-sized particles through a set of nested, wire-mesh screens, each having a particular

number of square apertures per square inch(the sieve number) through which the particles are separated by shaking manually or by a vibrating machine. Here we assume the intermediate dimension as the grain diameter, though this method is not entirely devoid of disadvantages.

- Pipette analysis, the common method for separating silt-sized or smaller particles, involves the separation of grains of different sizes based on their variable settling velocities in a column of water at a given temperature (based on Stoke's law). A highly accurate instrument, the Laser Particle Size Analyzer, which works on Mie's theory and Beer-Lambert's law, is nowadays being used to measure the grain size of such fine particles with accuracy.

After measurement of the grain size, large quantities of data are generated, which must be reduced to a condensed form so that they can be used easily. For this, we take the aid of graphical plots and statistical methods.

2.2 Graphical Plots

2.2.1 Histogram

They promptly show the relative amount of sediment in each size class.

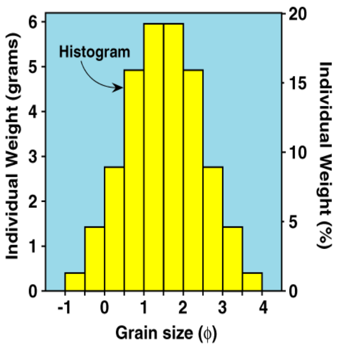


Figure 1: A Histogram

2.2.2 Frequency Curve

Smooth curves that join the midpoints of each bar on the histogram.

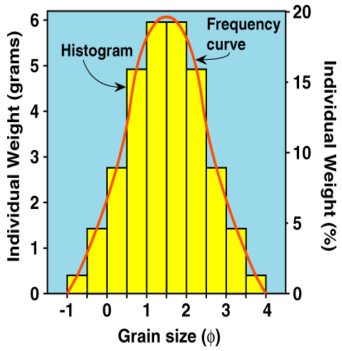


Figure 2: A Frequency Curve

2.2.3 Cumulative Frequency Curves

Smooth curves that represent the size distribution of the sample. The cumulative weight of each class represents the sum total of all the weights of the previous classes. This is plotted against the phi sizes to give us a smooth curve where we can determine the mean, median, mode and standard deviation of a grain-size distribution with much greater accuracy than the graphical method where individual weight percentage was used as a parameter.

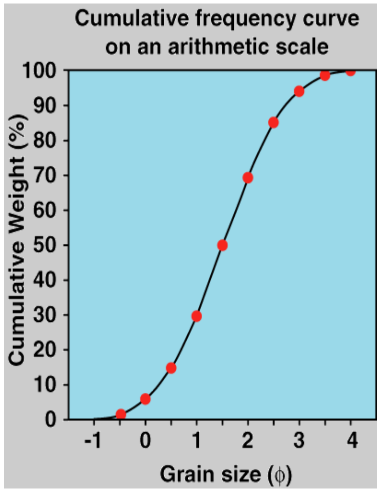


Figure 3: Cumulative frequency curve

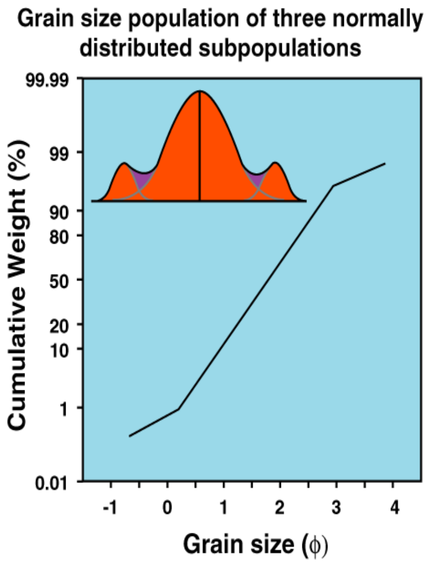


Figure 4: Normally distributed subpopulations plot as a series of straight line segments, each segment representing one

Cumulative frequency plots are used to determine the percentiles. ϕ_t is the grain size that is finer than t% of the total sample. ϕ_t is referred to as the t^{th} percentile of the sample.

For example-ϕ_{30} is 0.76 ϕ i.e. 0.76 ϕ is that grain size that is finer than 30% of the sample. Conversely 0.76 ϕ, is coarser than 70% of the sample.

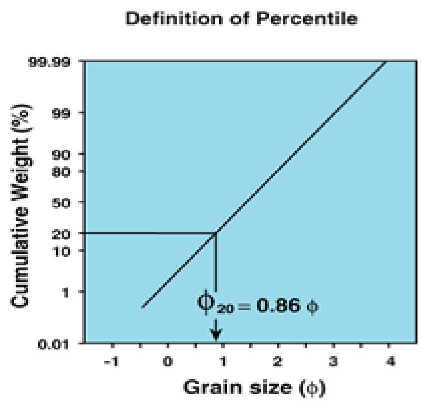


Figure 5: Percentile

2.2.4 Median

It is the midpoint of the distribution i.e. the 50th percentile. 50% of the sample is finer than the median and 50% of the sample is coarser than the median.

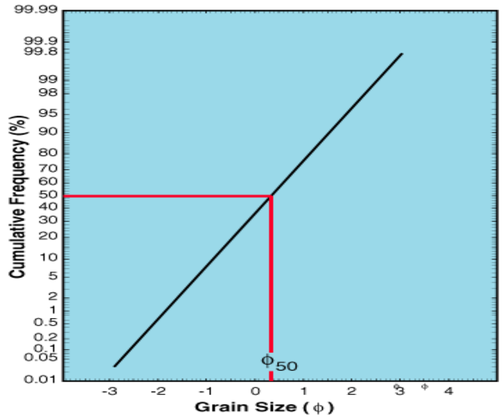


Figure 6: Median of the above distribution is approximately 0.35 ϕ

2.2.5 Mean

This is the best graphical measure for determining overall size. It is the mathematical average of the grain sizes in the distribution.

$$M_z = \frac{\emptyset_{16}+\emptyset_{50}+\emptyset_{84}}{3} \quad \text{(Eq. 2)}$$

2.2.6 Standard Deviation

It is the sorting coefficient or dispersion coefficient of the sediment.

$$\sigma = \frac{\emptyset_{84}-\emptyset_{16}}{4} + \frac{\emptyset_{95}-\emptyset_{5}}{6.6} \quad \text{(Eq. 3)}$$

68% of the total weight of sediment in a sample falls within +/- 1 standard deviation, σ of the mean. Here, Mean = 0.34ϕ and σ = 0.75ϕ So, %3.86 of the sample falls in the range from -0.41 to 1.09ϕ. Also 95.4% of the sample falls within ±2 σ from the mean and 99.7% of the samples fall within ±3 σ from the mean.

This is known as the 68- 95-99.7 rule, or the empirical rule, or the 3-sigma rule.

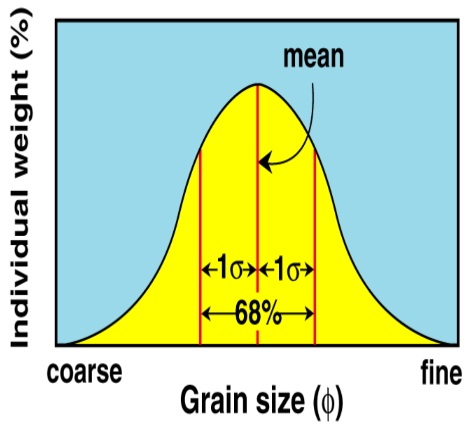


Figure 7: Pictorial representation of standard deviation of a sample

Table 2: Sorting of Sediments

Very Well Sorted	0 <σ< 0.35ϕ
Well Sorted	0.35 <σ< 0.50ϕ
Moderately Well Sorted	0.5 <σ< 0.71ϕ
Moderately Sorted	0.71 <σ< 1.00ϕ
Poorly Sored	1.00 <σ< 2.00ϕ
Very Poorly Sorted	2.00 <σ< 4.00ϕ
Extremely Poorly Sorted	σ> 4.00ϕ

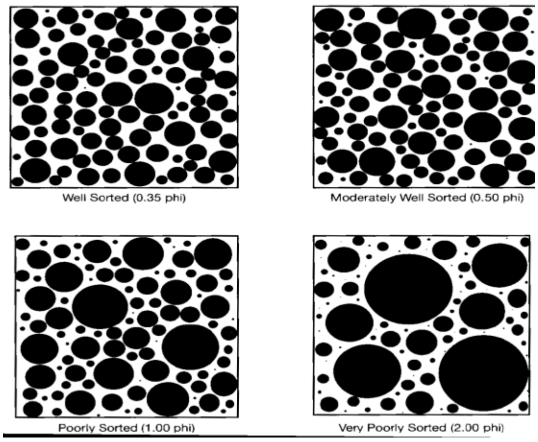


Figure 8: Sorting

2.2.7 Skewness

It is a measure of symmetry of the distribution. It's values ranges from 0 to 1.

$$SK_t = \frac{(\phi_{84}+\phi_{16}-2\phi_{50})}{2(\phi_{84}-\phi_{16})} + \frac{(\phi_{95}+\phi_{5}-2\phi_{50})}{2(\phi_{95}-\phi_{5})} \quad \text{(Eq. 4)}$$

- When skewness is 0, it represents a perfectly symmetrical distribution. Here, mean = median = mode.
- When skewness is < 0, it means that the distribution contains more coarse particles than a perfectly symmetrical distribution. The mean is coarser than median.such a distribution is known as coarse-tailed distribution.
- When skewness > 0, it means that the distribution contains a greater number of fine particles than a perfectly symmetrical distribution. The mean should be finer than the median. such a distribution is known as fine-tailed distribution.

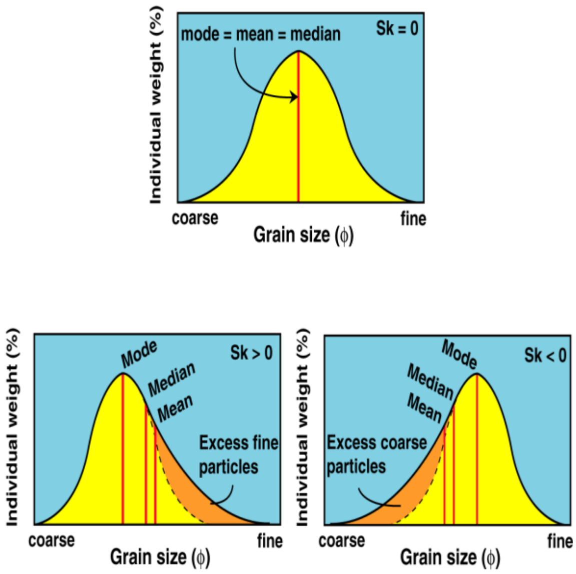


Figure 9: Perfectly Symmetrical, Fine tailed & coarse tailed distributions

Table 3: Skewness of Sediments

Fine Skewed	Sk> 0.3
Fine Skewed	0.1 <Sk< 0.3
Near Symmetrical Skewed	-0.1 <Sk< 0.1
Coarse Skewed	-0.3 <Sk< -0.1
Coarse Skewed	Sk< -0.3

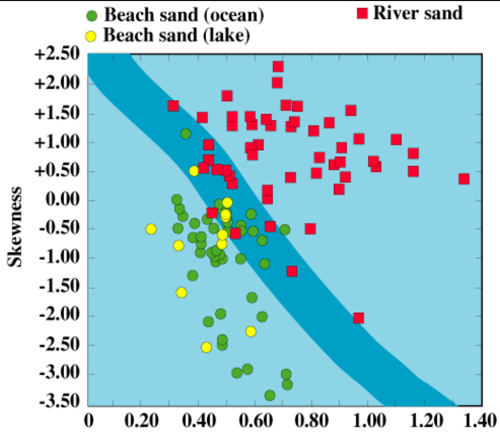


Figure 10: Graphical representation of skewnessvs sorting coefficient

Skewness is plotted against the sorting coefficient (ϕ) to determine the processes involved in transportation of the sediment and depositional environment.

2.2.8 Kurtosis

It is a measure of the peakedness of the distribution and is related to sorting. The more the peakedness, the better is the sorting. In the normal probability curve, defined by the Gaussian formula, the phi diameter interval between the ϕ5 and ϕ95 points should be exactly 2.44 times the phi diameter interval between the ϕ25 and ~ϕ75.

$$K = \frac{(\emptyset_{95} - \emptyset_5)}{2.44(\emptyset_{75} - \emptyset_{25})} \quad \text{(Eq. 5)}$$

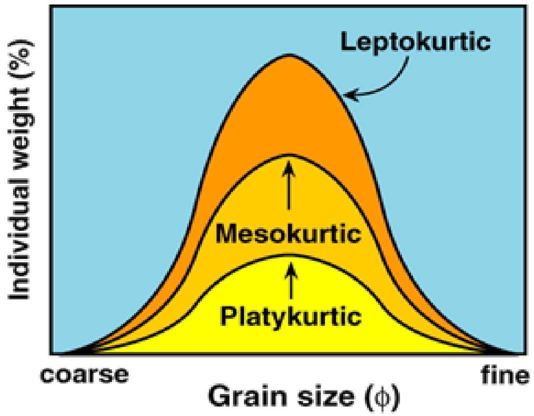


Figure 11: Kurtosis

Table 4: Kurtosis of Sediments

Sharp Peaked (Leptokurtic)	K > 1
Normal (Mesokurtic)	K = 1
Flat Peaked (Platykurtic)	K < 1

2.3 Statistical Method:

Method of moments- Grain size parameters can be directly calculated without referring to graphical data using the following formulae:

2.3.1 Mean

It is first moment.

$$M_z = \frac{\sum fm}{n} \quad \text{(Eq. 6)}$$

2.3.2 Standard Deviation

It is second moment.

$$\sigma = \sqrt{\frac{\sum f(m - M_z)^2}{100}} \quad \text{(Eq. 7)}$$

2.3.3 Skewness

It is the third moment.

$$SK_t = \frac{\sum f(m - M_z)^3}{100\sigma^3} \quad \text{(Eq. 8)}$$

2.3.4 Kurtosis

It is the fourth moment.

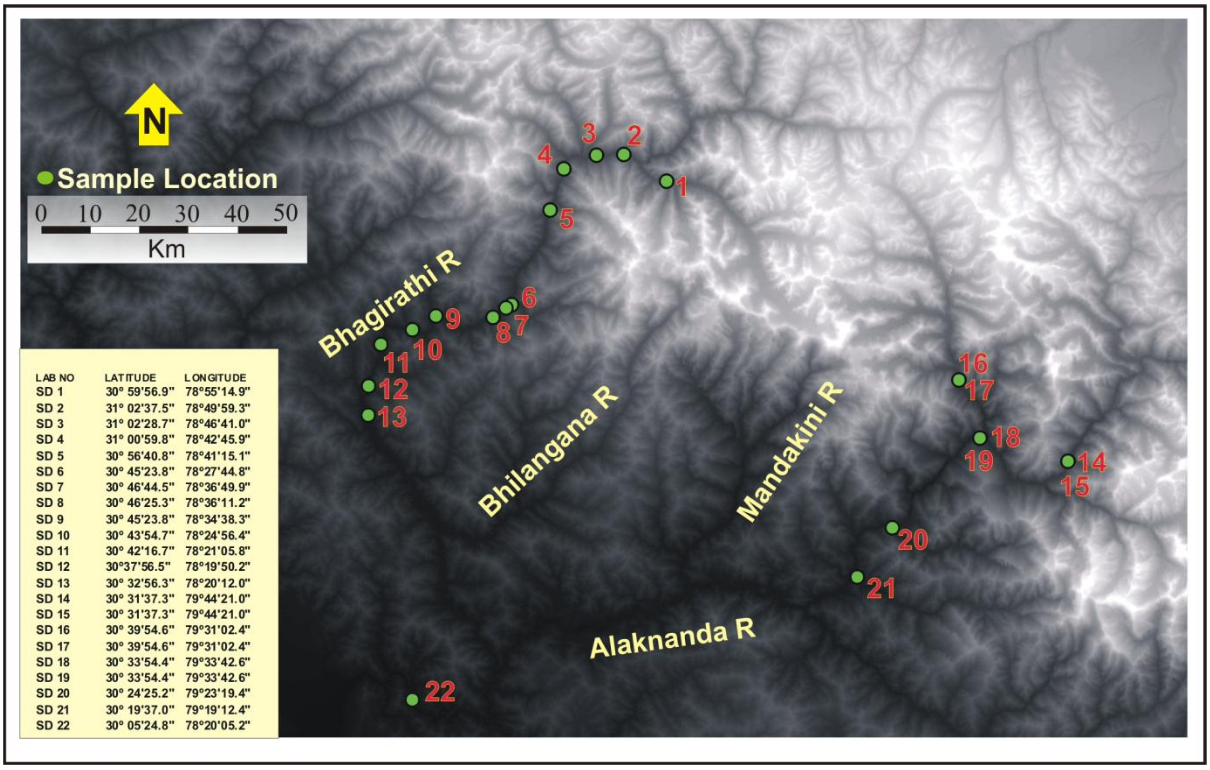
$$K = \frac{\sum f(m - M_z)^4}{100\sigma^4} \quad \text{(Eq. 9)}$$

Where;

- f is weight percent that is frequency in each grain size class,
- m is mid-point of each grain size class in phi values,
- n is total number in samples

3. STUDY AREA

All the samples were collected from the headwaters of Ganga that is from Alaknanda & Bhagirathi River. The Bhagirathi river rises from the Gangotri glacier at Gomukh which is present at an elevation of around 4000 m whereas the other major stream which originates in the Ganga basin is the Alaknanda which originates from Satopanth & Bhagirath Kherag glaciers. The Alaknanda basins occupy an area of 11.8 × 10^3 km^2 (Chakrapani and Saini, 2009; Panwar et al., 2016). Both the rivers flowing down the hill meet at Devprayag to form Ganga River. Hence, we can say that upto Devprayag the Ganga river basin have two diverse sub basins that are Alaknanda basin and Bhagirathi basin. The Bhagirathi-Alaknanda river basins upto Devprayag cover a catchment area of around 19,600 sq. km (AHEC, 2011).



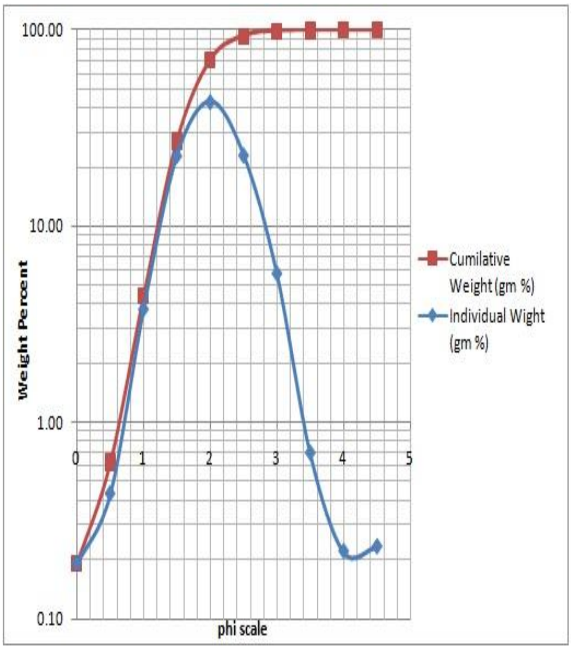
4. METHODOLOGY

Coarse fractions are dried in a convection oven at, or slightly less than 100 C. When the samples became dry (overnight is usually sufficient), they are left to cool. If the whole sample is more, the sample is typically split using coning and quartering and a representative sample of about 100 gram is weighed. The larger the analyzed sample the more accurate the grain size analysis. Samples of known weight are passed through a set of sieves of known mesh sizes. Sieves are assembled in downward decreasing mesh diameters, the coarsest on the top, the finest on the bottom, the 0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, and 4.0 phi sieves, and a residue collecting pan, at the lowermost position to collect the residual sample. The assembly of sieves is fixed in a mechanical sieve shaker for a minimum of at least 5 minutes with vertical vibrating amplitude of 2.5mm. The weight of sediment retained on each sieve is measured and converted into a percentage of the total sediment sample.

5. RESULT AND DISCUSSION

The cumulative weight and weight percentage curves of different samples are shown below:

5.1 Sample: SD 11



Sieve interval/arrangement - **Half phi (Ø)**
Made of weighing machine - METTLER
Least count of weighing machine - 10^-4 gm
Sieve machine model - FRITSCH analysette 3
Set amplitude - **2.5mm**
Sieving time for sample - **5 min**
Input power source - 220 V A.C.
Weight of sample taken - 100.0074gm

C.I.	M.No.		W.R.	C.W.
(Ø)	(mm)	(Ø)	gm in %	gm in %
<0	1.000	0.0	0.19	0.19
0-0.5	0.710	0.5	0.43	0.62
0.5-1.0	0.500	1.0	3.77	4.39
1.0-1.5	0.355	1.5	22.75	27.14
1.5-2.0	0.250	2.0	42.88	70.02
2.0-2.5	0.180	2.5	22.95	92.97
2.5-3.0	0.125	3.0	5.73	98.70
3.0-3.5	0.090	3.5	0.70	99.40
3.5-4.0	0.063	4.0	0.22	99.62
>4.0	-0.063	4.5	0.23	99.85

Errors:

Sieve loss= 100.00-99.85
0.15gm
% loss= (0.15/100.00)*100
0.15%

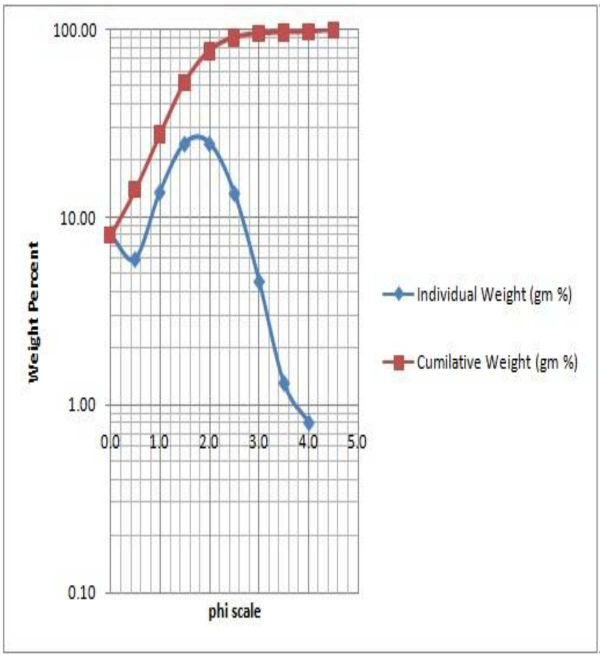
Sieve interval/arrangement - Half phi (Ø)
Made of weighing machine - METTLER
Least count of weighing machine - 10^-4 gm
Sieve machine model - FRITSCH analysette 3
Set amplitude - **2.5mm**
Sieving time for sample - **5 min**
Input power source - 220 V A.C.
Weight of sample taken - 100.0076gm

C.I.	M.No.		W.R.	C.W.
(Ø)	(mm)	(Ø)	gm in %	gm in %
<0	1.000	0.0	8.04	8.04
0-0.5	0.710	0.5	5.98	14.02
0.5-1.0	0.500	1.0	13.65	27.68
1.0-1.5	0.355	1.5	24.75	52.43
1.5-2.0	0.250	2.0	24.80	77.23
2.0-2.5	0.180	2.5	13.45	90.68
2.5-3.0	0.125	3.0	4.55	95.24
3.0-3.5	0.090	3.5	1.30	96.54
3.5-4.0	0.063	4.0	0.80	97.34
>4.0	-0.063	4.5	2.26	99.60

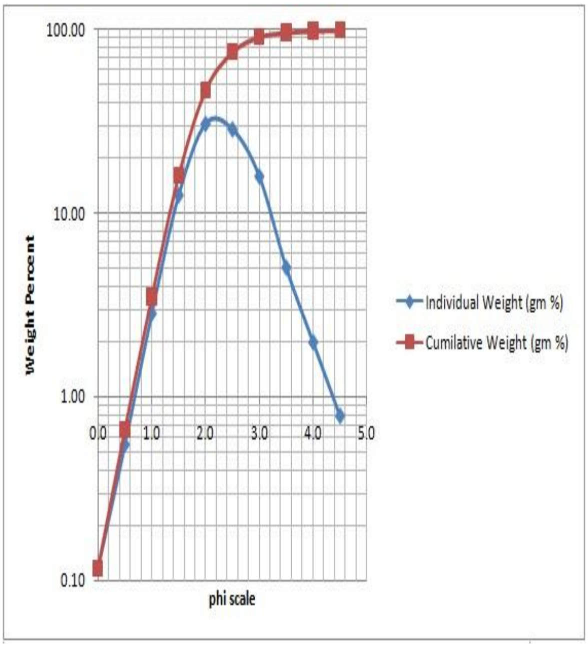
Errors:

Sieve loss= 100.00-99.60
0.40gm
% loss= (0.40/100.00)*100
0.40%

5.2 Sample: SD 12



5.3 Sample: SD 13



Sieve interval/arrangement - Half phi (Ø)
Made of weighing machine - METTLER
Least count of weighing machine - 10^-4 gm
Sieve machine model - FRITSCH analysette 3
Set amplitude - 2.5mm
Sieving time for sample - **5 min**
Input power source - 220 V A.C.
Weight of sample taken - 100.0016gm

C.I.	M.No.		W.R.	C.W.
(Ø)	(mm)	(Ø)	gm in %	gm in %
<0	1.000	0.0	0.12	0.12
0-0.5	0.710	0.5	0.55	0.67
0.5-1.0	0.500	1.0	2.84	3.51
1.0-1.5	0.355	1.5	12.55	16.06
1.5-2.0	0.250	2.0	30.71	46.77
2.0-2.5	0.180	2.5	28.64	75.41
2.5-3.0	0.125	3.0	15.89	91.29
3.0-3.5	0.090	3.5	5.06	96.35
3.5-4.0	0.063	4.0	1.98	98.34
>4.0	-0.063	4.5	0.79	99.12

Errors:

Sieve loss= 100.00-99.12
0.87gm
% loss= (0.87/100.00)*100
0.87%

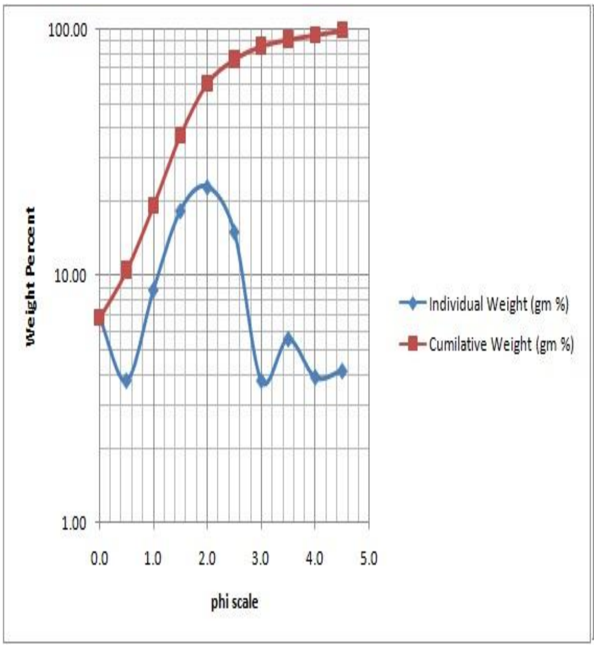
Sieve interval/arrangement - Half phi (Ø)
Made of weighing machine - METTLER
Least count of weighing machine - 10^-4 gm
Sieve machine model - FRITSCH analysette 3
Set amplitude - 2.5mm
Sieving time for sample - **5 min**
Input power source - 220 V A.C.
Weight of sample taken -100.0155gm

C.I.	M.No.		W.R.	C.W.
(Ø)	(mm)	(Ø)	gm in %	gm in %
<0	1.000	0.0	6.77	6.77
0-0.5	0.710	0.5	3.77	10.55
0.5-1.0	0.500	1.0	8.80	19.34
1.0-1.5	0.355	1.5	18.42	37.38
1.5-2.0	0.250	2.0	22.99	60.75
2.0-2.5	0.180	2.5	15.13	75.88
2.5-3.0	0.125	3.0	3.77	85.90
3.0-3.5	0.090	3.5	5.56	91.47
3.5-4.0	0.063	4.0	3.90	95.36
>4.0	-0.063	4.5	4.13	99.49

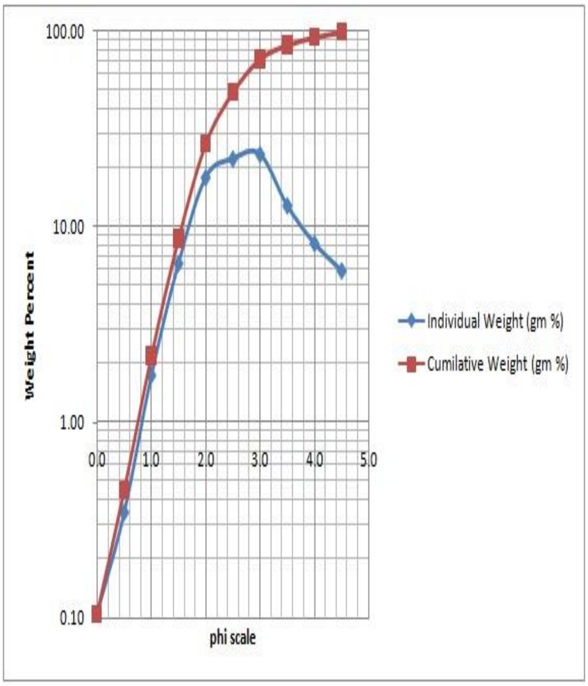
Errors:

Sieve loss= 100.01-99.49
0.52gm
% loss= (0.52/100.01)*100
0.52%

5.4 **Sample:** SD 14



5.5 **Sample:** SD 15



Sieve interval/arrangement - Half phi (Ø)				
Made of weighing machine - METTLER				
Least count of weighing machine - 10^-4 gm				
Sieve machine model - FRITSCH analysette 3				
Set amplitude - 2.5mm				
Sieving time for sample - **5 min**				
Input power source - 220 V A.C.				
Weight of sample taken - 100.0016gm				
C.I.	**M.No.**		**W.R.**	**C.W.**
(Ø)	**(mm)**	**(Ø)**	**gm in %**	**gm in %**
<0	1.000	0.0	0.11	0.11
0-0.5	0.710	0.5	0.35	0.45
0.5-1.0	0.500	1.0	1.74	2.19
1.0-1.5	0.355	1.5	6.51	8.70
1.5-2.0	0.250	2.0	17.91	26.61
2.0-2.5	0.180	2.5	22.29	48.90
2.5-3.0	0.125	3.0	23.54	72.44
3.0-3.5	0.090	3.5	12.85	85.29
3.5-4.0	0.063	4.0	8.24	93.53
>4.0	-0.063	4.5	5.97	99.50

Errors:

Sieve loss= 100.00-99.49

0.50gm

% loss= (0.50/100.00)*100

0.50%

Sieve interval/arrangement - Half phi (Ø)				
Made of weighing machine - METTLER				
Least count of weighing machine - 10^-4 gm				
Sieve machine model - FRITSCH analysette 3				
Set amplitude - 2.5mm				
Sieving time for sample - **5 min**				
Input power source - 220 V A.C.				
Weight of sample taken - 100.0080gm				
C.I.	**M.No.**		**W.R.**	**C.W.**
(Ø)	**(mm)**	**(Ø)**	**gm in %**	**gm in %**
<0	1.000	0.0	3.01	3.01
0-0.5	0.710	0.5	8.46	11.46
0.5-1.0	0.500	1.0	25.99	37.46
1.0-1.5	0.355	1.5	33.00	70.45
1.5-2.0	0.250	2.0	22.06	92.51
2.0-2.5	0.180	2.5	5.86	98.37
2.5-3.0	0.125	3.0	1.23	99.61
3.0-3.5	0.090	3.5	0.21	99.81
3.5-4.0	0.063	4.0	0.06	99.87
>4.0	-0.063	4.5	0.04	99.91

Errors:

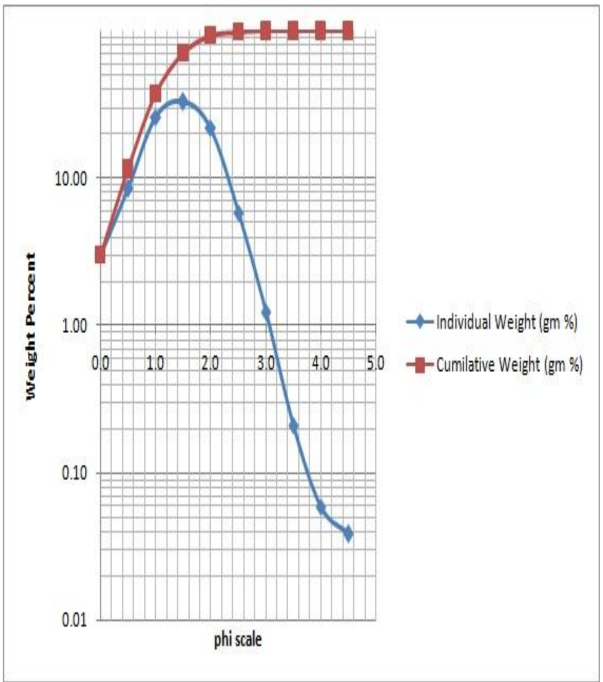
Sieve loss= 100.00-99.91

0.09gm

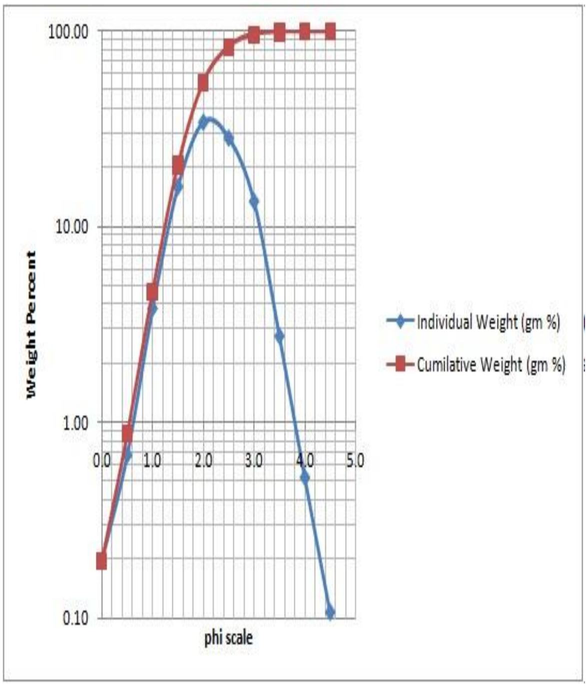
% loss= (0.09/100.00)*100

0.09%

5.6 Sample: SD 16



5.7 Sample: SD 17



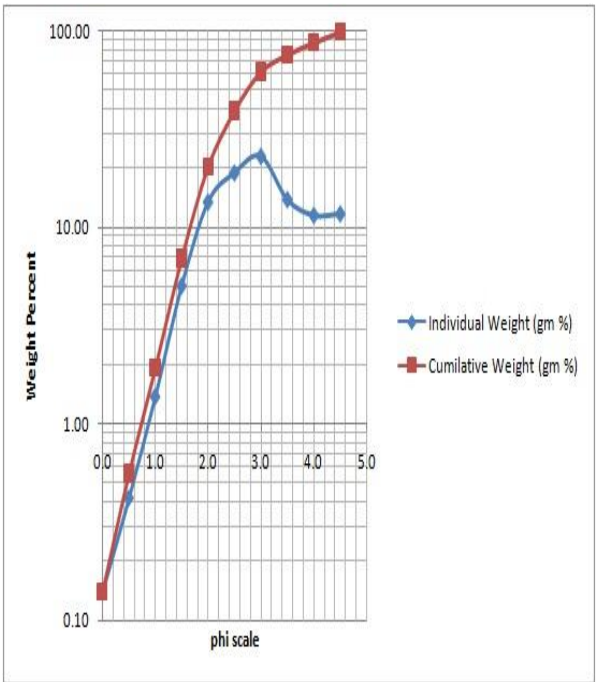
Sieve interval/arrangement - Half phi (Ø)
Made of weighing machine - METTLER
Least count of weighing machine - 10^-4 gm
Sieve machine model - FRITSCH analysette 3
Set amplitude - 2.5mm
Sieving time for sample - **5 min**
Input power source - 220 V A.C.
Weight of sample taken - 100.0009gm

C.I.	M.No.		W.R.	C.W.
(Ø)	(mm)	(Ø)	gm in %	gm in %
<0	1.000	0.0	0.20	0.20
0-0.5	0.710	0.5	0.68	0.88
0.5-1.0	0.500	1.0	3.82	4.70
1.0-1.5	0.355	1.5	15.99	20.68
1.5-2.0	0.250	2.0	34.11	54.80
2.0-2.5	0.180	2.5	28.33	83.13
2.5-3.0	0.125	3.0	13.44	96.56
3.0-3.5	0.090	3.5	2.75	99.32
3.5-4.0	0.063	4.0	0.52	99.84
>4.0	-0.063	4.5	0.11	99.95

Errors:

Sieve loss= 100.00-99.94
0.05gm
% loss= (0.05/100.00)*100
0.05%

5.8 **Sample:** SD 18



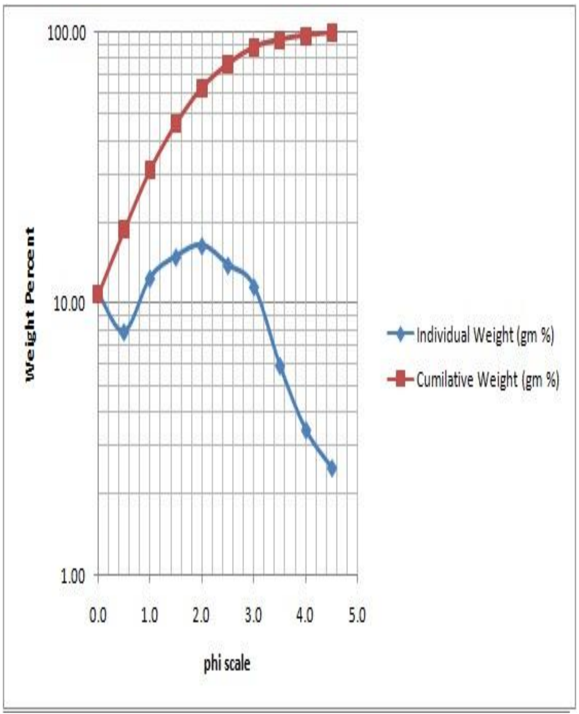
Sieve interval/arrangement - Half phi (Ø)
Made of weighing machine - METTLER
Least count of weighing machine - 10^-4 gm
Sieve machine model - FRITSCH analysette 3
Set amplitude - 2.5mm
Sieving time for sample - **5 min**
Input power source - 220 V A.C.
Weight of sample taken - 100.0042gm

C.I.	M.No.		W.R.	C.W.
(Ø)	(mm)	(Ø)	gm in %	gm in %
<0	1.000	0.0	0.14	0.14
0-0.5	0.710	0.5	0.42	0.55
0.5-1.0	0.500	1.0	1.37	1.92
1.0-1.5	0.355	1.5	5.02	6.94
1.5-2.0	0.250	2.0	13.45	20.39
2.0-2.5	0.180	2.5	18.95	39.34
2.5-3.0	0.125	3.0	23.01	62.36
3.0-3.5	0.090	3.5	13.86	76.22
3.5-4.0	0.063	4.0	11.51	87.72
>4.0	-0.063	4.5	11.70	99.43

Errors:

Sieve loss= 100.00-99.42
0.57gm
% loss= (0.57/100.00)*100
0.57%

5.9 **Sample:** SD 19



Sieve interval/arrangement - Half phi (Ø)
Made of weighing machine - METTLER
Least count of weighing machine - 10^-4 gm
Sieve machine model - FRITSCH analysette 3
Set amplitude - 2.5mm
Sieving time for sample - **5 min**
Input power source - 220 V A.C.
Weight of sample taken - 100.0016gm

C.I.	M.No.		W.R.	C.W.
(Ø)	(mm)	(Ø)	gm in %	gm in %
<0	1.000	0.0	10.81	10.81
0-0.5	0.710	0.5	7.88	18.69
0.5-1.0	0.500	1.0	12.43	31.13
1.0-1.5	0.355	1.5	14.92	46.04
1.5-2.0	0.250	2.0	16.40	62.44
2.0-2.5	0.180	2.5	13.88	76.32
2.5-3.0	0.125	3.0	11.58	87.90
3.0-3.5	0.090	3.5	5.91	93.81
3.5-4.0	0.063	4.0	3.42	97.23
>4.0	-0.063	4.5	2.48	99.70

Errors:

Sieve loss= 100.00-99.70
0.30gm
% loss= (0.30/100.00)*100
0.30%

Table 5: Comparative study of all the samples

Sample No.	Data Reduction Method	Mean	Standard Deviation	Skewness	Kurtosis
SD 11	**Graphical**	1.57	0.45	0.08	5.12
	Moment	1.78	0.5	0.35	5.29
SD 12	**Graphical**	1.16	0.85	1.48	1.27
	Moment	1.46	0.78	1.42	5.58
SD 13	**Graphical**	1.64	0.59	0.06	1.32
	Moment	2.07	0.66	0.41	3.73
SD 14	**Graphical**	1.58	1.13	0.05	1.33
	Moment	1.64	1.06	0.66	3.33
SD 15	**Graphical**	2.31	0.84	0.08	1.01
	Moment	2.54	0.83	0.17	2.67
SD 16	**Graphical**	0.94	0.58	-0.14	0.99
	Moment	1.18	0.6	0.11	3.63
SD 17	**Graphical**	1.68	0.65	-0.07	1.17
	Moment	1.95	0.6	0.01	3.4
SD 18	**Graphical**	2.53	0.91	0.1	0.85
	Moment	2.75	0.89	0.02	2.56
SD 19	**Graphical**	1.35	1.12	0.08	0.65
	Moment	1.61	1.15	0.18	0.62

6. CONCLUSION

The cumulative curve's I[st] segment have high angle for all the samples hence the sample are of from a relatively high energy area.

The values of different parameters of the given samples are shown in the above table. All the values are coming nearly equal with the only exception in the value of kurtosis. A general trend was observed in all the samples that the values are higher in the moment method.

There are only two samples that are SD 11 & SD 19 which are showing similar values by both the methods. However, samples named SD 19 & SD 18 were collected from the same site locations with a separation of very few meters having nearly same coordinate, but the value of kurtosis is nearly similar in sample SD 19 whereas the values are different for sample SD 18.

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8. REFERENCES

AHEC (Alternate Hydro Energy Centre). (2011). Report of Assessment of cumulative Impact of Hydropower projects in Alaknanda and Bhagirathi Basins, IIT Roorkee, The National River Conservation Directorate, Ministry of Environment and Forests, Government of India, 2011.

Bui EN, Mazullo J, Wilding LP. 1990. Using quartz grain size and shape analysis to distinguish between aeolian and fluvial deposits in the Dallol

Bosso of Niger (West Africa). Earth Surface Processes and Landforms 14: 157–166.

Chakrapani GJ, Saini RK (2009) Temporal and spatial variations in water discharge and sediment load in the Alaknanda and Bhagirathi Rivers in Himalaya, India. J Asian Earth Sci 35:545–553

Colby, B.R. (1964) Discharge of sands and mean velocity relationships in sand-bed streams. US Geol. Surv. Prof. Pap., 462-A: A1–A47.

Folk RL, Ward WC. 1957. Brazos River bar: a study in the significance of grain size parameters. Journal of Sedimentary Petrology 27: 3–26.

Friedman GM. 1979. Differences in size distributions of populations of particles among sands of various origins. Sedimentology 26: 3–32.

Leopold, L.B., Wolman, M.G. and Miller, J.P. (1964) Fluvial Processes in Geomorphology. W.H. Freeman and Company, San Francisco, CA, 522 pp.

Miall, A.D. (2006) The Geology of Fluvial Deposits: Sedimentary Facies, Basin Analysis and Petroleum Geology. Springer-Verlag, Berlin.

Moss, A.J. (1972) Bed load sediments. Sedimentology, 18, 159– 219.

Panwar, S., Khan, M. and Chakrapani, G. (2016). Grain size characteristics and provenance determination of sediment and dissolved load of Alaknanda River, Garhwal Himalaya, India. Environmental Earth Sciences, 75(2).

Singh P (2010) Geochemistry and provenance of stream sediments of the Ganga River and its major tributaries in the Himalayan region, India. Chem Geol 269:220–236

Tripathy GR, Goswami V, Singh SK, Chakrapani GJ (2010) Temporal variations in Sr and 87Sr/86Sr of the Ganga headwaters: estimates of dissolved Sr flux to the mainstream. Hydrol Process 24(9):1159–1171

Wentworth, C.K. (1922) A scale of grade and class terms for clastic sediments. J. Geol., 30, 377–392

Yadav SK, Chakrapani GJ (2011) Geochemistry, dissolved elemental flux rates, and dissolution kinetics of lithologies of Alaknanda and Bhagirathi rivers in Himalayas, India. Environ Earth Sci 62:593–610