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Scope and Impact of River Sand Mining in Ajmer, Rajasthan

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Abstract: Sand has become a very important mineral for society due to its many uses mainly in infrastructural activities. Sand and gravel have long been used as aggregate for construction of roads and buildings. Today, the demand for these materials continues to rise. In India, the main source of sand is from river flood plain sand mining, in-stream mining, coastal sand mining, paleo channel sand mining, and sand mining from agricultural fields. As one of the driest states in India, Rajasthan's entire river surface constitutes very less percentage of the total surface water resources in India. This paper discussed about the scope and impact of river sand mining in Ajmer, Rajasthan. The rivers in the district are monsoon fed rivers. These rivers flow more rigorously in rainy season and carries sufficient load of sediments which are produced due to erosion of the country rocks in the catchment. The running water transport and deposit sediments in river beds. Sand mining has many positive impacts on the economy and on the quality of life of people. However, if extracted in excess amount beyond the replenishment rate, it has an adverse and destructive impact, on the river system. Total Mining areas cover about 31.94 sq km area in Ajmer district which is 0.38 % of the entire area of the district. Maximum concentration of the Built-up mining areas, in south western part of the district.

I. INTRODUCTION

Sand Mining is a process of the actual removal of sand from the foreshore including rivers, streams and lakes. Sand is mined from beaches and inland dunes and dredged from river bed. The sand is dug up, the valuable minerals are separated in water by using their different density, and the remaining ordinary sand is re-deposited. River sand is vital for human well-being and for sustenance of rivers. River sand is one of the world's most plentiful resources and has the ability to replenish itself. 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[1, 2].

River sand mining is a common practice as habitation concentrates along the rivers and the mining locations are preferred near the markets or along the transportation route, for reducing the transportation cost. River sand mining can damage private and public properties as well as aquatic habitats. Excessive removal of sand may significantly distort the natural equilibrium of a stream channel[3, 4]. 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[5]. Sand is also a habitat for crustacean species and other related marine organisms[6, 7].

II. RAJASTHAN: RIVER SYSTEMS AND SAND EXCAVATION

As one of the driest states in India, Rajasthan's entire river surface constitutes merely 1% of the total surface water resources in India. These are entirely rain-fed, divided into 14 basins covering 59 sub-basins. The Aravalli constitutes the main watershed, its drainage divided between the Arabian Sea and Bay of Bengal. The state has 7 major reservoirs and 41 rivers, most of which are seasonal. Only the Chambal and Mahi river basins are perennial. The rivers are classified into three main types based on their drainage pattern:

1. Drainage into the Arabian Sea: Luni, Sabarmati, Mahi
2. Drainage into Bay of Bengal: Banas, Chambal, Banaganga
3. Inland drainage: Sota-Sabi (Sahibi), Kantli, Ruparel

The Luni river system rises from the western slopes of the Aravalli range (near Ajmer), while Banas and other streams rise from the eastern slopes of this range and join the Chambal. The main river courses like Sabarmati, Banas, etc. and

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tributaries of the Luni run more or less parallel to Aravalli range Jaisamand Lake is a water structure situated on Udaipur-Banswara road, around 52 kms from Udaipur town in Rajasthan. It was the largest artificial lake of the country for quite some time. The purpose of construction of this lake was to provide facilities for regeneration and preservation of wildlife. The catchment area of 180,974 comprises of 6% irrigated and 16% un-irrigated land, 16% forests 25% culturable wasteland and 37% not available for cultivation. Jaisamand catchment area can be sub divided into 2 main basins, (1) Gomti river basin, (2) Jhamri river basin – (Sub Basin-I: Makradi Nadi and Sub Basin-II: Ruparel Nadi). Jhamri River basin covers about 40% of Jaisamand catchment area. The remaining area is covered by Gomti river basin. The catchment area comprises of parts of Girwa, Salumber, Sarada, Dhariyavad and Vallabhnagar Tehsil of Udaipur district. (Purohit, undated) Jaisamand River in Udaipur has 9 rivers and 99 nalas in its catchment area draining into the Jaisamand Lake.

This is part of the Mewal region. Other rivers where large scale sand excavations have been carried out are,

1) Udaipur: Khadka River,

2) Bhilwara: Banas River, Manik River, located on the right bank of the Banas River about 50 kms northeast of Udaipur and 5 kms from Nathdwara,

3) Pali district: Luni River.

III. TOPOGRAPHY, SLOPE, RIVER SYSTEM AND BUILD UP AREA IN AJMER

Ajmer district is situated almost in the central portion of Rajasthan and a part of Aravalli hill range passes for about 175 km. strike length with 25- 30 km. width, occupies the western part of the district with general NE-SW disposition trend, which forms the high steep hills and valleys. The highest point of the Aravalli range in Ajmer district reached is 869 mt. above the sea level and is the dividing point of the watershed of subcontinent of India between Arabian Sea & Bay of Bengal. Other high peaks are Taragarh (865 mt) near Tadgarh. These peaks are occupied by quartzites in general and soft rocks such as biotite schist and gneisses occupy slopes and valleys. A transverse gap at places in the Aravalli range provides communication ways, for transport and water drainage[8]. The intensity of gaps decreases towards South West.

To the South East of Ajmer's Aravalli range, lies the plain occupied by Pre- Aravalli gneisses. Huge exposures are seen as small mounds where it is resistant due to the intrusions of granites and pegmatites. The plain slopes gently towards East. To the East in the higher and more hugged portion, alluvium is scanty but as one moves further East, the plains becomes more continuous and much of the area of Kishangarh, Nasirabad , Kekri, etc, is covered by alluvium, which has practically meagre topographic dissimilarities except a few hillocks of quartzites and mounds occupied by granites, epidiorites and gneisses. Similarly, on the western side of the hill range, around Pisangan and Govindgarh, topography is more or less plain with some low mounds, occupied by granite and gneisses, in general. A brief description of the rivers flowing in Ajmer District is given below:

Sagarmati River: This River originates on the southwestern slope of the Sulta Dungar hill east of Ajmer at an elevation of 2000‟ in the Alwar quartzites. It has a total, length of 24 miles and a gradient of 29.5 feet/Mile. It has a sinuosity index (the ratio between the straight line length and the curved length or the river) of 1.1 and so its channel can be described as straight.

Saraswati River: The Saraswati river originates at an elevation of 2657' 3 km east of Basan village on the western slopes of a ridge. It has a total length of 23 miles before joining the Luni River. It has a sinuosity index of 1.1 and a gradient of 43.5 feet/mile. Its channel shows two prominent meanders near its confluence with the Luni River.

Dai River: The Dai river originates in the south eastern slope of the Aravalli Range, Near Nasirabad tehsil of Ajmer District. Its catchment area is 3015 km2. It flows southeast for about 40 km and east for about 56 km in Ajmer district before joining the Banas River near bilaspur village in Tonk District.

Khari River: Khari is a tributary of the Banas River which originates in the hills near Deogarh in Rajsamand district. Its total catchment area is 6268 sq km. It flows northeast for about 192 km through Udaipur, Bhilwara and Ajmer Districts befor joining the Banas River near Chosala village in Ajmer District. The Khari has sandy bed and is dry for the major part of the year.

Rupangarh River: Rupangarh River originating near Ajmer city has northeasterly flow and join the Sambhar salt lake from south after draining about 625 sq. Jan hilly areas of Ajmer District.

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Lakes: There are a number of lakes and ponds in the district, a brief description of which is given below:

Ana Sagar -The Ana Sagar to the northwest of Ajmer city is the biggest. This is oval in outline. It is surrounded by the Mahabir forest hills in the north, the Madar hills in the east, the Taragarh ridge in the south and the Nag Pahar in the west. The Erinpura granite to forms its floor and it receives a number of nalas from all directions of which the Benri nala flowing from the southwest is the longest. It appears to have been constructed by Ana, grandson of Bisal Deo Chauhan. It has been silted up in the west.

Foy Sagar – The Banri nala has been dammed up in the middle of its course to give rise to a lake which has been called Foy Sagar. It appears to have been constructed by Mr. Foy engineer in 1891-92 on whose name it has been called. It lies in the Banri Valley between the Nag Pahar and the Taragarh ridges and has been silted up on the western side.

Pushkar Lake – The Pushkar lake is an important pilgrimage centre in Rajasthan and lies to the south of the township surrounded by the Dungri Pahar in the north, the Gurumba Pahar in the northwest, the Nag Pahar in the east and southeast, the Parvata Pahar in the south and the Savitri Pahar in the southwest. There are sand hills and dunes in the west and north. It also receives a few streams of which the Gori nala flowing from the south is important. It is floored by alluvium.

The rivers in the district are monsoon fed rivers. These rivers flow more rigorously in rainy season and carries sufficient load of sediments which are produced due to erosion of the country rocks in the catchment. The running water transport and deposit sediments in river beds. The quantum of deposition of sediments varies from stream to stream, depending upon numbers of factors such as rainfall in catchment area, lithology of catchment, discharge velocity, river profile and geomorphology of the river course. Sand replenishment in monsoon fed river is governed with a dynamic process which depends mainly on monsoon rains [9, 10] and other factors mentioned above, therefore area specific long term study need to be carried out for reaching average figures of quantity of sand/bajri replenishment in the rivers of the district[11]. Exact figures of replenishment will be calculated by project proponent at the time of preparing mining plan and getting EC. Tentative mineral potential of sand in important rivers of the district is estimated with the help of Survey of India Toposheets and through local information[12]. The mineral resources have been calculated considering average depth up to 1.5 meter and the Bulk Density of river bed material to be 1.6.
54

Other Lakes and Tanka- There are other small lakes and tanks in the district, some with water and some others dried up. The Navatal north of Srinagar, the Phul Sagar to the north of Bir village (26°23‟ & 74° 44‟), the Bhawani khara tank southwest of Sardarpura (26° 18‟30”& 74° 39‟), the Jangi Talab west of Makrera (26°18‟30” & 74° 34‟50”), the Bindhia Tal east of Chorasiawas (26° 29‟45” & 74°‟37”) and the Phul Sagar northwest of Kayar deserves to be mentioned. There are also same small rivers and nallas like Nahar, Masi, which is not taken in consideration while calculative the minerals potential.

Built-up land is an area of human habitation developed due to non-agricultural use and that has a cover of buildings, transport and communication, utilities in association with water, vegetation and vacant lands. In Ajmer district, total Built-up land is spread in an area of about 206.27 sq km which is 2.43 % of the entire 8481 sq km area of the district. Built-up land of the Ajmer district can be categorized into 3 classes viz., Urban, Rural and Mining.

a) Urban: Urban areas are non-linear built up areas covered by impervious structures adjacent to or connected by streets. This cover is related to centers of population. This class usually occurs in combination with, vegetated areas that are connected to buildings that show a regular pattern, such as vegetated areas, gardens etc. and industrial and/or other areas. It includes residential areas, mixed built-up, recreational places, public / semi-public utilities, communications, public utilizes/facility, commercial areas, reclaimed areas, vegetated areas, transportation, industrial areas and their dumps, and ash/cooling ponds. In Ajmer district, total Urban areas cover about 103.68 sq km which is 1.22 % of the entire area of the district.

b) Rural: These are the lands used for human settlement of size comparatively less than the urban settlements of which the majority of population is involved in the primary activity of agriculture. These are the built-up areas, smaller in size, mainly associated with agriculture and allied sectors and non-commercial activities. They can be seen in clusters non-contiguous or scattered. In Ajmer district, Rural areas cover about 70.65 sq km which is 0.83 % of the entire area of the district.

c) Mining: Mining areas encompass area under surface mining operations. The recognizable impacts of these activities on the landscape are unmistakable giant pit mines covering vast areas. The presence of water bodies does not necessarily imply inactive or unused extractive areas; ponds or lakes are often an integral part of an extractive operation. It includes

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surface rocks and stone quarries, sand and gravel pits, brick kilns, etc. These are areas of stockpile of storage dump of industrial raw material or slag/effluents or waste material or quarried/mixed debris from earth's surface. Total Mining areas cover about 31.94 sq km area in Ajmer district which is 0.38 % of the entire area of the district. Maximum concentration of the Built-up mining areas, in south western part of the district.

IV. IMPACT OF SAND MINING

1. **Impact of river sand mining on fresh water ecosystem:** Sediments play a decisive role in the development and quality of the riverine environment, and sediment dynamics determine river morphology and habitat-forming processes. The ecological impacts of sand mining on rivers may be direct where aggregate removal is directly responsible for ecosystem damage, habitat loss and other physical changes to the ecosystem, or indirect where aggregate removal can alter channel morphology which in turn can alter the distribution of habitats and ecosystem functioning, deterioration of water quality, and hydraulic changes affecting movement of fish and habitat availability.

2. **Abiotic impact to river systems:** Abiotic impacts to river systems include changes in channel morphology and larger scale river features, altered composition and movement of sediment leading to the redistribution of river habitats.

3. **Impact on invertebrates:** Increased turbidity and suspended sediment concentrations lead to decreased invertebrate populations either through direct removal during mining activities, or habitat loss and disruption through the filling of interstitial spaces of the bed substrate.

4. **Impact on fish and other aquatic life:**
5. **Impact on riverine vegetation:** The impacts include fragmentation of riparian forest and other riparian vegetation types due to the creation of accessible roads and storage sites, decrease in cover of aquatic plant communities due to increase scouring, decreased light penetration.

6. **River bed sand mining and groundwater:** River and aquifers bear a complex but significant relationship, both in the context of development paradigms and from the perspective of ecosystem and the environment. A river channel can be considered as a locus of the lowest points in an area, implying that it is connected to aquifers upstream and downstream. Complex exchanges of ground water with the river-flow are bound to occur, depending upon the morphology of the river, the aquifer boundaries and the hydrological conditions in the river and the interconnected aquifers. These exchanges are variable in space and time. However, a strip of sand deposition in a river channel plays an important role in this exchange[13, 14].

7. **Impact on lives and livelihoods:** Sand mining has adverse impacts on the lives and livelihoods of the people, especially those staying in close proximity to the river banks. One of the common problems faced due to sand extraction is river bank erosion. During heavy rains, water enters into the fields and other areas, destroying the crops. It also pollutes the local drinking water resources. Sand erosion has an indirect impact on the availability of water. Sand extraction leads to reduction in the ground water tables. Ground water which was easily available within few meters depth, people have now started digging deep bore wells to assess water. Due to shortage of drinking water, some villages have to start depending on drinking water from November-January itself. Reduction in groundwater has also reduced the area under cultivation, and therefore food and fodder availability. Fishing communities are also the most affected. Many fisher folk have reported loss of local species. Sand mining has also impacted the river bank farming.

V. CONCLUSION

Sand mining has many positive impacts on the economy and on the quality of life of people. However, if extracted in excess amount beyond the replenishment rate, it has an adverse and destructive impact, on the river system, making it unsustainable. Sand deposition eventually leads to reduction in conveyance capacity of river leading to flood in rivers. Proper dredging of sand keeps the bed at the desired level[15, 16]. Thus if dredging is not done, due to continuous deposition of sand, the depth of river may get reduced. This will result in flooding of water and loss of properties. It also facilitates the navigation in the channel. Sand is the main fine aggregate in concrete. Riverbeds are major sources of clean sand. There is a change in traditional housing of people in India and sand has become one of the essential material for construction. The off-site impacts are, primarily, transport related, whereas, the on-site impacts are generally channel related. The on-site impacts are classified into excavation impacts and water supply impacts. The impacts associated with excavation are channel bed lowering, migration of excavated pits and undermining of structures, bank collapse, caving, bank erosion and valley widening and channel instability. The impacts on water supply are reduced ground water recharge to local aquifers, reduction in storage of water for people and livestock especially during drought periods.

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Many reports show that depletion of sand in the streambed and along coastal areas causes the deepening of rivers and estuaries, and the enlargement of river mouths and coastal inlets. It may also lead to saline-water intrusion from the nearby sea. Thus in-stream sand mining results in the destruction of aquatic and riparian habitat through large changes in the channel morphology. Impacts include bed degradation, bed coarsening, lowered water tables near the streambed, and channel instability. It is well understood that mining changes the physical characteristics of the river basin, disturbs the closely linked flora and fauna, and alters the local hydrology, soil structure as well as the socio-economic condition of the basin. In general, it was reported that in-stream mining resulted in channel degradation and erosion, head cutting, increased turbidity, stream bank erosion *etc.* All these changes adversely affect fish and other aquatic organisms either directly by damage to organisms or through habitat degradation or indirectly through disruption of food web.

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