



Preliminary Draft Report

District Survey Report

For

(Planning & Execution of) Minor Mineral Excavation



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&

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Preface

On January 15th 2016, Ministry of Environment, Forest and Climate Change, Government of India issued a notification and in which Para 7(iii) (a) and Annexure X purpose and structure of District Survey Report has been discussed. District Survey report (DSR) will be prepared in every district for each minor mineral. The District Survey Report will guide systematic and scientific utilization of natural resources, so that present and future generation may be benefitted at large. The purpose of District Survey report (DSR) *“Identification of areas of aggradations or deposition where mining can be allowed; and identification of areas of erosion and proximity to infrastructural structures and installations where mining should be prohibited and calculation of annual rate of replenishment and allowing time for replenishment after mining in that area”*. The District Survey report (DSR) will contain mainly data published and endorsed by various departments and websites about Geology of the area, Mineral wealth details of rivers, Details of Lease and Mining activity in the District along with Sand mining and revenue of minerals. This report also contains details of Forest, Rivers, Soil, Agriculture, Road, Transportation and climate etc.

Banda is a district of Uttar Pradesh , and Banda Town is the district headquarters. It is a part of Chitrakoot Division. Located in historical Bundelkhand region, Banda is famous for its Shajar stone which is used for making jewellery, and the historically and architecturally significant sites Khajuraho and Kalinjar. Khajuraho is a World Heritage Site famous for its elaborately carved temples. The fortress of Kalinjar is famed for its war history and its glorious rock sculptures.

Disclaimer: - The data may vary due to flood, heavy rains and other natural calamities. Therefore, it is recommended that EAC/SEIAA/DEIAA may take into consideration all its relevant aspects / data while scrutinizing and granting EC to the concerned Authority as applicable.

Introduction

District Banda is located in geographical extends between 24° 53' to 25° 55' N latitudes and 80° 07' to 81° 34' E longitudes. The total geographic area of the districts is about 4460 Sq.Km. The district forms part of the northern fringe of the peninsular India coming in contact with the Gangetic alluvium. North side of this district is bounded by Fatehpur district, west by Mahoba, east by Chitrakoot and south side bounded by State of Madhya Pradesh. District headquarter is at Banda having 04 tehsils and 8 blocks. As per the 2011 census the district has population of 1,799,410 of which male and female were 965,876 and 833,534 respectively. Literacy rate of the district is 54.2%.

Banda district falls under Chitrakoot Division and Banda town is the district headquarters. There are 04 Tehsils, 08 blocks, 02 Nagar Palika and 06 Nagar Panchayat. The district has 01 Parliamentary constituency and 04 Assembly seat. Out of the total villages of the district, 660 villages are populated and 34 are inhabited.

Sand is the main mineral available on the banks of the river Yamuna and Ken. Sand is available which is used in construction and few minor stones are also found in the rocky mountain which are used by the Public Work Department for road construction in and nearby districts.

Banda district is drained by Yamuna, and Ken rivers. River Yanuna bifurcates the district Banda from Fatehpur in north and flows from west to east in the entire district. River Ken is the tributary of River Yamuna at Chilla Ghat in district Banda.



(Source: mineral.up.nic.in)



Fig. 1: Location map of Banda

General Profile of the district

Banda is one of the districts of Buldalkhand region of Uttar Pradesh having a rich historical tradition going back to the remote antiquity, is famous for its Shajar stone, used for making jewellery and the historically and architecturally significant sites Khajuraho and Kalinjar. Khajuraho is a World Heritage Site famous for its elaborately carved temples. The fortress of Kalinjar is famed for its war history and its rock sculptures. The district is said to be the birthplace of the great ancient poet Valmiki who has written the immortal epic Ramayana in Sanskrit language. His ashram at Lalapur Bagrehi hills was one of the ancient centers of Vedic Learning.

Every Year Banda-District celebrates week long Kalinjar Mahotsava to promote Kalinjar Fort's Heritage & Tourism. Kalinjar Mahotsava includes many Cultural and Social activities.

In 2006 the Ministry of Panchayati Raj named Banda one of the country's 250 most backward districts out of a total of 640. It is one of the 34 districts in Uttar Pradesh currently receiving funds from the Backward Regions Grant Fund Programme.

Climate Condition

May is the hottest month with mercury shooting upto 47.0 °C. With the advance of monsoon by mid June, temperature starts decreasing. January is usually the coldest month with temperature going upto 5.8 °C.

Rainfall & Humidity

The average annual rainfall is 902.00 mm. The climate is typical subtropical characterized by long and intense summers. About 80% of the annual rainfall is

received from south-west monsoon. The relative humidity is highest in August about 85% and lowest in April.

Topography & Terrain

The district largely consists of irregular uplands with outcrops of rocks intermingling mostly with lowlands, frequently under water during rainy season. The Ken River traverses the district from north-east to southwest. The tract lying to the right of the river is intersected by numerous smaller river and rivulets, but to its left is a flat expanse, most part of which is made up of Mar and Kabar soils, eroded and converted into ravines along the banks of the rivers Ken and the Yamuna.

Water Course & Hydrology

On the basis of hydrogeological information ground water occurs in unconfined conditions in shallow depths and confined conditions in deeper depth in alluvium. The thickness of alluvium varies from 45.00 to 200.00 mbgl in the district. Granites (Bundelkhand) has also good potential and yield at economical discharge. Ground water occurs in fractures and joints in the hard rock. The potential fractures are encountered from around 28.00 to 96.00 meters in some places.

As per the depth to water level data of 27 permanent ground water monitoring stations in the year 2009, pre monsoon water level ranges from 2.75 mbgl (Khurand) to 26.95 mbgl (Bhitar Kerdera). In the post monsoon period, depth to water level varies from 0.95 mbgl (Girwan) to 22.50 mbgl (Pailani). Water level fluctuation varies from 0.0 in Rolyhdyajue to 8.02 m at Naraini. It is observed that the hilly and rocky area the fluctuation is higher than the plain. Fluctuation is more where less order streams are found.

Long term water level trend records in the area from 27 national hydrographic stations (2000-2009) in ten years show that (except Mataudh) all other wells are showing declining trend. The falling trend ranges from 0.0979 m/yr (Girwan) to 1.5087 m/yr at Paprenda.

Ground Water Quality

The electrical conductance is in the range of 570 to 2600 $\mu\text{m}/\text{cm}$ at 25°C . Total hardness is from 110 to 400 mg/lit. Fluoride ranges from 0.16 to 0.89 mg/lit and Nitrate is upto 306 mg/l which is high. Phosphate is absent.

Ground Water Development

The stage of ground water development in the district is 36.71%. Leaving net ground water availability for future irrigation 50247.33 ham. The maximum stage of ground water development is in Jagura block 59.91% and minimum in Bilanda block 24.96%. All the 8 blocks are in the safe category.

Topography & Slope

The district largely consists of irregular uplands with outcrops of rocks intermingling mostly with lowlands, frequently under water during rainy sesason. The Baghein River traverses the district from southwest to north-east. The tract lying to the right of the river is intersected by numerous smaller river and rivulets, but to its left is a flat expanse, most part of which is made up of Mar and Kabar soils, eroded and converted into ravines along the banks of the rivers Ken and the Yamuna.

Drainage System

The total geographical area of the district is 4460 km^2 . The Yamuna, Ken and several tributaries of river Yamuna are flowing in the Banda district. Average

rain in the district approximate 902.00 mm. General climate of the district is healthy and pleasant. The net irrigated area is 153804 Ha and the net area sown is 336000 Ha, which shows that 45.77% area is irrigated by ground water and the surface water while the rest depends on rainfall.

Table 1: Drainage System with Description of main rivers

S.No.	Name of River	Area Covered (Sq.Km.)	% Area Covered
1.	Yamuna River	51.88	1 %
2.	Ken River	100.68	2 %

Table 2: Salient features of Important rivers and streams

S.No.	Name of River / stream	Total length in the District (in Km)	Place of Origin	Altitude at Origin
1	Yamuna River	124.70	Yamunotri Glacier, Lower Himalaya in Uttarakhand	6,387 m
2	Ken River	143.84	Village Ahirgawan on the north-west slopes of Barner Range in Jabalpur	550 m

			district	
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Yamuna River

Yamuna Rivers enters in Banda at village Bhaura Daria and passes through Budhed, Khaptiha Khurd, Amchauli in and out of district boundary. Finally at Joraupur, river Yamuna exits from District Banda.

Table 3: List of villages through which river Yamuna passes

S.No.	Name of Place	Elevation
1.	Bhaura daria	120
2.	Budheda	120
3.	Khaptiha Khurd	119
4.	Amchauli	117
5.	Mahabara	115
6.	Piparodar	115
7.	Basdhari	114
8.	Lasada	112
9.	Chilla Ghat	112
10.	Sadi Madanpur	110
11.	Laumar	110
12.	Gaura	108
13.	Amlı Kaur	106
14.	Augasi	106

15.	Marka	104
16.	Charaka	104
17.	Matehana	102
18.	Mudvara	100
19.	Kheda	100
20.	Kathar	98
21.	Joraur pur	98

Ken River

Ken Rivers enters in Banda at village Chilla ghat, it is tributary of Yamuna river and passes through Khajuri, Dighwat, Pailani in and out of district boundary. Finally Ken river, at village Bilharka, river Ken exits from District Banda.

Table 4: List of villages through which river Ken passes

S.No.	Name of Place	Elevation
1.	Chilla Ghat	112
2.	Khajuri	112
3.	Dighwat	110
4.	Pailani	110
5.	Kukuwa Khas	110
6.	Madauli Khurd	109
7.	Amlor	108
8.	Rehutan	108
9.	Khaptiha Kalan	106
10.	Khairei	106

11.	Sandi	105
12.	Pathari	105
13.	Chheharao	104
14.	Chatkan	104
15.	Kanwara	104
16.	Hateti Purwa	104
17.	Ganchha	103
18.	Madhopur	103
19.	Bhasround	102
20.	Govindpur	102
21.	Sarai Salimpur	102
22.	Samastpur	101
23.	Akbar Girwan	101
24.	Nihalpur	100
25.	Bariyari	100
26.	Gaur shivpur	98
27.	Barsanda Manpur	98
28.	Ramnai	98
29.	Barauli	97
30.	Kharoni	97
31.	Chandaura	96
32.	Jigani	96
33.	Bhina	96
34.	Bhlharka	96

Table 5: List of drains in District Banda

S.No.	Name of Water body	Merges with
1.	Baredi Nala	Yamuna River
	Bisahil Nala	
	Barwa Nala	
	Karaili Nala	
	Gupla Nala	
	Havya Nala	
	Pandui Nala	
2	Gohariya Nala	Ken River
	Jhari Nala	
	Nimni Nala	
	Suindi Nala	
	Ghghar Nala	
	Gajha Nala	
	Madrar Nala	
	Chuwa Nala	

Fauna

Animals depend on forest not only of food but also for habitat. The diversity of fauna are found in the State. Since their list is long, mention shall be made here only of important species mainly found in the district:

Fish: Mahaser, Hilsa, Saul, Tengan, Parthan, Rasela, Vittal, Rohu, Mirgal, Kata, Labi, Mangur, Cuchia, Eel, Einghi, Mirror Carp, Trout.

Amphibia: Frog and Toad.

Reptiles: Bamania, Pit-viper, Lizard, Goh, Cobra, Tortoise, Krait, Dhaman and Crocodile.

Aves: Cheel, Vulture, Peacock, Nightingale, Pigeon, Parrot, Owl, Nilkanth and Sparrow.

Mammals: Shrew, Porcupine, Squirrel, Hare, Mongoose, Cow, Buffalo and Mouse.

Other common species found here are Panther, Sambhar, Cheetal, Kastura, Chinkara, Black Deer, Nilgai, Back-brown Bear, Mountain Goat, Hyena, Hill Dog, Elephant etc. Among the birds Fowl, Pheasant, Partridge, Florican, Duck, Goose and Wader are common.

Flora

The main forest species found in the districts are: Teak, Kardhai, Dhou, Tendu, Khair, Palash, Bamboo, Medicinal Shrubs, Herbs and trees like Amla, Bahera, Bel, Arjun, Mahua, Seja, Chironji, etc.

Table 6: Distribution of Forest in Banda

S.No	Name of village (Forest)
1.	Bahadurpur (RF)
2.	Chatkan (RF)
3.	Maruli (RF)
4.	Khare (RF)
5.	MANpur (RF)
6.	Ganchha (RF)
7.	Pailani (RF)
8.	Kukuwara (RF)

9.	Nari (RF)
10.	Khazipur (RF)
11.	Gopalpur (RF)
12.	Garaba Purwa (RF)
13.	Parbatia Pahar (PF)
14.	Garha (PF)
15.	Gauhani PF)
16.	Nehra (PF)

Land form & Seismicity

In the earthquake zonal map of India the district lies in zone II liable to low damage by earthquakes. Although no major earthquake occurred close to it, the tract being not far from the Great Himalayan Boundary fault, experiences the effects of moderate to great earthquake occurring there.

Soil

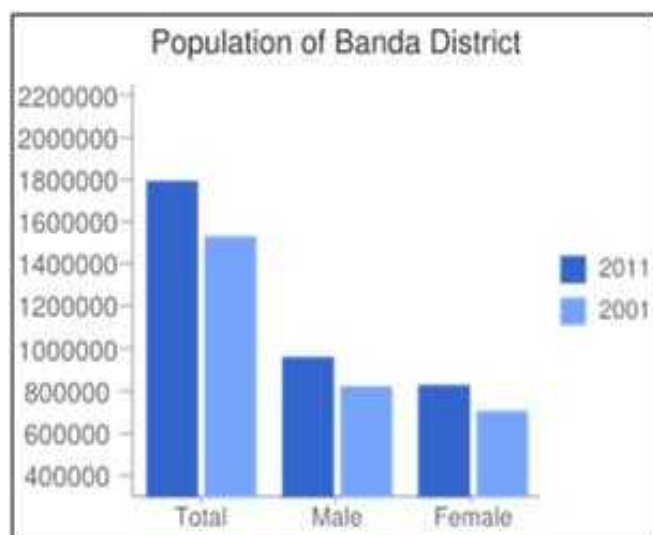
In Banda district loose sediments as well as black cotton soil is found. Black cotton soil is prominent in the central part. Four major type of soil a) Rakar, b) Mar, c) Kabar and d) Padua are dominant in the district.

Demography

In 2011, Banda had population of 1,799,410 of which male and female were 965,876 and 833,534 respectively. In 2001 census, Banda had a population of 1,537,334 of which males were 826,544 and remaining 710,790 were females. Banda District population constituted 0.90 percent of total Maharashtra population.

In 2001 census, this figure for Banda District was at 0.93 percent of Maharashtra population.

Population Distribution



Rural Urban Distribution

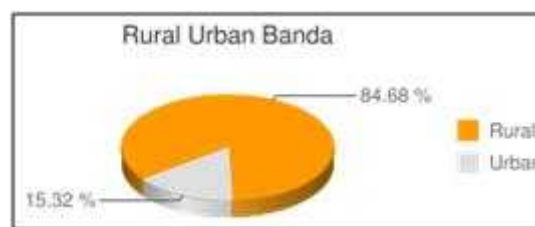


Fig.2: Demography of Banda

Table 7: Demographic details of Banda

Description	2011
Actual Population	1,799,410
Male	965,876
Female	833,534
Population Growth	17.05%
Area Sq.km	4,408
Density/ Km²	408
Proportion to Uttar Pradesh Population	0.90%
Sex Ratio (per 1000)	863
Child Sex- Ratio (0-6 age)	902
Average Literacy	66.67
Male Literacy	77.78
Female Literacy	53.67

Total Child Population(0-6 age)	294,972
Male Population(0-6 age)	155,080
Female Population(0-6 age)	139,892
Literates	1,002,937
Male Literates	630,626
Female Literates	372,311
Child Proportions (0-6 age)	16.39%
Male Proportions(0-6 age)	16.06%
Female Proportions (0-6 age)	16.78%

Source :<http://www.census2011.co.in/census/district/526-Banda.html>

Physiography of the district

The area comprises Precambrian Bundelkhand granites unconfirmably overlain by Vindhyan are quaternary alluvium. The main and major drainage of the district are Yamuna, and Ken which are part of Yamuna river system.

Physiographically the area can be divided into three physiographic units–

- (1) Alluvial Plain
- (2) Marginal Alluvial
- (3) High Land (Hard rock) area

Land utilization pattern of the district

The land use pattern (2005-06) in the State has been indicated in the Table below. The total cultivated area of the district is 11588 ha. And the total cropped area is 405954 ha. The cropping intensity in the district is 122.2 %. The area sown during rabi is more as compared to area sown in kharif. Land use Pattern in Banda district is given below in Table:

Table 8: Land use pattern of Banda

S.No.	Particulars	Area (Ha)
1.	Cultivated Area	11588
2.	Forest	5421
3.	Non Agri. Use	30622
4.	Net sown area	351472
5.	Follow land	28438
6.	Area Sown more than Once	63519
7.	Total Cropped Area	405954
8.	Cropping Intensity	122.2
Total Area		897136.2

Source: Comprehensive - District Agriculture Plan (C-DAP), District Planning Committee Banda (UP)

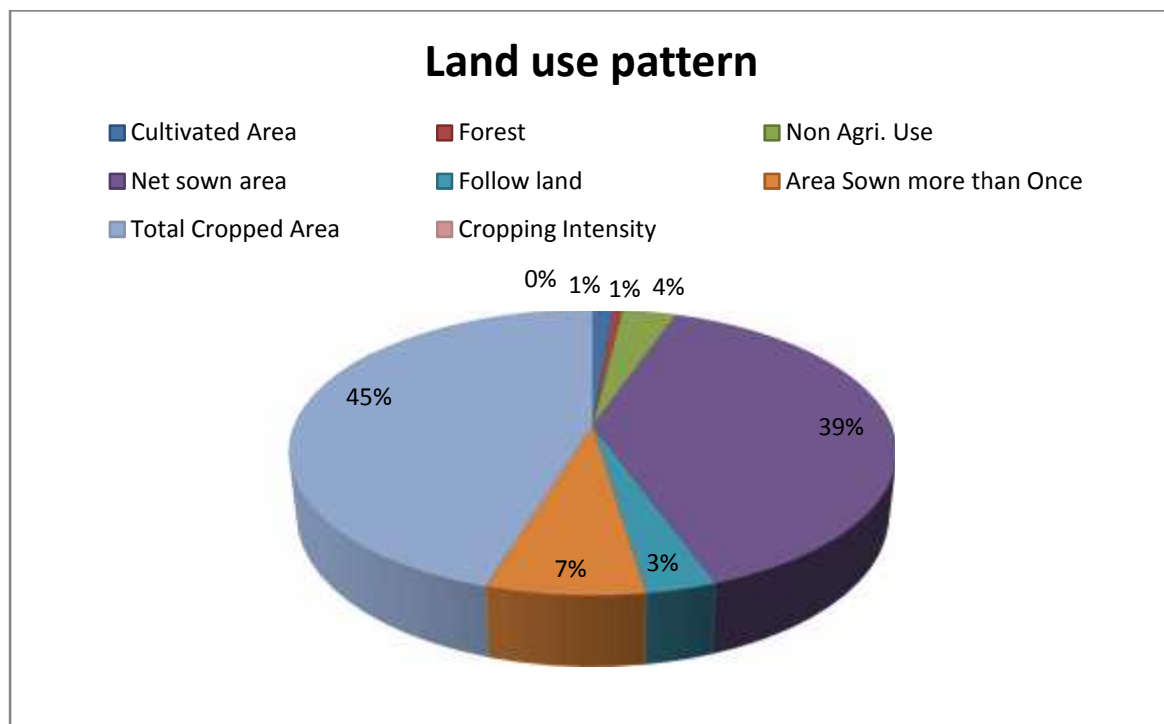


Fig 3: land use pattern

Land use pattern is largely influenced by the available irrigation facilities, which ultimately affect the economy of the area. Irrigation facilitates the intensive

use of land resources and results in the increase of Gross Cropped Area and also improves the intensity.

Cropping Pattern

The three main cropping seasons in the district are Kharif, Rabi and Zaid. The other crops raised in the district include wheat, paddy, maize, pulses and oilseeds. Main fruits grown are mango and guava. The production and productivity of the major crops in the district are summarized below in Table:

Table 9: Cropping pattern of Banda

S.No.	Crop	Area(ha)
1.	Arhar	17481
2.	Urd	4748
3.	Maize	17
4.	Mung	2033
5.	Groundnut	1298
6.	Jowar	26677
7.	Paddy	57836
8.	Seseme	170
9.	Bajra	2005
10.	Soybean	208
11.	Lentil	47250
12.	Gram	104656
13.	Wheat	127107
14.	Barley	1222
15.	Potato	53
16.	Onion	79
17.	Pea	1807
18.	Musturd	2165
19.	Linseed	2165

Source: Comprehensive - District Agriculture Plan (C-DAP), District Planning Committee Banda (UP)

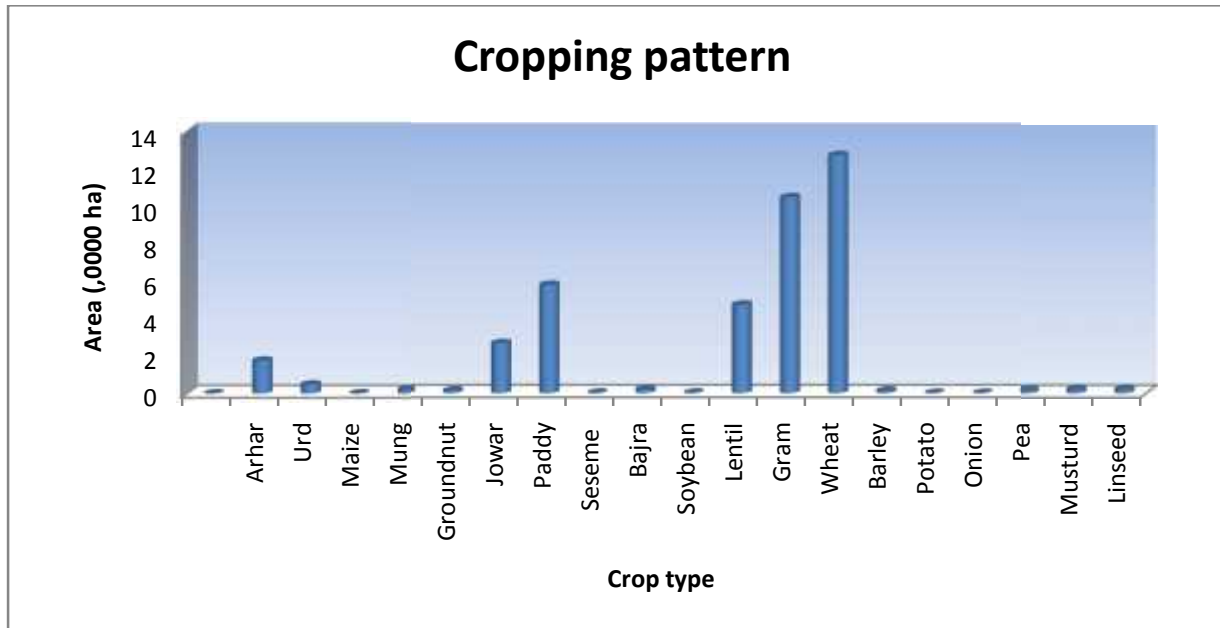


Fig 4: Cropping Pattern of Banda District

Geology

The district forms part of the northern fringe of the Peninsular India coming in contact with the Gangetic alluvium. It has an important place in the geology of the country owing to the presence of all Pre Cambrian rocks, probably right from the oldest ones in the Indian sub- continent, in a compact linear east-west stretch.

During the last few years the geological survey of India have carried out regional geological mapping of most of the area, mineral appraisal by detailed mapping, geophysical and geochemical investigations where necessary for pyrophyllite, clays and base metal.

Mineral wealth

As per geological and mineral atlas of India sheet no 14, miscellaneous bulletin no-30 and mineral resource map of district the area contained alluvial loam along with some percentage of sand upto a deep layer. Mineral wealth of the district has great significance in terms of socio-economic prosperity and economic base.

Soil

In Banda district loose sediments as well as black cotton soil is found. Black cotton soil is prominent in the central part. Four major type of soil a) Rakar, b) Mar, c) Kabar and d) Padua are dominant in the district. The classification of soil of the district is given below.

- (a) A variety of rakar in Banda district has stones of various sizes. Apart from the red and black soils, some varieties of loamy, alluvial soils are found along river banks. Among these, the **rakar** variety is stony and found on sloping surfaces of ravine land. It is a highly degraded kind of coarse soil. However, where irrigation is available, the soil is suitable for cultivation of jowar, til and bajra.
- (b) The second variety of black soil, called **mar**, what is generally called black cotton soil. It has high clay content and is prone to waterlogging. The soil has relatively high organic matter content, and hence can be cropped without use of fertilisers.
- (c) The **kabar**, resembles black cotton soils of central India. Its colour varies from dark black to grey black and brownish black. It has high clay content; hence it is highly adhesive, retains moisture, and quickly turns dry and into hard blocks.

- (d) A yellowish, light-coloured variety of red soil, called **padua**, is sandy and has some clay content. It is well aerated and easily accepts water. Padua soil is found across UP, Banda and is suited for cultivation of wheat.

Mineralogy of soil in Banda

The district forms part of the vast Indo-Gangetic alluvial tract. The origin of the Indo- Gangatic tract as a whole is now attributed to sag in the earth's crust, formed in the upper Eocene times, between the Gondwana land and the raising Himalayan belt. The loamy, alluvial soils, locally known as Rakar, forms slightly elevated terraces, usually above the flood level. The newer alluvia, locally called khaddar, are contained to the lowland tracts.

Description of Rivers

The main rivers running through the district are Yamuna and ken River. A brief account is given below.

Yamuna River

The Yamuna River is one of the important and sacred rivers of India. It is the largest tributary of the River Ganga. It originates from Yamunotri glacier in the Mussoorie range of the lower Himalayas, and after traversing 1,376 km joins the river Ganga at Allahabad. The drainage area of the Yamuna basin is 366,220 sq km, which comprises part of seven states, viz. Uttarakhand, Himachal Pradesh, Uttar Pradesh, Haryana, Delhi, Rajasthan and Madhya Pradesh. The Yamuna River has four main tributaries in the Himalayan region: Rishi Ganga, Hanuman Ganga, Tons, and Giri. In the plains, the main tributaries are the Hindon, Chambal, Sind, Betwa and Ken. The river water is generally used for irrigation, drinking and

industries as well as for mass bathing, laundry, cattle bathing, and secretion of the cremation ash. The construction of diversion structures at regular intervals (Hathinikund, Wazirabad, Okhla, Gokul, etc.) for irrigation, domestic and industrial water supply, has largely modified the flow regime of the river. The inflow of wastewater either treated or partially treated in the river further aggravates the water quality problem of the river. Though the green revolution was important for food security, but lack of regulation in the groundwater abstraction has led to ground water table depletion causes damage in causal linkage between surface and ground water, resulting change in surface water dynamics during the lean season of the river. This is the main reason of dry river segments observed between Hathinikund and Palla (Delhi).

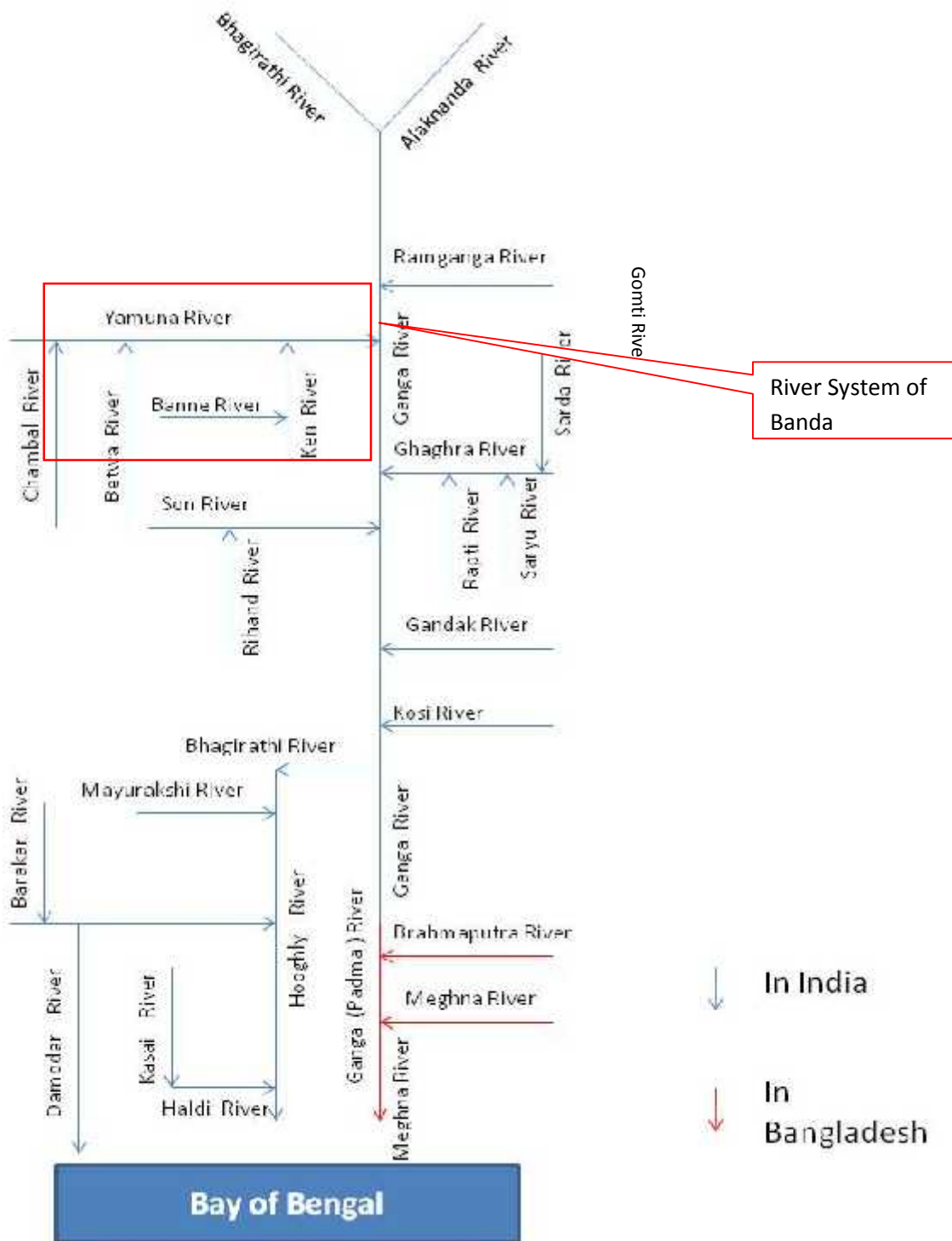


Fig 6: River System of India

Ken River

The Ken River is one of the major rivers of the Bundelkhand region of central India, and flows through two states, Madhya Pradesh and Uttar Pradesh. It is a tributary of the Yamuna. The Ken River originates near village Ahirgawan on the north-west slopes of Barner Range in Jabalpur district and travels a distance of 427 km, before merging with the Yamuna at Chilla village, district Banda in Uttar Pradesh at 25°46 N 80°31 E.

Ken has an overall drainage basin of 28,058 km², out of which 12,620 km² belong to Sonar River its largest tributary, whose entire basin lies in Madhya Pradesh; and along its 427 kilometres (265 mi) course it receives water from its own tributaries such as Bawas, Dewar, Kaith and Bank on the left bank, and Kopra and Bearma of the right. Out of its total length of 427 kilometres (265 mi) it flows for 292 kilometres (181 mi) in Madhya Pradesh, 84 kilometres (52 mi) in Uttar Pradesh, and 51 kilometres (32 mi) forms the boundary between the two states.

Other Rivers of Banda

Chan River- This stream rises in the upland below the Patha proper, on which the village of Rukma and Dadri are situated, sometimes called The Dadri-ka-Patha, lying to the south of karwai. It flows in shallow bed, stream with boulders, as far as the village of Semardaha.

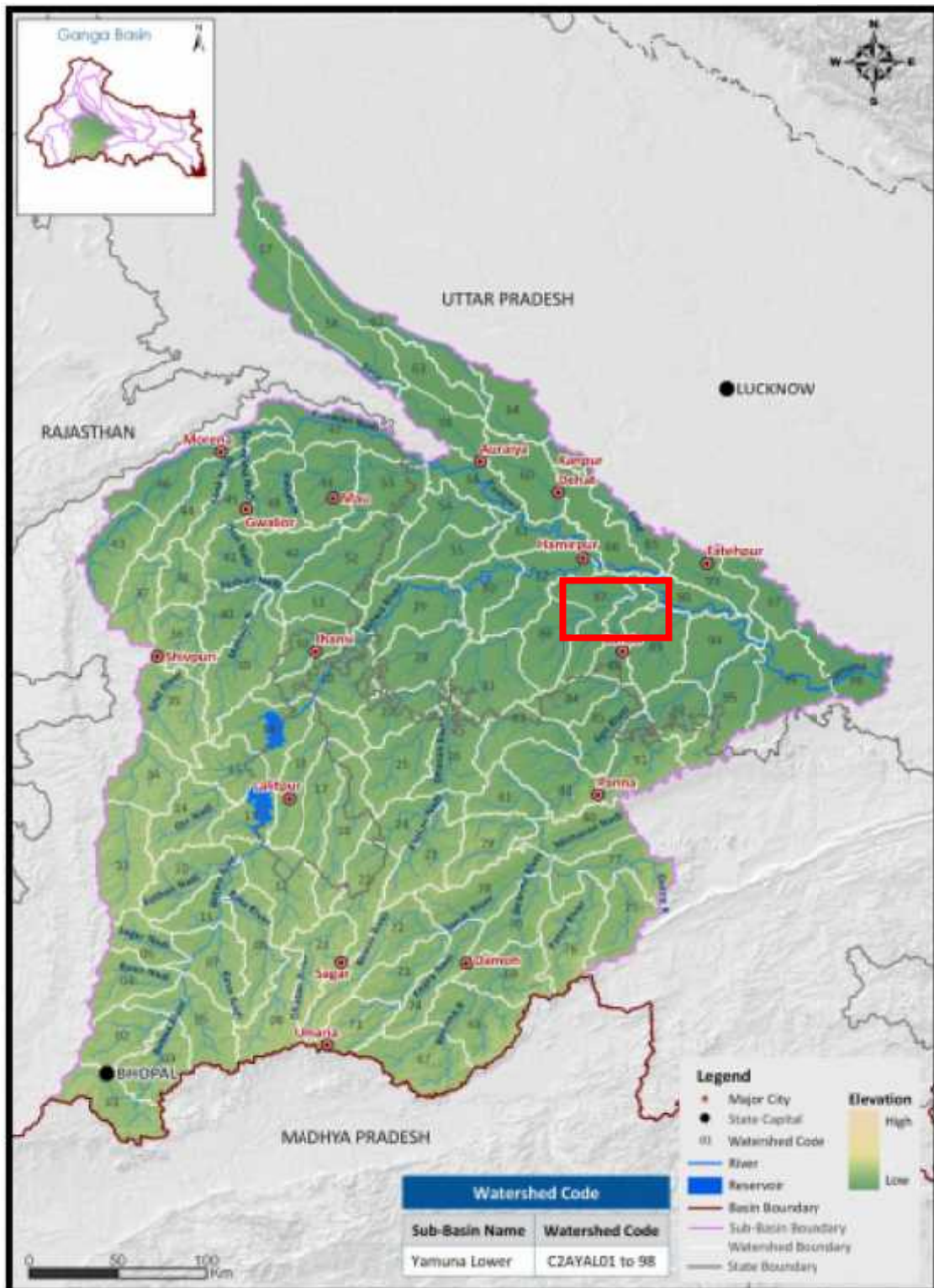
Bardaha River- This stream flows from the highlands of Rewah in the south-east corner of tehsil Karwi, and after a short course in this district flows out eastward into district.

Garra River- the last stream of any importance is the Garara, One branch rises near the village of Jamrahi and the other in Adhrauri, Both in Tehsil Naraini. The

united stream flows due north joining the Yamuna at the village of jalalpur in tehsil Baheru.

Beghain River- It is perennial rivers, it issues from a hilla near kohari in district and enters at the village of Masauni Bharatpur in tehsil Naraini. Flowing north-eastward through tehsil Naraini.

Paisuni River- This stream, one of the tributaries of the Yamuna, rises in the hills of Madhye Pradesh. Near its junction with the Yamuna it forms some remarkable curves amidst lowlying land, chiefly in the village of Bhadedu, which it often floods. Its banks are usually steep and its characteristics are like those of the baghain.



Source: www.india-wris.nrsc.gov.in

Fig 7: District Banda (part of Yamuna lower Sub Basin)

Table10: Catchments Details of Yamuna River

S.No.	State	Area (Sq km) in Yamuna River
1.	Uttar Pradesh and Uttrakhand	74,208
2.	Himanchal Pradesh	5,799
3.	Haryana	21,265
4.	Rajasthan	102,883
5.	Madhya Pradesh	14,023
6.	Delhi	1,485

Table 11: Catchments Details of ken River

S.No.	State	Area (Sq km) in Ken River
1.	Madhya Pradesh	12,620
2.	Uttar Pradesh	15,438

Process of deposition

Sediment transport is critical to understanding how rivers work because it is the set of processes that mediates between the flowing water and the channel boundary. Erosion involves removal and transport of sediment (mainly from the boundary) and deposition involves the transport and placement of sediment on the boundary. Erosion and deposition are what form the channel of any alluvial river as well as the floodplain through which it moves. The amount and size of sediment moving through a river channel are determined by three fundamental controls: competence, capacity and sediment supply. Competence refers to the largest size (diameter) of sediment particle or grain that the flow is capable of moving; it is a hydraulic limitation. If a river is sluggish and moving very slowly it simply may not have the power to mobilize and transport sediment of a given size even though such sediment is available to transport. So a river may be competent or

incompetent with respect to a given grain size. If it is incompetent it will not transport sediment of the given size. If it is competent it may transport sediment of that size if such sediment is available (that is, the river is not supply-limited). Capacity refers to the maximum amount of sediment of a given size that a stream can transport in traction as bedload. Given a supply of sediment, capacity depends on channel gradient, discharge and the calibre of the load (the presence of fines may increase fluid density and increase capacity; the presence of large particles may obstruct the flow and reduce capacity). Capacity transport is the competence-limited sediment transport (mass per unit time) predicted by all sediment-transport equations, examples of which we will examine below. Capacity transport only occurs when sediment supply is abundant (non-limiting). Sediment supply refers to

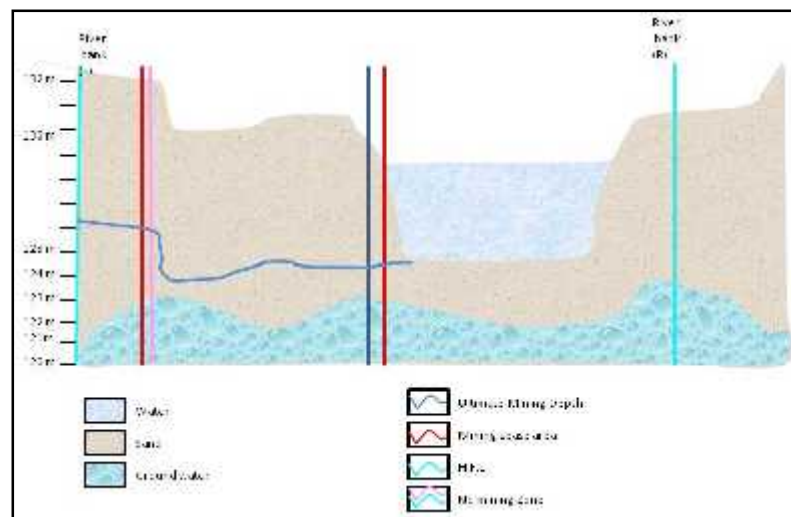


Fig 8: Standard Sand Mining Operation

the amount and size of sediment available for sediment transport. Capacity transport for a given grain size is only achieved if the supply of that calibre of sediment is not limiting (that is, the maximum amount of sediment a stream is

capable of transporting is actually available). Because of these two different potential constraints (hydraulics and sediment supply) distinction is often made between supply-limited and capacity-limited transport.

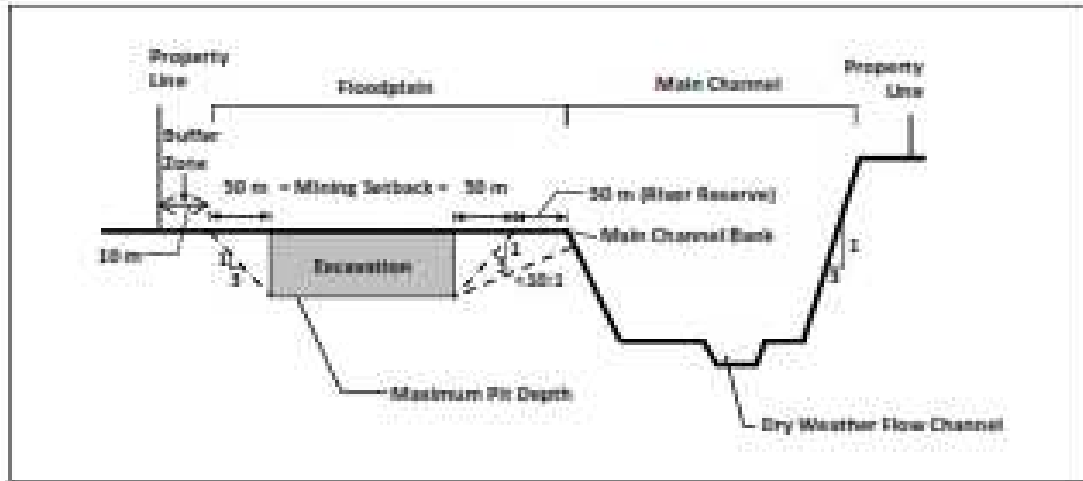


Fig. 9: Floodplain Excavation Pit Geometry for Streamlined Floodplain

Most rivers probably function in a sediment-supply limited condition although we often assume that this is not the case. Much of the material supplied to a stream is so fine (silt and clay) that provided it can be carried in suspension, almost any flow will transport it. Although there must be an upper limit to the capacity of the stream to transport such fines, it is probably never reached in natural channels and the amount moved is limited by supply. In contrast, transport of coarser material (say, coarser than fine sand) is largely capacity limited.

Modes of Sediment Transport

The sediment load of a river is transported in various ways although these distinctions are to some extent arbitrary and not always very practical in the sense that not all of the components can be separated in practice:

1. Dissolved load
2. Suspended load
3. Intermittent suspension (saltation) load
4. Wash load
5. Bed load

Sediment Transport in Rivers

The loose boundary (consisting of movable material) of an alluvial channel deforms under the action of flowing water and the deformed bed with its changing roughness (bed forms) interacts with the flow. A dynamic equilibrium state of the boundary may be expected when a steady and uniform flow has developed (Nalluri & Featherstone, 2001). The resulting movement of the bed material (sediment) in the direction of flow is called sediment transport and a critical bed shear stress (τ) must be exceeded to start the particle movement. Such a critical shear stress is referred as incipient (threshold) motion condition, below which the particles will be at rest and the flow is similar to that on a rigid boundary.

Sediment Influx Rate

Sediment influx in Ephemeral streams is generally confined to the beginning of the rainy season as velocity of the water washes down medium to fine sand and silt depending on the velocity and gradient of land. Cobbles, pebbles and boulders will be transported but only over short distance. Boulders are normally 256 mm and above are normally transported either by dragging action or by saltation.

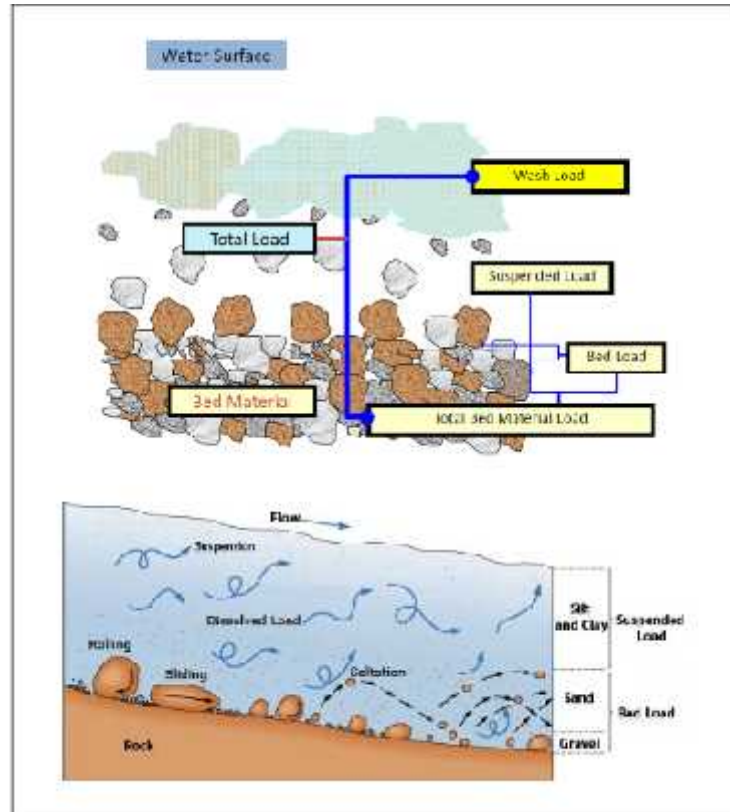


Fig.10: Sediment Transport in river

Recharge is in two forms, one general deposition of coarse, medium and fine sand when the velocity of the river water decreases below the carrying capacity. However, flash floods due to heavy rains in the upper reaches often causes rapid transportation of boulder, sand etc., along with silt which can never deposit

Recharge Rate: It is dependent upon the following 4 factors

1. Velocity of the water and change of velocity
2. Size of particles
3. Temporary increase in density of carrying media due to presence of silt load.
4. Artificial or natural barriers being encountered within the river course, where due to the sudden check in velocity, materials are deposited.

The numerical sedimentation rate varies from 50cm medium sand to as much as 3m of medium and fine sand where the slope of the river bed is less than 10^0 slope per season. For silt and clay, these only be deposited in the flood area and normally varies between 1-5m over 6 months period.

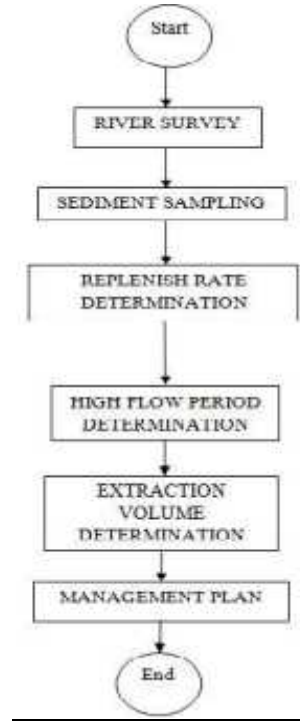


Fig11: Flow chart for volume estimation

Estimation of Sedimentation

The sedimentation rate in India is estimated using empirical formula, actual observed data and reservoir sedimentation survey. The recommended BIS (12182-1987) method has been widely used for reservoir planning. In addition the sediment data is also collected by the state governments on river systems in their respective territories. Thus there is enough data to estimate both the average annual sediment yield and also the distribution of annual sediment yields. There are also situations where the gauging stations provide nested systems of catchments. In these situations data can be used to identify the contribution to the total sediment yield from individual sub-catchments. Though this data is extremely useful and is

recommended to be fully used for estimation of sediment rate, the data need to be interpreted with care. The sediment measurements are, in general, based on bottle sample taken from near the water surface. In general, the suspended sediment concentration varies with depth, with the sediment concentration being greatest at the lower levels. This means that the measurement may under estimate the suspended sediment concentrations. The data provides an excellent resource for estimating sediment yield directly. The sediment yield depends on catchment area, the average catchment slope, the lithology of the catchment, the land use, the drainage density, the annual/seasonal precipitation and storm events etc. There are a number of empirical methods developed in USA and still used worldwide to assess sediment erosion like the Universal Soil Loss Equation (USLE), Modified Universal Soil Loss Equation (MUSLE) and Revised Universal Soil Loss Equation (RUSLE). Some work has been done in India and certain empirical relations have been developed linking annual sediment yield with some of these parameters (CWC, 2010).

Estimation of sediment yield from the catchment area above the reservoir is usually made using river sediment observation data or more commonly from the experience of sedimentation of existing reservoirs with similar characteristics. On adopting the first procedure, it is usually necessary (though often not complied within practice) to evolve proper sediment water discharge rating curve and combine it with flow duration (or stage duration curve) based on uniformly spaced daily or shorter time units in case of smaller river basins. Where observed stage/flow data is available for only shorter periods, these have to be suitably extended with the help of longer data on rainfall to eliminate, as far as possible, the sampling errors due to shortness of records. The sediment discharge rating curves may also be prepared from hydraulic considerations using sediment load formulae,

that is, modified Einstein's procedure but this has not yet become popular. It is also necessary to account for the bed load which may not have been measured. While bed load measurement is preferable when it is not possible, it is often estimated as a percentage generally ranging from 5 to 20 percent of the suspended load. However, practical means of measuring bed load of sediment needs to be undertaken particularly in cases where high bed loads are anticipated. To assess the volume of sediment that would deposit in the reservoir, it is further necessary to make estimates of average trap efficiency for the reservoir in question and the likely unit weight of sediment deposits, time averaged over the period selected. The trap efficiency would depend mainly on the capacity inflow ratio but would also vary with location of controlling outlets and reservoir operating procedures. The density of deposited sediment would vary with the composition of the deposits, the location of the deposit within the reservoir, the flocculation characteristics of clay and water and the age of the deposit. For coarse material (0.0625 mm and above), variation of density with location and age may be unimportant but for silt and clay, this may be significant. Normally, a time and space average density of these fractions, applicable for the period under study is required for finding the overall volume of deposits. For this purpose, the trapped sediment for the period under study would have to be classified in fractions by corrections in inflow estimates of the fractions by trap efficiency. Most of the sediment removed from the reservoir should be from the silt and clay fraction. In some special cases, local estimates of densities at a point in the reservoir may be required instead of average density over the reservoir. Estimates of annual sediment yield/sedimentation rate assessed from past data are further required to be suitably interpreted and wherever necessary, the unit rates which would apply to the future period are computed by analysing data for trends or by making

subjective adjustments for the likely future changes. Where the contributing drainage area is likely to be reduced by upstream future storages, only such of the projects as are under construction or which have the same priority of being taken up and completed as the project in question are considered for assessing the total sediment yield. Sediment observation data (see IS:18QO-1968*) is necessary if the yield is being assessed from hydrometric data. If observational methods are inadequate, the possibility of large errors should be considered. For drawing conclusions from reservoir re-surveys, it is important that reduction of at least 10 percent or more has been observed in the capacities of the two successive surveys; if this is not done, inaccuracies in the successive surveys will distort the estimation of the capacity reduction between the surveys. If the loss of capacity is small, useful conclusions may not be forthcoming, and in such cases, river sediment measurements with its large observational errors may still provide a better estimate. It is essential to make a proper assessment of sediment yield for reservoir under study taking relevant factors into account (BIS:12182-1987).

A proper assessment of the effects of sediment transport and of the measures that may be necessary for its control requires knowledge of the processes of sediment erosion, transportation, and deposition, and of their interaction with the hydrological processes in the catchment.

Erosion of catchments

The most significant agent for eroding sediments from land is running water. Other agents of land erosion include wind, ice, and gravity. The processes by which water degrades the soil are complicated and depend upon the rainfall properties, soil properties, land slope, vegetation, agricultural methods, and urbanization process. The last two factors account for the most important effects of man's activities on erosion. Empirical equations have been developed for the

determination of soil loss (sheet erosion) from agricultural lands. One of them, developed by Musgrave for conditions prevailing in the United States, is given as

$$E = IRS^{1.35}L^{0.35}P^{1.75}$$

Where,

E is the mean annual soil loss, in millimetres

I is the inherent erodibility of the soil, in millimetres

R is a land-cover factor

S is the land slope, in per cent

L is the length of the slope in metres, and

P is the 30-minute, two-year rainfall depth, in millimetres.

The values of the parameters I and R, are determined empirically from regional studies.

Channel erosion

Channel erosion is caused by the forces of the concentrated flow of water. Its rate depends on the hydraulic characteristics of channel flow and on the inherent erodibility of channel materials. In non-cohesive materials, the resistance to erosion is affected by the size, shape, and specific gravity of the particles and by the slope of the bed. In cohesive materials it also depends on the bonding agents. The relationships between the hydraulic variables and the parameters influencing the erodibility of channels are not fully understood and are often expressed by empirical formulae. Stream and river-control works may have a serious local influence on accelerating channel erosion if they cause an increase in channel depth, flow velocity, change the direction of the flow, or reduce the natural sediment load. The latter effect occurs frequently below dams and may persist for many kilometres downstream. Bare land and badlands may develop gullies with rates of advance that can be computed by empirical formulae containing such

parameters as the drainage area of the gully, slope of the approach channel, depth of rainfall, and clay content of the eroding soil.

Transportation of sediments in channels

Fine (suspended) sediments transported in rivers originate mainly from the topsoil of the catchment and from the banks of the channels. However, fine sediments also originate from sewage and other return flows for example such sediments comprise about one third of the suspended-sediment load in the lower Rhine river. A large portion of the transported material comes to rest on flood plains, especially upstream from hydraulic structures. The settled material undergoes compaction and other physical and chemical changes that can sometimes prevent its re-erosion by flows that would have carried it previously. A decrease is usually found in the mean annual sediment transported per unit area of the catchment as the area of the catchment increases. The concentration of suspended sediment in runoff is described by various formulae such as

$$\log cs = C \log Q + B$$

in which,

cs is the concentration expressed in weight per unit volume of water,

Q is the water discharge,

C is a dimensionless coefficient, and

B is a function of the rainfall depth of the antecedent discharge or of other meteorological and hydrological variables.

The concentration of suspended sediment varies within the channel cross-section. It is relatively high in the lower portion and may also be non-uniform laterally. So that its sampling at several points or along several verticals of the cross-section is often necessary for obtaining its mean. The mean concentration should be evaluated to yield the total sediment weight per unit time when multiplied by the

water discharge. The graph of suspended sediment against time usually has a peak that does not occur simultaneously with the peak discharge. This lag is a result of the specific conditions in a watershed, and no generalization has yet been formulated for the evaluation of this difference.

Bed-load transport

Coarse sediments (bed load) move by sliding, rolling, and bouncing along channels and are concentrated at or near the channel bed. The variables that govern transport are the size and shape of the particles and the hydraulic properties of the flow. As a consequence of the interaction between the hydraulic forces and the coarse sediment, the channel bed assumes different configurations known as plane, ripples, dunes, flat, standing waves, and antidunes. They exert resistance to the flow of water that varies within a wide range and assumes a maximum value for the dune configuration.

Sedimentation

When approaching its mouth, the flow velocity of a river decreases along with its ability to carry sediment. Coarse sediments deposit first, then interfere with the channel conveyance, and may cause additional river meanders and distributaries. The area of the flowing water expands, the depth decreases, the velocity is reduced, and eventually even fine sediments begin to deposit. As a result, deltas may be formed in the upper portion of reservoirs. The deposited material may later be moved to deeper portions of the reservoir by hydraulic processes within the water body. Sediments are deposited in accordance with their settling velocity. A significant concentration of suspended sediments may remain in the water column for several days after its arrival in a reservoir. This may interfere with the use of the stored water for certain purposes, e.g. for water supply or recreation. It should be emphasized that not all of the sediment deposits in a reservoir. A large portion

of it remains in the upper zones of the watershed, some is deposited upstream from reservoirs, and some is carried downstream by the released water. The sediment-trapping efficiency in a reservoir depends upon the hydraulic properties of the reservoir, the nature of the sediment, and the hydraulic properties of the outlet. The density of newly deposited sediment is relatively low but increases with time. The organic component in the sediment may undergo changes that may reduce its volume and enhance biochemical processes in the stored water (WMO, 1994).

Method of Mining

- a) Extracting gravel from an excavation that does not penetrate the water table and is located away from an active stream channel should cause little or no change to the natural hydrologic processes unless the stream captures the pit during periods of flooding. The exception is that changes in evapotranspiration, recharge, and runoff may create minor changes to the ground-water system, which may in turn affect stream flow.
- b) Limiting extraction of material in floodplains to an elevation above the water table generally disturbs more surface area than allowing extraction of material below the water table.
- c) In-stream extraction of gravel from below the water level of a stream generally causes more changes to the natural hydrologic processes than limiting extraction to a reference point above the water level.

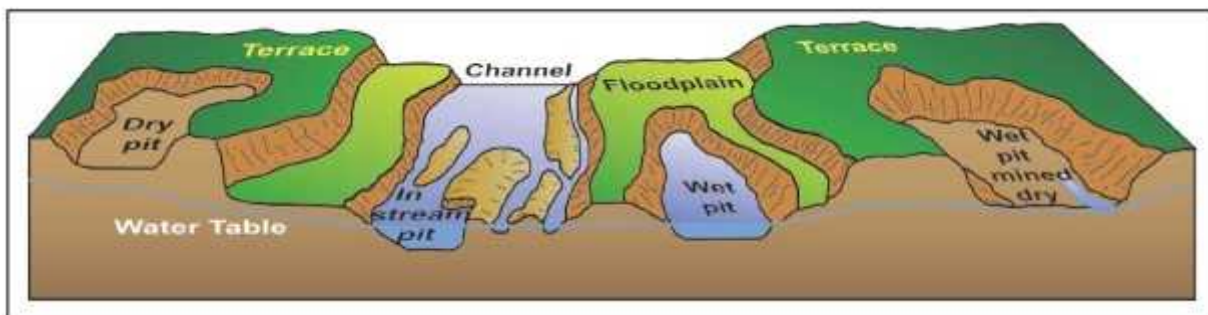


Fig 12: Aggregate extraction can take place in a number of in-stream and near-stream environments

- d)** In-stream extraction of gravel below the deepest part of the channel (the thalweg) generally causes more changes to the natural hydrologic processes than limiting extraction to a reference point above the thalweg.
- e)** Excavating sand and gravel from a small straight channel with a narrow floodplain generally will have a greater impact on the natural hydrologic processes than excavations on a braided channel with a wide floodplain.
- f)** Extracting sand and gravel from a large river or stream will generally create less impact than extracting the same amount of material from a smaller river or stream.

Annual rainfall

The climate is sub-humid and it is characterised by a hot dry summer and a bracing cold season. The average normal rainfall is 902.00 mm. About 80% of rainfall take place from June to September. During monsoon surplus water is available for deep percolation to ground water. There is a meteorological observatory at Banda, January is the coldest month with minimum temperature of the order of 5.8⁰ C. May and early June 7 from the hottest period of the year. The mean monthly maximum temperature is 47⁰C and mean monthly minimum temperature is 19.7⁰C. During March to May the air is least humid with relative humidity high in the morning and less in the evening mean. Monthly morning relative humidity is 85% and mean monthly evening relative humidity is 57%. During monsoon season the winds blow predominantly from east or southeast. (Source: Meteorological Department, Government of India, 2010.)

Table 12: Annual Rainfall of Hardoi district

YEAR	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual Total
2012	32	10.4	1.9	6.2	0.1	13.2	338	218.1	165	0	0.4	0	785.3
2013	0	78.8	2.7	1.2	0	410.8	331.1	306.6	35.9	0	2.9	1.7	1171.7
2104	84.9	33.9	48.2	0.1	0.9	54.4	104.4	157.9	82.5	0	13.2	14.2	594.6
2015	39.8	24.5	100.8	18	0.6	82.8	207.2	117.6	69.3	1.6	1.9	6.2	670.3
2016	11.1	7.9	6.3	0	30.2	71.4	583.5	452.2	56.9	0	0	0	1219.5

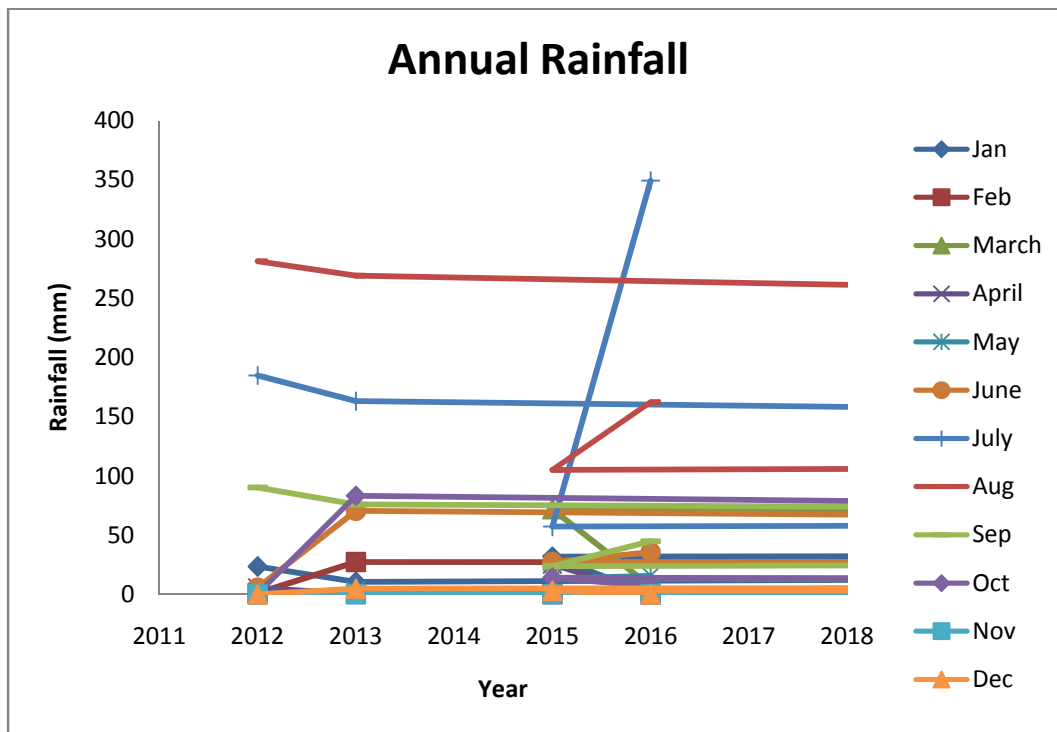


Figure 13: Annual Rainfall Pattern

Overview of mining activity in the district

Sand

Table 13 : Reserve estimation of sand on the banks of Yamuna river

Total stretch of Yamuna river area flowing through district Banda, U.P	Potential area for mining	Mineable mineral potential (MT)	Total area of Mining Lease in Banda, U.P	Average Production in last 03 years (MT)
124.70 km	2594 ha	1867.68 *# MT	241.16 ha	47.25 MT

The total area of Yamuna River. is almost 51.88Km², out of which 15-20% of water channel cannot be excavated. Area of existing / proposed mining lease area . is 241.16 ha. so the rest of the area i.e. 726.32 .ha. needs to be explored. Additional areas may be further assessed on the basis of various ecological, environmental, social and political considerations. It can be further studied as potential area for mining & revenue generation.

Table 14 : Reserve estimation of sand on the banks of Ken river

Total stretch of Ken river area flowing through district Banda, U.P	Potential area for mining	Mineable mineral potential (MT)	Total area of Mining Lease in Banda, U.P	Average Production in last 03 years (MT)
143.84 Km	5034 ha	1812.24 *# MT	1148.72 ha	126.66 MT

The total area of ken River. is almost 100.68 Km², out of which 15-20% of water channel cannot be excavated. Area of existing / proposed mining lease area . is1148.72 ha. so the rest of the area i.e. 3885.28 .ha. needs to be explored. Additional areas may be further assessed on the basis of various ecological, environmental, social and political considerations. It can be further studied as potential area for mining & revenue generation.

Table 14 : Reserve estimation of sand on the banks of Bagen river

Total stretch of Bagen river area flowing through district Banda, U.P	Potential area for mining	Mineable mineral potential (MT)	Total area of Mining Lease in Banda, U.P	Average Production in last 03 years (MT)
28 Km	60 ha	21.60*# MT	18.25 ha	91.09* MT

The total area of Bagen River. is almost 0.06 Km², out of which 15-20% of water channel cannot be excavated. Area of existing / proposed mining lease area . is 18.25 ha. so the rest of the area i.e. 41.75.ha. needs to be explored. Additional areas may be further assessed on the basis of various ecological, environmental, social and political considerations. It can be further studied as potential area for mining & revenue generation.

The volume calculated are as reserve up to 3m depth as suggested in Standard Environmental Conditions for Sand Mining in SUSTAINABLE SAND MINING MANAGEMENT GUIDELINES – 2016, issued by MoEF & CC, GOI, Delhi. The mineable volume will be finalized based on the Mine Plan and Environmental Clearance and may vary by 10% to 20% considering the concept of safety and stability of Riverbanks & site situation. And this will form the basis of Final Royalty.

**Considering the density of Sand 1.2g/cm³.*

Table 15: Detail Of Production of Sand / Bajri Or Minor Mineral In Last Three Years In District Banda

Sr No.	Year	Production Ordinary sand (in Cum)

1.	2014-2015	11,36,260
2.	2015-2016	6,69,070
3.	2016-2017	61,250

Table 16: Details Of Royalty Or Revenue Received In Last Three Years

Sr No.	Year	Royalti Received
1.	2014-2015	8,52,19,505.00
2.	2015-2016	6,86,03,604.00
3.	2016-2017	62,05,350.00

Table 17: List of Mining Quarries In The District With Location, Area And Period Of Validity

Sand

Sl.No	River	Tehsil	Village	Gata No. / Khand No.	Area (in Ha)	Minable Volume
1	Ken	Paulani	Khaptiha Kala	63/1, 62, 63/1	39.74	794800
2	Yamuna	Paulani	Sadi Madanpur	93/1ka,95/2,96/8,97,98	18.6	372000
3	Yamuna	Paulani	Sadi Madanpur	Part of 50,52/1,53,54,55,56,57,58,59,60/1/3	28.33	566600
4	Yamuna	Paulani	Sadi Madanpur	92/6,92/7,94	7.46	149200
5	Yamuna	Paulani	Sabada Khader	Part of 168	10	100000
6	Yamuna	Paulani	Sabada Khader	Part of 168	10	100000
7	Yamuna	Paulani	Sabada Khader	Part of 168	10	100000
8	Yamuna	Paulani	Sabada Khader	Part of 168	10	100000
9	Ken	Paulani	Sindhan Kala	99/3,99/22,100/7,101/5,103/10,104/2,104/5	18.21	364200

**District Survey Report-Banda
Preliminary Draft Report**

10	Ken	Paulani	Sadikhader	Part of 176,179,180, 177,Part of 147,Part of 144,Part of 141,143, 145, 145,142,122,121, Part of 114,Part of 117	46	920000
11	Ken	Paulani	Amlorkhader	176 Mi, 172Ga, 182,187	25.29	505800
12	Ken	Paulani	Amlorkhader	7,17,18,21,23,25,27,28 ,29,30,35,37,38,40,177 ,176Mi	25.29	505800
13	Ken	Naraini	Kilawal Raipur	04	20	400000
14	Ken	Naraini	Kilawal Raipur	721,722,723	20	400000
15	Ken	Naraini	Nihalpur Syuda	492/13	32	640000
16	Ken	Naraini	Risaura	116Ga	18	360000
17	Ken	Naraini	Lahureta	Part of 195/1	33	660000
18	Ken	Naraini	Lahureta	Part of 195/1,191,3	33	660000
19	Ken	Naraini	Bilharkha	Part of 5,Part of 9	25	500000
20	Ken	Naraini	Bilharkha	Part of 5,Part of 9	25	500000
21	Bagen	Atarra	Badausha	6261,6262,6478,6497, 6595,9597,6598	10	1000000
22	Bagen	Atarra	Bhadawal	1169,1858/3,1133/4,1 161/3,1949	22.94	229400
23	Yamuna	Baberu	Marka Khader	Part of 96	20	400000
24	Yamuna	Baberu	Marka Khader	Part of 96	20	400000
25	Yamuna	Baberu	Marka Khader	Part of 96	20	400000
26	Yamuna	Baberu	Marka Khader	Part of 96	20	400000
27	Bagen	Baberu	Lohara	4185Cha,4388,4463,44 70,4471,4472,4473,27 76,2709,4590	17	170000
28	Ken	Banda	Bhurendi	Part of 141,1137,1136, 1123/2,1125,1127,113 1,1132	37	740000
29	Ken	Banda	Durendi	678,680Kha,681Kha,68 2,677Ka,683Kha,676	24	480000
30	Ken	Banda	Durendi	4943,4942,4941,4939G a,4938,4937,4922Ka,4 923Ka,4925Ka,4931,49 59Ga,4958,4957,4955, 4883	40	800000
31	Ken	Banda	Durendi	4881,4880,4834,4842K ha	27	540000
32	Ken	Banda	Durendi	5029,5030Ka,5093Ka,5 094Ka,5097	20	400000
33	Yamuna	Paulani	Sadi Madanpur	50/2Ka, 50/2Kha,51 - ALLOCATED TO	42.49	849800

Stone

क्रमांक	तहसील	खदान का नाम	गाटा संख्या	उपखनिज
1.	नरैनी	बरुआस्योढ़ा	42,44	पत्थरमोरम
2.	नरैनी	बरुआस्योढ़ा	42,44	पत्थर
3.	नरैनी	गिरवां	1876	पत्थर
4.	नरैनी	गिरवां	1876	पत्थर
5.	नरैनी	गिरवां	1876	पत्थर
6.	नरैनी	गिरवां	1876	पत्थर
7.	नरैनी	खोही	367	पत्थरमोरम
8.	नरैनी	खोही	367	पत्थरमोरम
9.	नरैनी	खोही	319	पत्थरमोरम
10.	नरैनी	जरर	2451	पत्थरमोरम
11.	नरैनी	जरर	2451	पत्थर
12.	नरैनी	जरर	2450,2451	पत्थरमोरम
13.	नरैनी	गढ़ा	1229	पत्थरमोरम
14.	नरैनी	गढ़ा	1229	पत्थरमोरम
15.	नरैनी	गढ़ा	1229	पत्थरमोरम
16.	नरैनी	गढ़ा	1149	पत्थरमोरम
17.	नरैनी	बडोखरखुर्द	332	पत्थर
18.	नरैनी	बडोखरखुर्द	332	पत्थरमोरम
19.	नरैनी	गिरवां	1876	पत्थर
20.	नरैनी	पनगरा	1227	पत्थरमोरम
21.	नरैनी	पनगरा	314	पत्थरमोरम
22.	नरैनी	नहरी	587	पत्थर
23.	नरैनी	नहरी	587	पत्थर
24.	नरैनी	गौरशिवपुर	252	पत्थर
25.	नरैनी	गौरशिवपुर	255	पत्थर
26.	बांदा	दुरेडी	1730	पत्थर
27.	बांदा	दुरेडी	2363	पत्थर

28.	नरैनी	मसानी	315	पत्थरमोरम
29.	नरैनी	कुलसारी	1063	पत्थरमोरम
30.	नरैनी	पिथौराबाद	259	पत्थरमोरम
31.	नरैनी	नरैनी	72 / 2	पत्थर
32.	नरैनी	गिरवां	1876	पत्थर
33.	बांदा	मटौध	918 / 29	पत्थर
34.	बांदा	मटौध	642	पत्थर
35.	बांदा	मटौध	3851	पत्थर
36.	बांदा	मटौध	631	पत्थर
37.	नरैनी	पिथौराबाद	259	पत्थर मोरम
38.	नरैनी	पनगरा	314	पत्थर
39.	नरैनी	नहरी	634	पत्थर
40.	नरैनी	नहरी	634	पत्थर
41.	नरैनी	नहरी	309	पत्थर
42.	नरैनी	नहरी	587	पत्थर
43.	नरैनी	जरर	2450, 2451	पत्थर मोरम

Table 18: List of existing mining permit in District

Sand

Tehsil	Village/ Khadan name	Gata No.	Area (acre)	River name	Available Quantity (cum)
Banda	Hettipurwan (khand no 1)	part of 3061	10	Ken river	80,940
Banda	Hettipurwan (khand no 2)	part of 3061	9	Ken river	61,280
Pailani	Khaptiha	356	10	Ken river	80,940
Pailani	Khaptiha	455	10	Ken river	80,940
Pailani	Sindhankalan	683	10	Ken river	80,940
Atrra	Kullukheda	8117	11.04	Bagen	44,680
Atrra	Chandore	2494	11.34	Bagen	45,810
Atrra	Lamehta	1039	7.69	Bagen	31,120

Stone

क्र०सं०	तहसील	खदान का नाम	गाटासं०	रकबा(एकड़में)	उपखनिज
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1.	नरैनी	बरुआस्योढ़ा	41,42	5.00	पत्थरमोरम
2.	नरैनी	खोही	367	3.00	पत्थरमोरम
3.	नरैनी	खोही	427	2.00	पत्थर
4.	नरैनी	जरर	2450	1.50	पत्थर
5.	नरैनी	बडोखरखुर्द	332	4.00	पत्थरमोरम
6.	नरैनी	बडोखरखुर्द	332	3.75	पत्थरमोरम
7.	नरैनी	बडोखरखुर्द	332	1.00	पत्थरमोरम
8.	नरैनी	पनगरा	314	3.25	पत्थरमोरम
9.	अतर्रा	कन्दौरा	300	2.00	पत्थरमोरम
10.	बांदा	मटौध	918	5.00	पत्थर
11.	नरैनी	गिरवां	1876	5.00	पत्थर

Table 19: List of other mining permit in District

S No.	Minor Mineral	Tehsil	Village name	River name	Gata no/zone No/Khand No.	Area (Ha)
1	3	5	6	7	8	9
1	Sand/Morum	Banda	Kanvara	Ken River	part of 431, part of 337	72.84
2	Sand/Morum	Banda	achhrore	Ken River	part of 1130, 532	68.29
3	Sand/Morum	Banda	Marauli	Ken River	part of 333	60.7
4	Sand/Morum	Pailani	Sadimdanpur	Yamuna River	40, 41, 42, 43, 44, 45, 46, 47, 48, part of 49, part of 50	24.28
5	Sand/Morum	Pailani	barehta	Ken River	2/3, 3, 4, 5, 6/5, 7/4, 8/3, 10/4, 11/2, 12/3, 51, 52, 53, 54, 55, 57/2, 69/7, 82/2, 111/3, 121/3, 123, 126/2, 130/6, 131, 132	10.55
6	Sand/Morum	Banda	pathri	Ken River	part of 72, part of 73, part of 74, 75	83.08

7	Sand/Morum	Pailani	sadikhadar	Ken River	part of 89, 100, part of 101 102, part of 114, 115, part of 117, 118, 119, 120, part of 77, 73	36.43
8	Sand/Morum	Pailani	sadikhadar, Khairai	Ken River	part of 60, 60, part of 4, 2	48.15
9	Sand/Morum	Naraini	Pathra	Bagen River	450, 472//2, 473, 475, 971, 1003, 1005, 1078, 1081, 1192	10.45
10	Sand/Morum	Pailani	Madouli khadar	Ken River	58, 107, 108, 109, 110, 111, 114, 217/1, 218/1, 216/1, 44, 47/3	8.9
11	Sand/Morum	Banda	Marauli	Ken River	part of 333, 336, 337, 332	66.17
12	Sand/Morum	Pailani	khaptiha/rehuta	Ken River	64//2, 66//1, 68, 73, 78, 85, 88//1, 90, 98, 99, 377, 378, 469, 1//39, 39//28	35.56
13	Sand/Morum	Pailani	khaptiha	Ken River	part of 100, 356	48.56
14	Sand/Morum	Pailani	khaptiha	Ken River	455	16.18
15	Sand/Morum	Pailani	Padohra Khadr	Ken River	125, 126, 131, 163, 165, 166, 174, 180	16.18
16	Sand/Morum	Naraini	gaurshivpur	Ken River	2, 8//4, 40, 35, 42, 60, 43/8	19.6

DISCUSSION

Ordinary earth and Sand has become very important minerals for our society due to its many uses. Ordinary earth can be used for making brick, filling roads, whereas sand may be used as building sites, brick-making, making glass, sandpapers, reclamations, and etc. The role of sand is very vital with regards to the

protection of the coastal environment. It acts as a buffer against strong tidal waves and storm surges by reducing their impacts as they reach the shoreline. Clean sand is indeed a rare commodity on land, but common in sand dunes and beaches. The composition of sand is highly variable, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide, or SiO₂), usually in the form of quartz which because of its chemical inertness and considerable hardness, is the most common mineral resistant to weathering and it has become a very important mineral for the expansion of society. Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. River sand is one of the world's most plentiful resources (perhaps as much as 20% of the Earth's crust is sand) and has the ability to replenish itself. River sand is vital for human well being & for sustenance of rivers. Sand mining is a sensitive environmental issue which is taken into the consideration by Geology & Mining Department, Govt. of U.P. and Ministry of Environment & Forest, Climate Change. Govt. of India. Geology & Mining Department, Govt. of U.P. had notified in rule no. 41 of Uttar Pradesh Minor Mineral Concession Rules, 1963 and MoEF &CC in **Standard Environmental Condition For Sand Mining, of SSMMG, 2016** has given minimum distance from the mining lease area are compared and maximum distance permissible from the MLA is given in **Table 17**.

Table 17: Environmental Sensitivity Analysis of Site

S. No.	Feature	Max. distance	Reference
1.	School	50 m	UPMMCR,1963
2.	Hospital	50m	UPMMCR,1963
3.	Road(NH)	100 m	SSMMG,2016

4.	Road(SH)	50 m	UPMMCR,1963
5.	MDR	50 m	UPMMCR,1963
6.	Railway Station	100 m	UPMMCR,1963
7.	Chak Road	10 m	UPMMCR,1963
8.	Bridge or embankment	200 m	UPMMCR, 1963
9.	Water supply /Irrigation scheme	200 m	UPMMCR, 1963

As a resource, sand by definition is ‘a loose, incoherent mass of mineral materials and is a product of natural processes.’ These processes are the disintegration of rocks and corals under the influence of weathering and abrasion. When sand is freshly formed the particles are usually angular and sharply pointed but they grow gradually smaller and more rounded as they become constantly worn down by the wind or water (ISM Envis, Dhanbad)

The “**SUSTAINABLE SAND MINING MANAGEMENT GUIDELINES – 2016**” of MoEF&CC envisages to ensure that sand and gravel mining is done in environmentally sustainable and socially responsible manner; availability of adequate quantity of 21 aggregate in sustainable manner; improve the effectiveness of monitoring of mining and transportation of mined out minerals; conservation of the river equilibrium and its natural environment by protection and restoration of the ecological system; avoid aggradation at the downstream reach especially those with hydraulic structures such as jetties, water intakes, etc.; to ensure the rivers are protected from bank and bed erosion beyond its stable profile; no obstruction to the river flow, water transport and restoring the riparian rights and in-stream habitats; to avoid pollution of river water leading to water quality deterioration; to prevent depletion of ground water reserves due to excessive draining out of ground water;

and streamlining the process for grant of environmental clearance for sustainable mining. The MoEF&CC has also issued notifications SO No. 141(E) dated 15.01.2016 and SO No. 190(E) dated 20.01.2016 under Environment (Protection) Act, 1986 on mining of minor minerals and constitution of District Level Environment Impact Assessment Authority and District Level Environmental Appraisal Committee. These notifications have delegated the power to grant environmental clearance for sand mining to an Authority headed by the District Magistrate. These notifications promote use of satellite imagery to decide the site suitable for mining and quantity of sand which can be mined. The MoEF&CC prescribes following procedures for sand mining;

- a) Parts of the river reach that experience deposition or aggradation shall be identified first. The Lease holder/ Environmental Clearance holder may be allowed to extract the sand and gravel deposit in these locations to manage aggradation problem.
- b) The distance between sites for sand and gravel mining shall depend on the replenishment rate of the river. Sediment rating curve for the potential sites shall be developed and checked against the extracted volumes of sand and gravel.
- c) Sand and gravel may be extracted across the entire active channel during the dry season.
- d) Abandoned stream channels on terrace and inactive floodplains be preferred rather than active channels and their deltas and flood plains. Stream should not be diverted to form inactive channel.
- e) Layers of sand and gravel which could be removed from the river bed shall depend on the width of the river and replenishment rate of the river.
- f) Sand and gravel shall not be allowed to be extracted where erosion may occur, such as at the concave bank.

- g) Segments of braided river system should be used preferably falling within the lateral migration area of the river regime that enhances the feasibility of sediment replenishment.
- h) Sand and gravel shall not be extracted within 200 to 500 meter from any crucial hydraulic structure such as pumping station, water intakes, and bridges. The exact distance should be ascertained by the local authorities based on local situation. The cross-section survey should cover a minimum distance of 1.0 km upstream and 1.0 km downstream of the potential reach for extraction. The sediment sampling should include the bed material and bed material load before, during and after extraction period. Develop a sediment rating curve at the upstream end of the potential reach using the surveyed cross- section. Using the historical or gauged flow rating curve, determine the suitable period of high flow that can replenish the extracted volume. Calculate the extraction volume based on the sediment rating curve and high flow period after determining the allowable mining depth.
- i) Sand and gravel could be extracted from the downstream of the sand bar at river bends. Retaining the upstream one to two thirds of the bar and riparian vegetation is accepted as a method to promote channel stability.
- j) Flood discharge capacity of the river could be maintained in areas where there are significant flood hazard to existing structures or infrastructure. Sand and gravel mining may be allowed to maintain the natural flow capacity based on surveyed cross- section history.
- k) Alternatively, off-channel or floodplain extraction is recommended to allow rivers to replenish the quantity taken out during mining.
- l) The Piedmont Zone (Bhabhar area) particularly in the Himalayan foothills, where riverbed material is mined, this sandy-gravelly track constitutes excellent

conduits and holds the greater potential for ground water recharge. Mining in such areas should be preferred in locations selected away from the channel bank stretches.

m) Mining depth should be restricted to 3 meter and distance from the bank should be 3 meter or 10 percent of the river width whichever less.

n) The borrow area should preferably be located on the river side of the proposed embankment, because they get silted up in course of time. For low embankment less than 6 m in height, borrow area should not be selected within 25 m from the toe/heel of the embankment. In case of higher embankment the distance should not be less than 50 m. In order to obviate development of flow parallel to embankment, cross bars of width eight times the depth of borrow pits spaced 50 to 60 meters centre-to centre should be left in the borrow pits.

o) Demarcation of mining area with pillars and geo-referencing should be done prior to start of mining.

The above notifications and Guidelines, being notified under the provisions of the Environment (Protection) Act, 1986, have acquired the status of statutory provisions and have to be followed.

GSI Guidelines-Geological Survey of India (GSI) has collated/ formulated considered geo-scientific opinions to address issues pertaining to riverbed gravel/sand mining. Besides resource extraction, ultimate objectives of riverbed mining should be:-

- (i) protection and restoration of the ecological system,
- (ii) to prevent damages to the river regime,

- (iii) to work out the sediment influx/ replenishment capacity of the river, to restore the riverine configuration (landforms and fluvial geomorphology, such as bank erosion, change of river course gradient, flow regime, etc.),
- (iv) to prevent contamination of ground water regime,
- (v) to prevent depletion of ground water reserves due to excessive draining out of groundwater, and
- (vi) to restore the riparian rights and in-stream habitats.

GSI has identified major hazards caused due to mining of sand/gravel as under:

- a) *Instream habitat*: The impact of mining may result in increase in river gradient, suspended load, sediment transport, sediment deposition, turbidity, change in temperature, etc. Excessive sediment deposition for replenishment/ refilling of the pits affect turbidity, prevent the penetration of the light required for photosynthesis of micro and macro flora which in turn reduces food availability for aquatic fauna. Increase in river gradient may cause excessive erosion causing adverse effect on the instream habitats. B
- b) *Riparian habitat*: This includes vegetative cover on and adjacent to the river banks, which controls erosion, provide nutrient inputs into the stream and prevents intrusion of pollutant in the stream through runoff. Bank erosion and change of morphology of the river can destroy the riparian vegetative cover.
- c) *Degradation of Land*: Mining pits are responsible for river channel shifting as well as degradation of land, causing loss of properties and degradation of landscape.
- d) *Lowering of groundwater table in the floodplain area*: Mining may cause lowering of riverbed level as well as river water level resulting in lowering of groundwater table due to excessive extraction and draining out of

groundwater from the adjacent areas. This may cause shortage of water for the vegetation and human settlements in the vicinity.

- e) Depletion of groundwater: excessive pumping out of groundwater during sand mining especially in abandoned channels generally result in depletion of groundwater resources causing severe scarcity and affecting irrigation and potable water availability. In extreme cases it may also result in creation of ground fissures and land subsidence in adjacent areas.
- f) Polluting groundwater: In case the river is recharging the groundwater, excessive mining will reduce the thickness of the natural filter materials (sediments), infiltration through which the ground water is recharged. The pollutants due to mining, such as washing of mining materials, wastes disposal, diesel and vehicular oil lubricants and other human activities may pollute the ground water.
- g) Choking of filter materials for ingress of ground water from river: Dumping of waste material, compaction of filter zone due to movement heavy machineries and vehicles for mining purposes may reduce the permeability and porosity of the filter material through which the groundwater is recharging, thus resulting in steady decrease of ground water resources.

The GSI has suggested that riverbed mining may be allowed considering minimization of the above mentioned deleterious impacts. The guidelines of National Water Policy of India should also be followed which states that watershed management through extensive soil conservation, catchment area treatment, preservation of forest, increasing of forest cover and construction of check dams should be promoted. Efforts shall be made to conserve the water in the catchments.

Following geo-scientific considerations have been suggested to be taken into account for sand/ gravel mining:-

1. Abandoned stream channels on terrace and inactive floodplains may be preferred rather than active channels and their deltas and floodplains. Replenishment of ground water has to be ensured if excessive pumping out of water is required during mining.
2. Stream should not be diverted to form inactive channel.
3. Mining below subterranean water level should be avoided as a safeguard against environmental contamination and over exploitation of resources
4. Large rivers and streams whose periodic sediment replenishment capacity are larger, may be preferred than smaller rivers.
5. Segments of braided river system should be used preferably falling within the lateral migration area of the river regime that enhances the feasibility of sediment replenishment.
6. Mining at the concave side of the river channel should be avoided to prevent bank erosion. Similarly meandering segment of a river should be selected for mining in such a way as to avoid natural eroding banks and to promote mining on naturally building (aggrading) meander components.
7. Scraping of sediment bars above the water flow level in the lean period may be preferred for sustainable mining.
8. It is to be noted that the environmental issues related to mining of minerals including riverbed sand mining should clearly state the size of mine leasehold area, mine lease period, mine plan and mine closure plan, along with mine reclamation and rehabilitation strategies, depth of mining and period of mining operations, particularly in case of river bed mining.

9. The Piedmont Zone (Bhabbar area) particularly in the Himalayan foothills, where riverbed material is mined. This sandy- gravelly track constitutes excellent conduits and holds the greater potential for ground water recharge. Mining in such areas should be preferred in locations selected away from the channel bank stretches. Areas where channel banks are not well defined, particularly in the braided river system, midstream areas should be selected for mining of riverbed materials for minimizing adverse effects on flow regime and instream habitat.

10. Mining of gravelly sand from the riverbed should be restricted to a maximum depth of 3m from the surface. For surface mining operations beyond this depth of 3m (10 feet), it is imperative to adopt quarrying in a systematic bench- like disposition, which is generally not feasible in riverbed mining. Hence, for safety and sustainability restriction of mining of riverbed material to maximum depth of 3m.is recommended.

11. Mining of riverbed material should also take cognizance of the location of the active channel bank. It should be located sufficiently away, preferably more than 3m away (inwards), from such river banks to minimize effects on river bank erosion and avoid consequent channel migration.

12. Continued riverbed material mining in a given segment of the river will induce seasonal scouring and intensify the erosion activity within the channel. This will have an adverse effect not only within the mining area but also both in upstream and downstream of the river course. Hazardous effects of such scouring and enhanced erosion due to riverbed mining should be evaluated periodically and avoided for sustainable mining activities.

13. Mineral processing in case of riverbed mining of the sandy gravelly material may consist of simple washing to remove clay and silty area. It may involve

crushing, grinding and separation of valueless rock fragments from the desirable material. The volume of such waste material may range from 10 to 90%. Therefore, such huge quantities of mine wastes should be dumped into artificially created/ mined - out pits. Where such tailings / waste materials are very fine grained, they may act as a source of dust when dry. Therefore, such disposal of wastes should be properly stabilized and vegetated to prevent their erosion by winds.

14. Identification of river stretches and their demarcation for mining must be completed prior to mining for sustainable development.

15. The mined out pits should be backfilled where warranted and area should be suitably landscaped to prevent environmental degradation.

16. Mining generally has a huge impact on the irrigation and drinking water resources. These attributes should be clearly evaluated for short-term as well as long-term remediation (MoWR,2017)

SUMMARY

Table 20: Present Status of Mining

Potential area for Mining	Sand		
	Yamuna River	Ken River	Bagey River
Mineable mineral Potential (MT)	47.25 MT	126.66 MT	18.25 MT
Total existing / proposed area for Mining	241.16 ha	1148.72 ha	91.09 ha

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