iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 7 **Issue:** IV **Month of publication:** April 2019

**DOI:** https://doi.org/10.22214/ijraset.2019.4057

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue IV, Apr 2019- Available at www.ijraset.com

# Environmental Impact Assessment of Sand Mining at Wainganga River with Special Reference to River Replenishment Rate

Umesh Shende[1], Tejaswini Gabhane[2], Shraddha Bharde[3], Runal Pawar[4], Samiksha Kumbhare[5], Shruti Donode[6], Prof Shahid Sheikh[7]

[1, 2, 3, 4, 5, 6] *B.E. Department of Civil Engineering, M.I.E.T. Shahapur, Bhandara, India*

[7] *Asst. Professors, Dept. of Civil Engineering, M.I.E.T. Shahapur, Bhandara, India*

***Abstract: Sand is significant mineral for our society which protects the environment, where this practice of sand and soil mining is becoming an environmental effect as the requirement of sand increases in industry and construction. Mining and its related activities can be responsible for considerable environmental damage. In this paper we are discussing about the direct and indirect impacts due to sand mining to the environment in Indian regions. The Modified Universal Soil Loss Equation (MUSLE) was related to average annual sediment yield.***

***The runoff factor of MUSLE is computed using the measured value of runoff and peak rate of runoff at outlet of the watershed. Sediment yield at the outlet of the study watershed is simulated for six storm event spread over the year 2000 and validated with the measured values.***

***The high coefficient of determination value (0.99) indicates the MUSLE model sediment yield prediction are satisfactory for practice purpose. Among available soil erosion and sediment yield models, the Universal Soil Loss Equation (USLE), the revised version of it (RUSLE) and its modified version is (MUSLE).***

***Keywords: Sand Mining, EIA, Replacement Rate, Wainganga River, Run off.***

## I. INTRODUCTION

Wainganga is a river in India, originating in the Mahadeo Hills in mundara near village Gopalganji in seoni Madhya Pradesh.

It is a tributary of the Godawari River. The river flows south in a winding course through the states of Madhya Pradesh and Maharashtra, roughly 579km. Sand is an important mineral for our society in protecting the environment, but the practice of sand mining is becoming an environmental issue as the demand for the sand increase in industry and construction. Sand is in high demand in construction sector by 2020. Sand mining which is done by manual mean is not affect the ecosystem of river and surrounding environment.

Sand erosion is an important item of consideration in the planning of watershed development works. It reduces not only the storage capacity of the downstream reservoirs but also deteriorates the productivity of the watershed.

### *A. Objective*

1) To workout the replenishment rate of the river for mining purpose.
2) To workout the mining of sand available for mining purpose.
3) To workout the environmental impact assessment because of mining of sand.
4) To list out the method for safe and environment friendly mining.
5) To compare the calculated value of rate of replenishment (sediment yield) with the quantity of sand mined.

### *B. Impact of sand mining*

1) The impact of sand mining is –ve above the limit rate of sand mining.
2) Before decide the limit, the authority to study about the replenishment rate greater that they decide the limit according to replenishment.
3) Replenishment rate is based on the average annual rainfall, catchment area, and gradient.
4) if we excavate sand according to replenishment rate , then it resist the –ve impact on environment.
5) It reduces the depth of river bed then the chances of flood is reduces.

### *C. Replenishment*

A replenishment may be steady and take place within the same time frame every month quarter or every year when projected need are well established, or replenishment rate may be variable and depend on various factors such as seasonal changes in demand and weather shortages are allowed.

### *D. EIA (Environmental Impact Assessment)*

1) EIA is specified as an activity purpose to recognize the impact on the bio-geophysical environment, on man and well-being of legislative proposals, projects, economy, and policies operation procedures and to interpret and communicate information.
2) EIA is backed the environment protection act in 1986.
3) EIA is systematic process of identifying process of future consequences of current or proposed.

### *E. Advantage Of EIA*

1) Facilitates the design of a monitoring programme and allows people to examine the underlying need for a project.
2) Gives people the opportunity to identify problems.
3) Helps a developer to design a more publicly acceptable project.
4) Exploration of alternatives can help identify cost-saving and other beneficial changes.

## II. LITERATURE REVIEW

1) *Sand Mining Effects, Causes And Concerns:* A case study from Bestiary Jaya, Selangor, Peninsular Malaysia
Muhammad Aqeel Ashraf1*, Mohd. Jamil Maah1, Ismail Yusoff2, Abdul Wajid3and Karamat Mahmood3.
The mining of soil from rivers and ex-mining areas in Selangor state is a frequent practice and may guide to destruction of public assets as well as impacts or extended stress on commercial and noncommercial living resources that localize these areas. Hydraulic and sediment transport modeling study were carried out to understand possible sand deposition and their flow towards Selangor River. The Hydrologic Engineering Centers River Analysis System (HEC-RAS) software was used to perform one-dimensional. The calculations for a full network of natural and constructed channels and to get input and output information in tabular and graphical formats The resulting vertical and horizontal distributions of sediment show encouraging agreement with the field data, demonstrating markedly different dispersal patterns .

## III. METHODOLOGY

There are many sediment transport equations which are suitable for use in the prediction of the rate of replenishment of river. Some of the famous sediment equations are

*A.* Modified universal soil loss equation(MUSLE)
*B.* USLE (universal soil loss equation)
*C.* RUSLE
*D.* Dandy- Bolton Equation

We used Modified universal soil loss equation (MUSLE) for estimation of sediment yield. In the present study, MUSLE is used to estimate sediment yield from the Wainganga River (Keolari-Ashti). Runoff factor is a major input into the MUSLE model. The sediment yield model like MUSLE is easier to apply because the output data for this model can be determined at the watershed outlet.

*Sand Availability, Its Production And Consumption (Last 3 Years Data 2015-16 To 2017-18):-*

In Bhandara district, near about 1459544 brass sand was available out of which near about 854613 brass sand was mined i.e. near about 58% of total available sand was mined. The year wise availability of sand and its production consumption is tabulated below:-

| Sr. no. | Year | Sand availability unit | Production | Consumption |
|---|---|---|---|---|
| 1 | 2015-16 | 523378 | 395640 | 395640 |
| 2 | 2016-17 | 674516 | 293609 | 293609 |
| 3 | 2017-18 | 261650 | 165364 | 165364 |
| | Total | 1459544 | 854613 | 854613 |

## IV. MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE)

$Y=11.8*(Q*qP)^{.56} *K*Ls*C*P$

Where,

Y = sediment yield of stream (t/yr/km$^2$),

Q = average annual runoff (m$^3$),

K = soil erodibility factor = 0.1,

qP = Highest discharge recorded (m$^3$/s),

Ls = gradient/slope length,

C = cover management factor = 0.1043,

P = erosion control practice = 1.

### *A. Longitudinal Profile Of The Wainganga River:-*

The longitudinal section of the river valley from its source to mouth is known as longitudinal profile. It is gradually formed due to the erosion and deposition along the course of the river. Longitudinal profile of the Wainganga River consists of 4 major segments and all four segments are differing from each other in respect of length and gradient. The figure shows the longitudinal gradient of the river is smoothly decreasing from Pipariya to Kumhari and from Pauni to Ashti where as a drastic change in gradient is observed from Kumhari up to mouth.

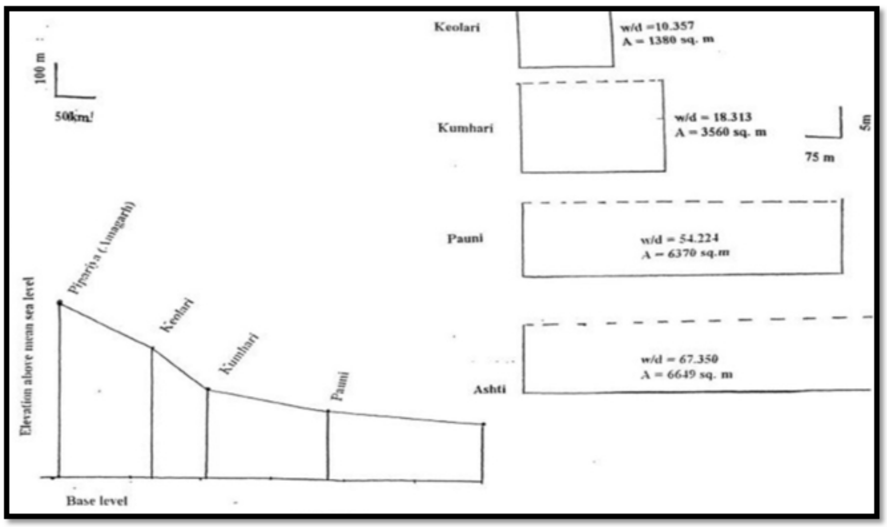



Fig: Longitudinal profile of river

### *B. Gradient Of The River Reaches*

| | Valley Length(Km) | Gradient |
|---|---|---|
| Keolari-Kumhari | 83 | 1:602 |
| Kumhari-Pauni | 175 | 1:2663 |
| Pauni-Ashti | 220 | 1:2688 |

The longitudinal profile is concave upward but it is rarely smooth because there is sharp change in the gradients of reaches keolari-kumhari and Kumhari-Pauni. The downstream reaches Kumhari- Pauni and Pauni-Ashti have equal gradients. Hence it can observe from the figure and table that longitudinal profile of the Wainganga River is steep in the upstream part and that of flat in the downstream part.

1) *Peak Discharge:* Maximum discharge (m$^3$/s) observed on a particular day during the whole year.
2) *Bank Full Discharge:* The discharge corresponding to danger level obtained from the flood hydrograph of discharge against water level.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue IV, Apr 2019- Available at www.ijraset.com

### *C. Average Monthly Discharge At CWC Stations*

| Month | Keolari | Kumhari | Pauni | Ashti |
|---|---|---|---|---|
| January | 1.88 | 1.598 | 34.44 | 37.52 |
| February | .826 | 1.054 | 24.92 | 27.15 |
| March | 0.306 | 0.750 | 20.83 | 75.78 |
| April | 0 | 0.615 | 13.46 | 22.48 |
| May | 0 | 0.325 | 14.51 | 15.09 |
| June | 6.59 | 18.683 | 170.49 | 210.12 |
| July | 42.275 | 212.385 | 811.2 | 1324 |
| August | 129.828 | 454.875 | 1178.66 | 3241.83 |
| September | 42.04 | 138.163 | 702.17 | 1254.43 |
| October | 10.543 | 19.737 | 311.05 | 576.73 |
| November | 2.657 | 6.268 | 57.00 | 100.62 |
| December | 1.515 | 2.463 | 25.26 | 38.00 |

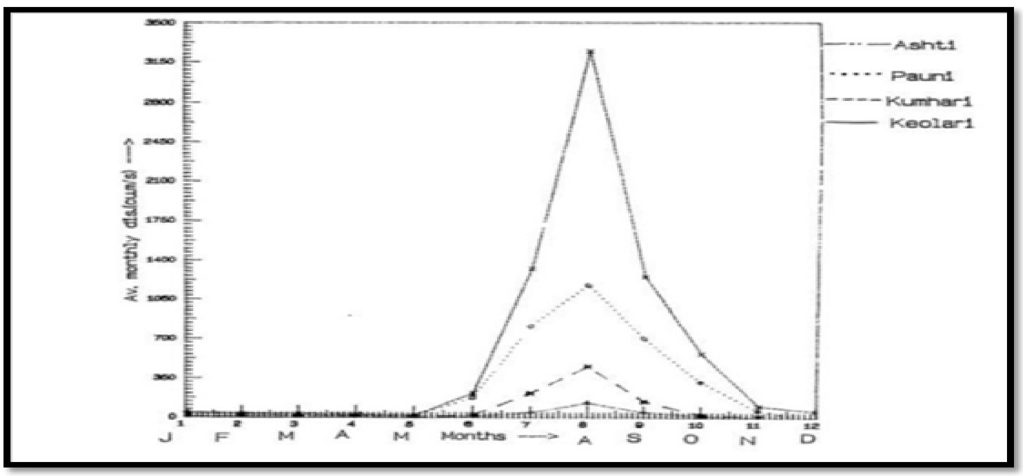



Fig : Average Monthly variation of discharge at CWC Stations

The variation of the average monthly discharge throughout the year corresponding to Keolari, Kumhari, Pauni, & Ashti stations is shown in above figure and table. It is observed from the plot that the Wainganga River is truly monsoonal river, discharge approaching to non monsoon months. The unit model distribution is observed at all stations along the Wainganga River and peak discharges occurred in August only. It is also observed that there is much difference in vast discharges of upstream stations and downstream stations reflecting the huge feeding of discharge by confluence tributaries in the downward direction.

### *D. Hydrological Characteristics Of The Wainganga River*

| Stations | Av. Annual discharge ($m^3/s$) | Av. Annual runoff ($m^3/m$) | Bank full discharge ($m^3/s$) | Highest discharge recorded ($m^3/s$) |
|---|---|---|---|---|
| Keolari | 19.872 | 736 | 3125 | 1670 |
| Kumhari | 71.410 | 1930 | 7887 | 3000 |
| Pauni | 280.330 | 12160 | 13524 | 18250 |
| Ashti | 572.146 | 19725 | 22560 | 28650 |

All discharges are based on the rate measured once per day. The peak discharge varies year wise at all CWC station. The systematic increase in peak discharge at all station up to 1991 and then it is decrease. Hence, during the period of five years (1988-1992) at all stations the highest peak discharge occurred in 1991. It is also revealed that in the last five years, the river has not exceeded the bank full discharge. Further, at the upstream station (Keolari & Kumhari) bank full discharge significantly exceed the highest discharge recorded in the history of river reflecting that no major flooding history at this stations. On the other hand bank full discharge is significantly lower than the highest distance discharge recorded for the downstream station (Pauni & Ashti) reflecting the occasional over bank spilling.

### *E. Sediment Budgeting:*

The total annual suspended load has been computed for upstream (Pauni) and downstream station Ashti and the data is presented in the table. Further, the comparison of annual suspended load for both station for the period 1988-1992. The total suspended load and the coarse plus medium fraction of the suspended load have been plotted separately, which provide interesting observations. Table clearly indicates that the total suspended load is extremely variable over the years and between the stations perhaps reflecting successive aggradations and degradation phases. Interestingly the (coarse medium) fraction of the suspended load is higher at upstream station (Pauni) than that the downstream station (Ashti). Sediment yield (sediment load transferred per unit area) has also been computed for both stations. Once again the sediment yield for the upstream station is higher than that of the downstream station, which support the popular belief that small river basin contribute higher sediment load (Subramanian et. al.....1989). Although there is no regular pattern of variations in the annual suspended load between the two stations, the total suspended load to transfer at the upstream.

| Year | Total load at Pauni (mt/yr) | Total load at Ashti (mt/yr) |
|---|---|---|
| 1988 | 11.955906 | 5.740880 |
| 1989 | 2.742397 | 3.911744 |
| 1990 | 13.270510 | 12.869566 |
| 1991 | 9.085237 | 6.0392925 |
| 1992 | 4.055135 | 5.951426 |
| Total | 41.109185 | 34.513207 |
| Avg. Annual sediment load (mt/yr) | 8.2218837 | 6.902641 |
| Sediment yield ($t/km^2/yr$) | 231.47 | 135.37 |

## V. DANDY-BOLTON EQUATION

### *A. For Runoff Less Than 2 Inches*

S=*1280*(Q)*0.46*(1.46-0.26log(A))*F

### *B. For Runoff Less Than 2 Inches*

S=*1958*(Q)*(e-0.055*Q)*(1.43-0.26log(A))

Where,
S=sediment yield of stream ($t/yr/km^2$),
Q=average annual runoff ($m^3$),
A=net drainage area in sq.mile

## VI. SUMMARY OF ANTICIPATED ENVIRONMENTAL IMPACTS

| Impacts | Mitigation measures |
|---|---|
| Land environment | |
| 1. Creation of temporary pits after excavation of sand. These pits will be filled by natural process of replenishment in due to course of time.<br>2. Very little possibility of soil erosion as working depth will be confined to only 3m below ground level.<br>3. Some adverse visual impact due to formation of the mining pits. | 1. Regular monitoring of sand replenishment in mined pits and reduction of working depth if replenishment rate is found inadequate.<br>2. No excavation within a distance of 30m from the river bank.<br>3. Factor of slope stability to be taken into consideration while excavating sand from the pit.<br>4. Tree planting along the approach road to minimize adverse visual impact. |

| Air environment | |
|---|---|
| 1. Since the mining will be done without blasting. Dust generation during excavation will be insignificant. However, there will be some deterioration in air quality as a result of generation of dust during loading and transportation.<br>2. Air born dust particles may cause diseases of respiratory system. | 1. Regular sprinkling of water on haul roads for dust suppression.<br>2. Compaction of haul roads.<br>3. Planting on both sides of haul roads.<br>4. If sand is dry, water will be sprayed over it to make it wet.<br>5. Transport vehicles will be covered with tarpaulin.<br>6. Regular maintenance of vehicles.<br>7. Regular maintenance of roads fortnightly scraping of road surface. |

| Water environment | |
|---|---|
| 1. No adverse impact on ground water regime is anticipated as there is no proposal of stream bed mining or diversion of any stream and the depth of mining is to be restricted to 3m or the ground water table, whichever is less.<br>2. The water drawl is estimated to the only 89.6KLD from the river and 0.8KLD from the nearby ground water sources. Since the river has sufficient water flow throughout the year & there is not much ground water drawl, the impact of water. | 1. Use of temporary portable toilets at the project site.<br>2. No mining activity during rainy season.<br>3. Periodic monitoring of water quality. |

| Noise environment | |
|---|---|
| 1. Generation of noise and vibrations from the machines and transport vehicles may cause some impact on the health of workers. | 1. Regular maintenance of vehicles and machines.<br>2. Plantation along approach roads.<br>3. Regular health checkups.<br>4. Only trained workers to be allowed to operate machines.<br>5. Regular maintenance of smoke silencers.<br>6. Creation of awareness among truck drives not to unnecessarily blow loud horns.<br>7. Periodic monitoring of noise levels. |

| Socio economic environment | |
|---|---|
| 1. Direct employment to about 164 persons in mining and other related activities and indirect employment to hundreds of people.<br>2. Improvement in economic status due to increase in income. | 1. Engagement of locally available workers on priority.<br>2. Organization of regular health checkup camps for workers and villagers twice in a year. |

## VII. CALCULATION OF TOTAL SEDIMENT YIELD BY DIFFERENT METHOD

| Biological environment | |
|---|---|
| 1. No adverse impact on forest resources and economically or medicinally important plant species is anticipated. There is no threat to terrestrial or aquatic fauna, biodiversity or wild life. However, there may be some retardation in growth of plants due to deposition of dust on foliage. Dust generated during transportation of sand may cause some harm to people and animals. | The following green areas are proposed to be developed:-<br>a) Road side plantation over length of 0.089 km on both sides of the approach road.<br>b) Road side plantation over a length of 1.520 km on both sides of the existing road to be used in transportation of sand.<br>c) Planting over a length of 1.860 km along the river side above highest flood level.<br>d) Free distribution of 3125 no. of saplings to villagers in Bhikampura and Ruhera villages. |

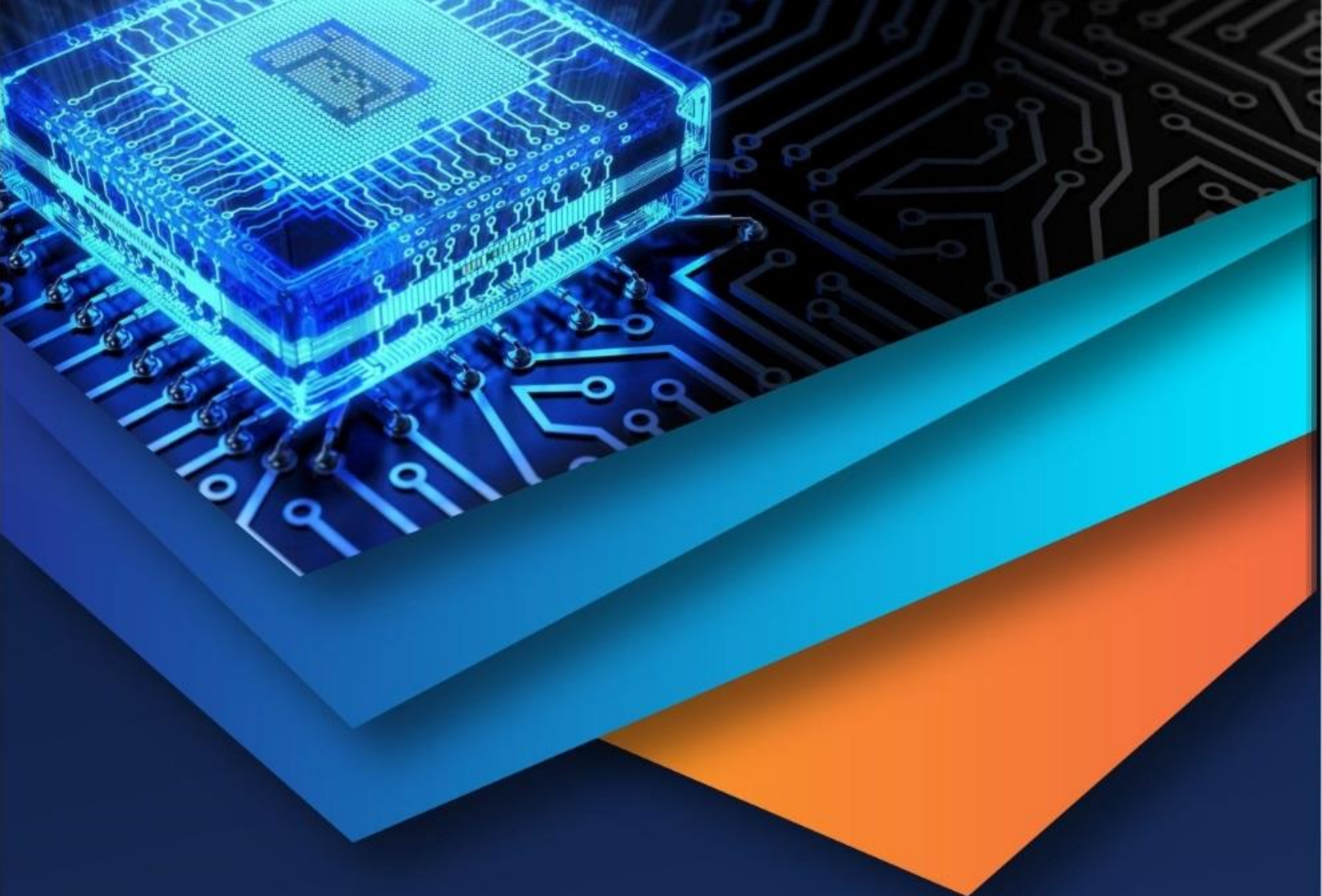
| Station | As per Dendy-Bolton method Total load in( $t/km^2/yr$) | As per calculation by MUSLE method in ( $t/km^2/yr$) |
|---|---|---|
| Keolari | 134.50 | 153.396 |
| Kumhari | 315.478 | 206.088 |
| Paoni | 231.47 | 235.56 |
| Ashti | 135.37 | 892.857 |

## VIII. CONCLUSIONS

In the present study, MUSLE model is used for the estimation and sedimentation yield for Wainganga River in Keolari-Ashti. Then the replenishment rate is sedimentation yield so much more than permitted sand mining quantity. Hence, the sand mining is safe of environmental friendly.

## REFERENCES

[1] Ashraf, M.A., Maah M.J and Yusuf, I.B. Study of Water Quality and Heavy Metals
[2] In Soil & Water of Ex-Mining Area Bestari Jaya, Peninsular Malaysia, 2010.
[3] In Indian context. Indian Journal of Engineering & Materials Sciences. Vol. 11,
[4] October, pp. 433-437 (2004).
[5] Gurubachan Singh, K. K. Mehta., R.C. Sharma.K.L Chawla., P.K. Joshi., N.P.
[6] Yaduvanchi. Technical bulletin on Sand mining or no mining in Agricultural fields in
[7] Haryana, 2007.
[8] Kundu , N. K and Ghose, M. K. Environ Conservat, 21 (2) 126-132 (1994).
[9] Surender Singh Chauhan. Mining, Development and Environment: A Case Study of
[10] Bijolia Mining Area in Rajasthan, India. J Hum Ecol, 31(1): 65-72 (2010)




10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429


# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY