INDIA RIVER WEEK 2020

Is Sand Mining Killing Our Rivers?

Extracting River Bed Materials

Draft East Zone Report Ver. 01

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Extracting River Bed Materials in the East Zone

After water, sand is the most consumed natural resource in the world, with uses ranging from road and building construction to toothpastes.[1] It is ironic therefore that the Government of India (GoI) has classified sand as a 'minor mineral'. That unfortunate label – perhaps because at one time the supply was assumed to be unlimited – has led to a colossal under valuation of this important resource and poor governance.

The poor governance is first reflected in the lack of official data – reliable or unreliable – of how much sand is extracted or used in each state of India. But the unofficial estimates are astounding. A recent WWF report estimated that in 2010 India consumed about 1.5 billion tons (BT) of sand, up from about 0.8 BT at the end of the 20th century (Koehnken & Rintoul, 2018). Assuming the same growth rate, in 2020 India may be consuming about 2.5 BT.

How Much is 2.5 BT of Sand?

That, 2.5 BT/per annum is a staggering amount. The Ganga-Brahmaputra river system deposits only ~ 0.73 BT of sediments every year in the Bay of Bengal (Singh M. et al, 2007). A back-of-a-bus ticket calculation shows that ~ 200 to 300 million trucks are probably required every year to transport this load. Discounting rainy days, it means that several lakh trucks are transporting sand every day in India! Assuming that a few thousand sand mining sites are active daily in India, it is not surprising then that one can see hundreds of trucks lined up every day at such locations. In 2016, according to Upendra Kumar Dhruv, then assistant commissioner of the Siliguri custom division, 350 to 400 trucks filled with boulders were crossing over to Bangladesh every day through the Chengrabanda and Fulbari borders.

Fig. 1: Trucks lined up along the Sone river to pick up sediments

[1] https://www.mining-technology.com/features/six-things-sand-mining/

The consequences of this woeful neglect are lethal. It has led to a boom in illegal extraction of river bed materials with 'sand mafias' ruling the roost at the more lucrative locations. Deaths, killings and violent clashes have followed. Crime has spread beyond the river beds.[2] The resulting geomorphological, ecological, and social impacts are enormous.

This report reviews the extraction of sediments and their impacts in the East Zone of India comprising of Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, Meghalaya, Assam, Sikkim, Bihar, Jharkhand, Chhattisgarh, Odisha, and West Bengal. The EZ region is vast not only in the number of states, the size of the region, but also in terms of its river systems. Compared to the North, West and South Zones, the EZ has nearly one to a few orders of magnitude greater availability of river water and sediment flows (Jain & Sinha 2003). The region mainly includes the lower Ganga, mid-Brahmaputra, upper Meghna, Subarnarekha, Mahanadi, and Indravati river basins (See Fig. 2). Many EZ rivers contribute to the Ganga-Brahmaputra-Meghna delta, the world's second largest sediment sink to the ocean, after the Amazon basin (Chakrapani 2005, Mouyen et al. 2018). The Mahanadi river basin is also an important contributor to sediment flows into the Bay of Bengal, although its sediment flux has declined over the last two decades (Panda et al. 2011). The Indravati, a tributary of the Godavari River is thus hydrologically, a component of the South Zone river basins.

The EZ is also high-priority in terms of the conservation of endangered freshwater biodiversity, as it supports significant populations of endangered Ganges River Dolphins, freshwater turtles, birds, fishes, crocodilians, otters, and the world's largest mangrove forests, the Sundarbans. Of the nearly 34 crore people living in the EZ, a large majority is dependent on capture fisheries besides agriculture. Due to the relatively greater availability of water and sediment, EZ rivers have already been exploited considerably for irrigation, inland navigation, riparian infrastructure (embankments ports, etc.), urban & industrial water supply, and hydropower. These rivers are also included in ambitious and potentially destructive mega-project plans such as the Inter-

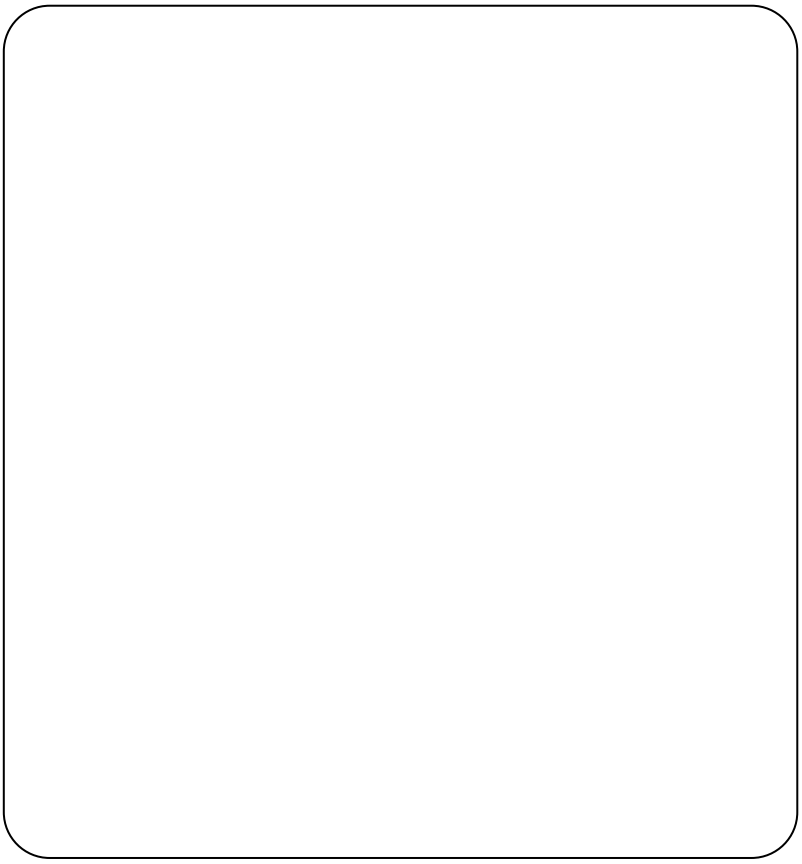

Fig. 2 : Rivers of the East Zone
Based on www.maps of India.com

[2] Rivers of course are not the only sources of sand as explained later.

Linking of Rivers (ILR), and the industrial development of inland waterways transport (IWT) by the Government of India. The issues of sand and sediment mining, and dredging, need to be located in this larger context.

This report is divided into two parts:

(A) An overview of the relevant issues in the East Zone, and

(B) A state-wise review of the issues

Part A: OVERVIEW

A.1 Definitions

What is sand? What is loosely called 'sand mining' actually refers to the extraction of river bed materials (RBM) or sediments. These include clay, silt, sand, pebbles, cobbles and boulders. These different sediment types are classified according to size (See Table1).

Table 1: Sediment Types According To Size

S.No.	Sediment Name	Size Range in mm	Loose Sediment Type	Cohesion
Fine-Grained				
1.	Clay	<1/256 mm or <0.004	Clay	Cohesive
2.	Silt	1/256 - 1/16 mm or 0.062-0.004	Silt	Cohesive
Course-Grained				
3.	Sand	Fine: 0.125- 0.062 Medium: 0.500-0.125 Coarse: 1.0-0.500 Very coarse: 2.0-1.0	Sand 1/16 mm to 2 mm	Non-cohesive
4.	Pebble	64-2 mm	Gravel	Non-cohesive
5.	Cobble	256 -64 mm	Gravel	Non-cohesive
6.	Boulder	>256 mm	Gravel	Non-cohesive

Source: https://www.tulane.edu/~sanelSon/eens1110/sedrx.htm

Uses of Sand: Beside construction purposes, sand is also widely used or the manufacture of glass and electronic devices, particularly chips for microelectronic devices. Massive amounts of sand are used for land reclamation, shale gas extraction and beach renourishment programmes (Torres A. et al 2017). Different grain sizes of river bed materials have different demands in the construction industry. Coarser and gravelly sands are more preferred in masonry and concrete work, whereas finer sand is used for plastering. Different river sands thus have different levels of demand, and river-specific sand mining impacts need to be evaluated accordingly.

Sources of Sand: There are several sources of natural and artificial sand. The natural sources include river beds, lake beds, flood plains and terrace deposits, paleo-channels, coastal/marine sand, aeolian (wind-blown) deposits on dunes and coal mines. More recently, artificial sand has been manufactured by crushing rocks, rubble, slag and mines refuse, pulverised concrete and construction debris. River bed sand is generally used for building construction. The medium grade is used for making concrete and fine sand is used for plastering.

Sediment mining, sand mining, and dredging: Mining involves the systematic extraction of sand or other sediment for their use. Sediments mining or loosely sand mining (hitherto SM), refers to extraction of any RBM from the active channel, flood plain and banks or terraces. Padmalal & Maya (2014) classify sand mining as 1) **in-stream mining** in the river bottom of the active channel, 2) **floodplain mining**: along river banks and islands influenced by the active channel, and 3) **terrace mining**: along older river banks with sediment deposits, often with agriculture or vegetation, that are not directly affected by river flows. In general, the impacts of in-stream and floodplain SM-DR operations are likely to be ecologically more severe and damaging as compared to terrace mining.

We also need to differentiate dredging from mining or extraction. Dredging involves dislodging but not the complete removal of sediment from rivers. The dislodged sediment is generally blown downstream in the river itself. Dredging is used for removal of debris, for training works, or to modify river channels for flood control, channelization and maintenance of navigable river channels for vessels traffic on waterways. Dredging results in 1) excessive and sudden fluxes of fine suspended sediment in the water column, 2) generation of noise, and 3) physical modifications of river bottom habitats (Reine et al. 2014, Wilber et al. 2015, Fisher et al. 2018). Dredging operations are carried out with large suction dredgers that use pneumatic pipes and drills to remove sediment from river bottoms.

Fig. 3: Dredging in river Ganga near Bhagalpur (Hindustan Times photo)

There are different methods of SM-DR. Pit mining includes dry and wet mining. Wet pit mining is conducted in river channels by digging in the riverbed. Water quality is generally found to be poorer around pit mining sites than non-mined sites. Mining from river sand bars includes excavation and 'skimming' or 'scalping' from sand bars and other fresh sediment deposits (Padmalal & Maya 2014). A third category of methods involves placing traps in the river channel to capture sediment flows. Mining in the active channels is done mostly with country boats and motorized boats, and terrace/ floodplain mining involves the use of heavy earth-moving machines and bulldozers. The different SM-DR techniques vary in their environmental impacts.

A.2 Rivers of the East Zone

The ecological impacts of SM-DR thus vary with regard to 1) sediment concentration, composition, and supply, 2) seasonality of river flow, and 3) types of impoundments on different rivers (Chakrapani 2005).

The East Zone rivers can be very broadly categorized as (i) Himalayan rivers originating in India, Nepal and Tibet and (ii) non-Himalayan rivers with their sources in the Vindhyan range, the Chota Nagpur plateau and the Eastern Ghats. The Himalayan rivers have high bed slopes in the upper and middle reaches but in their lower reaches, in the alluvial plains, their bed slopes are almost flat. Hence they can be called "energy-limited", as sediment supply is abundant but their capacity to transport it is low, due to the gentle gradient (Candel et al. 2020). In contrast the non-Himalayan rivers are 'supply-limited'. Their beds are more rocky and gravelly with relatively less sand. Their capacity to transport exceeds the availability of sand or fine transportable sediment (Kleinhans et al. 2002, Hauer et al. 2017). Thus SM-DR activities are dominant in the alluvial Himalayan river stretches, while gravel mining would dominate in channels with rocky or gravelly substrates.

In terms of seasonality, the Himalayan rivers may be perennial whereas the non-Himalayan rivers may be perennial or seasonal.

In the EZ, the cumulative and interacting impacts of impoundments, channelization, bank construction, and inland navigation on SM-DR could be more severe than in other regions.

Types of Impoundments

Barrages, Storage Dams & Hydropower Diversion Dams: Barrages are typically built on large alluvial rivers and allow for some flow downstream during most months of the dry-seaSon. Storage dams allow very little or no downstream flows in the dry-seaSon. Hydropower projects divert water into turbines, generate power at peaking water levels, and then return the water back to the active river channel downstream. Hydropower operations can cause perturbations to river flow repeatedly, within a single day. Storage dams and barrages store significant sediment in their reservoirs as compared to hydropower projects. Dams and barrages may attempt flushing or periodic sediment

removal, these attempts may not be adequate, leading to continuing overall declines in sediment fluxes downstream of dams (Gupta et al. 2012).

As downstream river discharges are reduced in magnitude below impoundments, sand or gravel deposited prior to impoundment, or during the flood-seaSon, becomes more convenient to access and harvest. If such SM-DR exceeds the annual incremental rate of sediment flow below impoundments, there can be strongly negative impacts on river geomorphology (Rinaldi et al. 2005). Sediment accumulated above Farakka, since 1975, has caused high risk of flooding and bank erosion hazards in upstream regions with backwater effects (Thakur et al. 2011).

Embankments: The construction of embankments and other channel or bank constructions can worsen the effects of SM-DR. Embankments are either constructed on both banks to channelize the river into a predetermined path, or only on the erosion-prone bank of meandering channels (riprap embankments). To construct embankments, floodplain and terrace excavation of sand and other substrate materials is carried out. Embankments are often prone to damages or breaching due to erosion, especially in the flood seaSon. Bank slippage is commonly encountered during breaching, resulting in massive sediment (sand and silt) deposition downstream of embanked channels. These deposits may also obstruct river flow and alter channel morphology, which in turn need dredging or sand extraction to allow unimpeded flow. In such cases, dredging may have a positive feedback, because the sediment extracted by dredging operations gets deposited further downstream, calling for furthermore SM-DR operations (Fisher et al. 2018).

ILR & IWT: Mega projects like the Inter Linking of rivers (ILR) and the Inland Waterways Transport (IWT) can severely impact sediments transport. ILR projects in the East Zone could significantally reduce sediment flows to the Ganga-Brahmaputra-Meghna delta in the Bay of Bengal. The National Waterway 1 project for IWT pivoted on major capital dredging and maintenance dredging, will also have a serious effect on sediment flows. Its most significant impact on biodiversity, however, could be on the well-being of the Gangetic River Dolphin, India's National Aquatic Animal (See Box: Underwater vessel noise and river bottom-dredging harms Ganges river dolphins).

Underwater vessel noise and river bottom-dredging harms Ganges river dolphins

In a first study of its kind on the Ganges river dolphin, scientists from ATREE have clearly demonstrated the negative impacts of vessel noise on the ecology and behavior of this species. It provides comprehensive evidence to show that the waterways development plans threaten the survival of the Ganga's biodiversity.

The National Waterways Act of 2016 of the Government of India (GoI) plans to "develop" 111 river stretches of the country for commercial transport, with the Ganga River from Haldia to Varanasi declared as National Waterway No. 1 (NW 1). Large-scale maintenance dredging, construction of ports, and major increases in cargo and goods traffic are planned. Environmentalists have voiced serious concerns about the potentially disastrous ecological impacts of commercial waterways development, especially on the endangered Ganges river dolphin, India's National Aquatic Animal and an IUCN Red List species.

The Ganges river dolphin has undergone a regression of its eye lenses while evolving over millions of years in the murky, sediments-rich Ganga and Brahmaputra basin rivers. Consequently, the species is effectively blind. It uses high-frequency ultrasound clicks for navigation, communication, and foraging. Due to its almost total reliance on sound for survival, underwater noise generated by ships, vessels, and dredging activities poses a serious threat to the species. Nearly 90 per cent of the river dolphin's present distribution in the Ganga and Brahmaputra basins in India is a part of the proposed 111 waterways.

The ATREE study used passive acoustic recordings and comparative analysis of Ganges river dolphin echolocation clicks when no vessels passed dolphins, and when vessels passed them, such that they were exposed to low frequency sounds from vessel engines and high frequency cavitation noise from propellers besides known information on the hearing range of these dolphins and other relevant scientific resources.

The most significant finding of the study was that the dolphins altered their acoustic click activity substantially when exposed to vessel noise, including changes in the repetition rate, frequency, and loudness of their clicks, significantly raising their metabolic stress. "In simple terms, this means that dolphins would have to spend 2.5 times more energy to do the same activities in noisy conditions, than they would normally spend in 'natural' conditions without vessel noise," says Nachiket Kelkar one of the study's authors. "As river flows reduce in the dry season the intensity of vessel traffic and corresponding ambient noise increase, leading to further intensification of these impacts on the dolphins," he adds.

An important lacuna in India's Noise Pollution (Regulation And Control) Rules, 2000 (with all amendments until 2017), is that there is no rule for underwater noise regulation and control. The present rules are only for noise in air and on land.

- *Edited extract from talk presented by Nachiket Kelkar at IRW 2018, November 2018*

A.3 Impacts of SM-DR on river geomorphologic and hydrological processes

Channel incision and narrowing, destruction of riparian and in-stream riverine habitats, reduction in sediment, coarsening and erosion of river beds, and increase in water turbidity are identified as the major physical impacts of sand mining (Koehnken et al. 2020). Alongside, increased channel instability and bank erosion, changes in river morphology, reduction in sediment availability, creation of deep pits and pools, are noted as important impacts.

Within rivers, heavy particles such as coarse sand and gravel are carried along the river bed continuously as bedload (rolling along the bed of the river) while fine particles are carried in suspension. The transported sand maintains a natural and stable river profile, particularly bank stability. The deposited sand banks absorb storms and flood waters and act as a defence against extreme weather events. Sediments transport also creates diverse habitats such as sheltered pools, braided channels and riffles which sustain wildlife and the longitudinal connectivity of the river.

Sediment load, sediment grain-size, water flow, and the slope of the river are maintained in equilibrium in a healthy river. Sediment mining affects each component of this balance. Extracting material reduces the total sediment in the river and reduces the availability of medium to coarse grains both of which lead to bed erosion.

Sand mining sites create an artificial sudden depression in the river bed. When water flows over this depression or 'nick point' it leads to turbulence, and the edge of the pit is rapidly worn away leading to the upstream movement of the depression. This leads to a sudden increase in the slope of the bed of the river at that point, which increases the speed at which the river flows, which in turn increases the energy of the river and the rate at which erosion occurs. This thus causes a 'self-feeding loop' where erosion occurs at an ever-increasing rate because of the changes caused by the erosion process. This process is termed 'channel incision' and often leads to channel narrowing.

Sand or gravel mining leads to loosening of sand, and the removal of sand and other sediment makes the river flow more rapid. The river is said to become "hungry" as a result of sediment removal, and its erosive power increases because sediment resistance to flow declines (Kondolf 1997, Kondolf et al. 2018). In the Mayurakshi River in Jharkhand, an increase in flooding intensity has been noted as a result of sand mining (Islam & Deb Barman 2020). Such changes are expected to be serious for supply-limited rivers (Hauer et al. 2017).

'Dry' mining, or mining outside the stream bed, also leads to changes in river shape and stability. This mining leads to deep pits very close to river courses, often with thin 'walls' of sand separating the pits from the river. In times of increased flow such as during the monsoon, these walls may be overtopped. The pits often being deeper than the river bed, the river is diverted into these and then carves a new path through the network of sand mining pits, often with catastrophic results.

Deltas while also being incredibly rich in biodiversity, absorb storm surges. Sand mining on a large scale, as practised in India, decreases the amount of sand brought down to the river delta. Consequently, these deltas erode.

In the case of rivers with gravel deposits, SM-DR has strong negative effects on groundwater-surface water exchanges and increases fine suspended sediment loads in the water column (Rinaldi et al. 2005). Rinaldi et al. even suggest that SM-DR activities should be allowed to large and aggrading rivers in order to sustain groundwater resources. Excessive excavation in the Sone river in Bihar, up to depths of 50 feet against the permitted depth of 10 feet has resulted in the reduction of groundwater levels in nearby areas.[3] Excessive sand mining in the Barnaar nala in Bhagalpur district has lowered the water level in the *pynes* (water channels) used for irrigation.

[3] https://www.theleaflet.in/illegal-sand-mining-ngt-agrees-to-look-into-allegations-of-illegal-operations-along-the-river-Sone/#

River Banks & Embankments Erosion

Tripura: River banks are rapidly eroding at several locations along the rivers like Haoura, Gomoti, Deo, Dhalai, Khowai and their tributaries in Tripura due to uncontrolled sediments mining from the riverbeds by machines. At several places in north Tripura, the National Highway is threatened by erosion. People are afraid of floods during the rainy seaSon.[4]

A far more serious situation prevails at Dibrugarh. Illegal sand mining from the Brahmaputra river bed at several locations near Dibrugarh is posing a serious threat to the eastern Dibrugarh Town Protection (DTP) dyke. However, every day 10 to 15 truckloads of sand are illegally extracted from the Brahmaputra river bed at Maijan area and sent out.[5] "The illegal sand mining has weakened the DTP dyke and if the concerned department didn't take action against the sand mafias then one day Dibrugarh goes under water," said Ram Mohan Lal, a senior citizen of Dibrugarh. Obviously, the directions in the Enforcement & Monitoring Guidelines for Sand Mining 2020 released in January 2020 are not being enforced in Dibrugarh.[6]

Odisha: In June 2019 irate residents of Sikharpur village in Balasore district of Odisha detained more than 100 trucks and tractors engaged in lifting of sand illegally from the Subarnarekha river bed. Laxmikant Giri, a villager, told the New Indian Express that JCBs being used instead of manual labour had led to the formation of craters on the river bed. It had adversely affected the river's flow and eroded its embankments.[7]

In Jagatsinghpur district unchecked mining was eroding the banks of the Mahanadi. Erosion of the river bed posed a grave threat to several villages in Tirtol and Kujang blocks and those along the Taladanda canal. Sources said the 400-metre-long and 250-metre-wide embankment of Mahanadi river, just 700 metre from the canal, had caved in. Use of machines had changed the natural topography of the region. Deep digging and lifting of sand had led to formation of ponds, threatening several villages in the two blocks due to the river changing its course during floods.[8]

Bihar: Illegal sediments mining is cited as a major cause for the flood havoc, in East & West Champaran districts in 2017. Admitting the impact, the disaster management officials said rampant

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[4] https://www.sentinelassam.com/north-east-india-news/tripura-news/sand-mining-river-banks-in-tripura-facing-massive-erosion/ (29 Feb 2020)

[5] https://nenow.in/north-east-news/assam/assam-illegal-sand-mining-poses-threat-to-dibrugarh.html (03 Feb. 2020)

[6] https://www.telegraphindia.com/states/north-east/sand-mining-threat-to-dyke-from-brahmaputra-riverbed-in-maijan/cid/1742621 (6 Feb 2020)

[7] http://www.newindianexpress.com/states/odisha/2019/jun/07/locals-detain-trucks-protesting-sand-mining-1987064.html (7 June 2019)

[8] https://www.newindianexpress.com/states/odisha/2020/aug/23/mahanadi-embankments-eroding-fast-due-to-illegal-sand-mining-2187158.html (23 Aug. 2020)

illegal mining had weakened the embankments at many places along the Gandak river, which collapsed in the face of steady build-up of water in the catchment areas.[9]

Bengal: Bank erosion due to rampant sediments mining has threatened the Patal-Bari — a heritage building on the banks of the Hooghly at Chandennagore in Bengal.[10]

Altering River Courses

Orissa: Baitarini river flows through Bhandaripokhari, Dhamnagar, and Chandabali blocks of Bhadrak district. Every year floods create havoc in these areas due to illicit sand mining corroding Baitarani banks. Unhindered sand mining on a 30 km stretch of the river from Akhuapada of Bhadrak to Dehudi in Anandpur causes the Baitarani to repeatedly change its course, creating floods every year. "Illegal mining has resulted in an artificial river called Gengei in the region. If government doesn't take immediate action then more than 8 panchayats will get marooned during the floods. We will be forced to agitate against the government if our problems not solved soon," says Chittaranjan Nayak a local resident.[11]

Bihar: Sand mining has hastened Ganga's shift from Patna. Ganga, which once flowed along Patna, has shifted away at least 5-6 kms away from its original course. In Patna district, the total length of the Ganga river is 99 km. The waterfront used to be around 20 km before the river started moving away from the city. Research published in 2014 said that river Ganga was shifting away from the city of Patna on an average of 0.14 km per year.

Experts believe that the change in the course of the river is due to several geogenic and anthropogenic reasons. "Lateral shifting of the river is a typical characteristic of any tropical river. But, at the same time, what has happened with Ganga, especially in and around Patna, is definitely man-made. Too much extraction of sand and building of brick kilns has led to the shifting of the river away from the city," says Prof. R.K. Sinha, the vice chancellor of the Nalanda Open University in Bihar and also known as 'Dolphin Sinha' for his work on the Ganges River Dolphins. "Excessive mining at the mouth of river Sone which meets Ganga near Patna has also caused the change in flow. The mining has eroded a lot of villages on the left side and deposited all the soil on the right, and a vast stretch of land has been created," he adds.[12]

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[9] https://www.hindustantimes.com/patna/illegal-sand-mining-in-river-beds-blamed-for-flood-fury-in-bihar-s-east-and-west-champaran/story-PUuQbOw8pjj24sWYCxpLVI.html (22 Aug 2017)

[10] https://www.hindustantimes.com/india-news/green-hopes-run-dry-as-rampant-mining-goes-unchecked-in-bengal/story-JrLcS1qhF2DiCLwKcSZjhL.html (11 July 2016)

[11] https://odishatv.in/odisha-news/illicit-sand-mining-corroding-baitarani-banks-people-blame-govt-apathy-462530 (17 July 2020)

[12] https://thewire.in/environment/mining-and-brick-kilns-hasten-gangas-shift-from-patna (20 May 2019)

A.4 Ecological Impacts of SM-DR

SM-DR activities, particularly with the use of heavy earth-moving machines removes riverbed materials. In the process the local ecosystems are severely disturbed. Multiple negative impacts on riverine and riparian biodiversity are noted in the literature. The primary impact is the loss of habitat for vegetation, invertebrates, fishes, turtles, crocodilians, birds, and mammals. This means the loss or shrinking of breeding/spawning sites, loss of food and ultimately changes in populations and community composition.

Vegetation: Aquatic plants are susceptible to increases in turbidity, changes in temperature, and oxygen availability in the water column following SM-DR. The disturbances caused by bar excavation or scalping to riparian reaches can trigger floodplain succession by pioneer plant species, and is known to increase riverside tree cover in some cases (Koehnken et al. 2020). The removal of gravel also had a similar effect on vegetation.

Freshwater invertebrates: Many freshwater invertebrates like caddis flies, molluscs, etc depend on substrates for breeding and larval feeding. In addition to coarse substrates, interstitial spaces between gravel or sand grains are critical for deposition of eggs and larval emergences. They offer refuges from aquatic predators ranging from insects to higher vertebrates, and are important in the early life-cycle stages of insects and other invertebrates (van Dolah et al. 1984, Meng et al. 2018, Koehnken & Rintoul 2018). Increased concentrations of fine suspended sediment in river water following SM-DR clog these spaces and make them unavailable after SM-DR, resulting in drastic changes in populations and community composition of the invertebrates (Meng et al. 2018). Freshwater mussels that use substrate for grazing and attachment throughout their post-larval lives are also directly affected by SM-DR (Brim Box & Mossa 2008).

In-stream mining has direct negative impacts, while floodplain or terrace mining have indirect effests, as they increase fine sediment that gets deposited into the river water later. Depending on the correspondence between life-history stages of invertebrates and the excessive release of fine sediments, impacts can range from complete changes and reduction in biocomplexity (number of species), to breeding failures, to loss of specific functional groups. Bar scalping and in-stream mining can increase water temperature and reduce the availability of dissolved oxygen by turbidity plumes, which can have drastic effects on invertebrates.

Negative impacts of sand mining have also been reported on plankton, with significant reductions in numbers and abundances of species at mined sites along the Ganga River (Prabhakar et al. 2019). As invertebrates form the bulk of primary consumers in riverine and lake food webs, such impacts can affect higher order organisms and animals in the food chain, all the way to human beings due to loss of fish, shrimps, etc. Declines in invertebrates can ultimately affect important ecosystem services for people, e.g. capture fishing of shrimps and mussels for food, pearls, etc. (Wilber et al. 2015).

Fishes: The life cycles of fishes are tuned to the natural variability in river flow and flooding conditions. Most river fishes time their spawning activity according to different temporal windows available during the monsoonal flood pulses, upon receiving physiological cues to spawn, from changes in river temperature, changing turbidity, increases in biological productivity, and greater, pulsed availability of organic matter. By the end of the flood pulse, fish larvae begin their growth and

dispersal, which continue through the dry-season. Some river fishes also breed during the dry-season, in summer and spring. Among river fish species, many fishes actively choose and guard spawning sites, which are linked to their preferences for coarse substrates (ranging from boulder crevices to gravels to sands; Bellamy et al. 1992). As gravel and sand mining targets for construction materials match closely with the substrate preferences of fish, nest-guarder or brooder species might be badly affected by the extraction of sediment from in-stream mining and dredging. Suction dredging can especially cause mass mortality of young fish, which cannot escape due to physical constraints.

Prolonged exposure to SM-DR can cause irreversible effects on fish spawning habitats, as well as on population and community structure (Kemp et al. 2011). SM-DR can lead to changes in turbidity, water temperature, and dissolved oxygen, which can cause mass kills of fish spawn and juveniles, due to smothering of fish by the entry of fine silt particles into gills, or eggs getting covered by silt and termination of embryo development. SM-DR induced changes in thermal regimes may cause fish mortality or avoidance of mined habitats (Kemp et al. 2011) and affect the swimming ability of fishes, besides reduced reproductive fitness due to severe physiological stress.

BOX Eastern India: state-wise details of SM-DR

Status of SM-DR, river flow regulation, biodiversity, and human dependence along selected major rivers from eastern India (states of Bihar, Jharkhand, Chhattisgarh, Odisha, and West Bengal). The status levels are qualitatively characterized as 1) L=Low, 2) M=Moderate, and 3) H=High, based on the relative frequency of news reports about the four variables. Only the Gandak river in Bihar and the Sundarbans in West Bengal can be classified as high-biodiversity river stretches with relatively low levels of human dependence, flow regulation, and sand mining.

Table 1. Eastern India: state-wise details of SM-DR

State(s)	River stretches	Status of SM-DR	Status of river flow regulation	Status of biodiversity	Status of human dependence
Bihar	Ganga (upstream of Patna)	M	M	M	H
Bihar	Ganga (downstream of Patna)	M	L	H	H
Bihar	Gandak	L	M	H	L
Bihar	Kosi	M	H	M	H
Bihar	Son	H	H	L	M
Bihar	Budhi Gandak	M	L	L	M
Bihar	Bagmati-Kamla Balan	M	H	L	M
Bihar	Mahananda	M	M	M	M
Jharkhand	Koel	H	H	L	H
Jharkhand	Mayurakshi	H	H	L	H
Jharkhand	Barakar	M	H	L	M

Chhattisgarh-Jharkhand	Rihand	H	H	L	H
Jharkhand-West Bengal	Ganga (at Farakka)	M	H	M	H
Jharkhand-West Bengal	Subarnarekha	H	H	L	H
Jharkhand-West Bengal	Ajoy	H	H	L	H
Jharkhand-West Bengal	Damodar	H	H	L	H
West Bengal	Hooghly	M	M	M	H
West Bengal	Teesta and N. Bengal rivers	H	H	M	M
West Bengal	Sundarbans	L	L	H	L
Chhattisgarh	Arpa, Sheonath	H	H	L	H
Chhattisgarh	Kharun	H	H	L	H
Chhattisgarh-Odisha	Mahanadi	H	H	M	H
Odisha	Brahmani	H	H	L	H
Odisha	Baitarani	H	H	L	H

Source: Nachiket Kelkar

Fisheries of food and ornamental fish species, can be severely affected by SM-DR, not only due to fish resource declines and degradation in water quality of rivers (CEBPOL-NBA 2018). SM-DR can cause heavy metal release into river waters, which can cause fish toxicity leading to high mortalities or physiological and genetic abnormalities (Affandi & Ishak 2019). Fish captured from such SM-DR sites could lead to morbidities and food poisoning in fish consumers as well. In rivers of North Bengal and Bihar, many fishers regularly catch prized ornamental fish species (e.g. loaches, barbs, torrent catfishes, etc.) that use coarse substrate river-bottoms (Barman & Das 2014). Regular dredging by fishers involved in small-scale gravel mining along these rivers, however, can damage fisheries productivity and the quality of fish resources utilized (Kjelland et al. 2015).

Very few studies exist on riverine fish community responses to SM-DR in India. Arun et al. (2006) showed that deepening and incision of river channels negatively affected the abundance of psammophilous (sand-dwelling) fish species. In larger rivers, fully rheophilic species whose larvae do not migrate into floodplain wetlands for the first year of their lives, are likely to be more susceptible to SM-DR. Tropical fishes are likely to be more resilient to SM-DR than temperate species (which have more specific thresholds of thermal and turbidity tolerance). River channels affected by SM-DR are also likely to promote the naturalization and spread of invasive alien fish species that may be tolerant to disturbance (Padmalal & Maya 2014).

Amphibians and Reptiles: Amphibians in the EZ mainly include frogs and toads. Their preferred habitats for spawning are wetlands and ponds with high density of aquatic vegetation. They are likely

to be most affected by sand extraction from wetlands located in floodplains and terraces. In general, however, since SM-Dr activities are much greater in river beds, the impacts of SM-DR on amphibians in the EZ are likely to be low.

SM-DR leads to negative impacts for turtles and crocodilians, as these species depend on sand bars and floodplains with fresh sand deposition for nesting and basking. Rare and endangered freshwater softshell and hard-shelled turtles found in the EZ include the peacock softshell turtle *Nilssonia hurum*, narrow-headed softshell turtle *Chitra indica*, the Cantor's giant softshell turtle (*Pelochelys cantorii*) and the Assam roofed turtle (*Pangshura sylhetensis*). They may be affected by floodplain sand mining.

In the EZ, natural (wild) gharial populations are found along 1) the Gandak river in Bihar (a breeding population), 2) the Mahanadi river (Odisha: small population not confirmed as breeding), 3) the Kosi and Ganga (Bihar-Jharkhand: small and scattered non-breeding populations), 4) the Hooghly (West Bengal, scattered records), and 5) the Brahmaputra (scattered records). The impacts of sand mining on gharials in the Gandak River are not as severe as in the Chambal. Sinha et al. (2020) and the Wildlife Trust of India team recorded six breeding sites of gharials, and our (ATREE's) field observations confirmed that these sites have low levels of SM-DR.

Bar scalping, done with small dredgers in the post-flooding season to divert river water into side-channels for irrigation, is not uncommon in the Gandak (ATREE team: personal observations). If such disturbances increase in the future, nesting sites may need more protection. The ATREE team's monitoring data for the Gandak revealed that, in spite of low levels of floodplain and terrace mining, there was a reduction in fresh sand bar deposits in the last decade, probably due to an increase in cucurbit cultivation on the banks. Additionally, there has been a significant reduction in sediment fluxes during the flood season in the Gandak River after the construction of the Triveni barrage in 1967-68 (based on Sinha & Friend 1994, Jha & Prasad 2002). This may have reduced fresh sand deposition and nesting site availability. What is the implication? Gharials may also be threatened by sand mining in the Mahanadi and Hooghly, but perhaps not as much in the other areas.

Birds: Riverine waders and shorebirds that nest on sand bars, islands, and mid-channel sand-spits such as the Indian Skimmer, River Tern, Black-bellied Tern, Small Pratincole, and River Lapwing may be affected by sand mining. These species are already threatened by reduced dry season flows in their summer breeding season. They nest in the peak summer (April-May), when the river water levels are at their lowest, and sand mining at its peak. Even low levels of sand mining can result in irreversible damage to nests at this time due to other predators.

Sand-nesting birds often use depressions at the bases of dunes or those near riparian plants for laying their eggs. Bar skimming and excavation are likely to cause nest damage to birds as they flatten undulating dunes that are created by wind action on floodplain sand. Sand mining impacts on birds have been reported in the Mahanadi river and in the Sone gharial sanctuary, where Indian Skimmers and Blackbellied Terns breed (Singh et al. 2015, Kar et al. 2018, Kar & Debata 2019). In the Namjyang Chu river in Arunachal Pradesh's Tawang district, sand mining has been found to affect

the freshwater wetlands where endangered Black-necked Cranes migrate in the winter.[13] Sand and gravel mining has also likely affected critically endangered species such as the White-bellied Heron, in Assam's rivers (Menzies et al. 2020).

Mammals: Among riverine mammals, the two species in the EZ likely to be affected the most are the Ganges River Dolphin *Platanista gangetica*, India's National Aquatic Animal, and the Smooth-Coated Otter *Lutrogale perspicillata* rated as vulnerable by IUCN. The endangered Ganges River Dolphin's population in eastern India is approximately 3000 individuals (WII 2018), which is about 60% of its surveyed and known global population. Indirect impacts of floodplain sand mining causes local sedimentation and reduction in river channel depth, which impairs longitudinal connectivity for species like river dolphins. This leads to river dolphins getting isolated in specific deep pool sections, with intervening channels getting cut off due to sand mining. Such impacts have been noted in the Kulsi (Mohan et al. 1998, Wakid 2009) and Barak rivers of Assam (Choudhury et al. 2019). For Ganges River Dolphins, a threat bigger and more direct than sand mining appears to be that of frequent maintenance dredging of riverbed sediment (See Box: Underwater vessel noise and river bottom-dredging harms Ganges river dolphins). As of now, there are no detailed studies on the effects of dredging noise and sediment disturbance on river dolphins. Preliminary field observations have indicated negative impacts. River dolphin diving patterns changed significantly during dredging operations at Bhagalpur in Bihar. Longer and quiescent dives indicate stressed behaviour in Ganges River Dolphins and it was found that dive-time intervals increased nearly three-fold during dredging as compared to before, indicating significant stress (Dey et al. 2019). It has been suggested that embankment constructions and minor dredging could create deeper pool habitats for Ganges river dolphins, which might provide them with temporary habitat (Todd et al. 2015). However, this apparent benefit may be easily offset by the increases in flow velocity, bank erosion, and degradation of water quality that usually accompanies such interventions.

Smooth-coated otters construct holts (or dens) in low-lying sand- and clay-rich floodplain areas, or along sand banks created by river erosion in the dry season, when they give birth to 2-3 pups. Otters may be highly susceptible to terrace and floodplain mining at this time, and may abandon such areas in search of relatively low-risk localities. In-stream mining or dredging can also affect otters through the loss of fish prey.

Impacts on water quality

SM-DR can cause the release of heavy metals and other pollutants into surface waters. In the absence of mining, these chemicals are "locked" in river sediments and even when present, are not a threat to water quality. SM-DR affects the buffering function of river sediment by disturbing and dislodging sediment. SM-DR is known to release toxic heavy metals such as Arsenic, Chromium, Cadmium, Nickel, and Lead into the river water column (Höss et al. 2010, Singh et al. 2018), and even contaminant loads (Eggleton & Thomas 2004), including pathogenic bacteria such as *E. coli* (Grimes 1975). In the EZ, Arsenic is already widespread in most groundwater aquifers, and has caused chronic toxicity to thousands of rural people. The release of Arsenic from river bottoms into the surface water column, despite its dilution, is likely to increase exposure to the contaminant. This is

[13] https://scroll.in/article/859163/illegal-sand-mining-threatens-winter-habitat-of-black-necked-tibetan-cranes-in-tawang

significant in the Gangetic plains, where a large population of floodplain dwellers depends on river water for domestic uses and even drinking water needs.

A.5 SOCIAL IMPACTS (To be completed)

Livelihoods impact

In June 2020 illegal sand mining activities in Barnaar river in the Chairya Bahiyar region of Bhagalpur threatened the traditional *pyne* irrigation system. Hundreds of acres of farmlands in Kodiya, Bahiyar, Chairya, Bahiyar and Bhadari Bahiyar areas have been irrigated by *pynes* (open channels that connect one ahar (water tank) to the next) for well over a century. Excessive sand mining, however, has lowered the river water level thus hampering water supply in the pynes. Villagers lowered the inlets of Pyne at the river mouth but in vain.

Fig. 5: Pyne irrigation channel of Charaiya Bahiyar. (Dainik Bhaskar)

Farmers used to maintain the Pyne irrigation channels on annual basis as its lone water supply source in the area. They asked administration to look into the issue, fearing more difficulties in future to fertile rice belt. Some famers are even trying to dig borewells but as the groundwater level is low this is not helpful.[14]

In the case of the Kosi river of Bihar, the magnitude of flooding and sediment deposition is so high that sediment management is an important issue post-flooding (Sinha et al. 2019). Sediment not only clogs outlets along the Kosi embankments, but can also block smaller channel inlets and wetlands, rendering them unproductive for human use (Yadav 2017). It has been suggested that the negative impacts of heavy sand deposition could be reduced by using the deposits for commercial uses (BASIX 2018). Similar strategies have been planned for de-silting dams, so that the sediment stuck behind them could be re-used, or even returned to the river downstream for ecological restoration of human-impacted floodplains (e.g. CWPRS 2017).

A.6 LAWS & GOVERNANCE

Part B: EASTERN & NORTHEASTERN INDIA STATEWISE REVIEW OF SM-DR

B.1 BIHAR

[14] https://www.bhaskar.com/local/bihar/bhagalpur/Sono/news/sand-mining-threatens-survival-of-pines-problem-of-irrigation-127444939.html (25 June 2020)

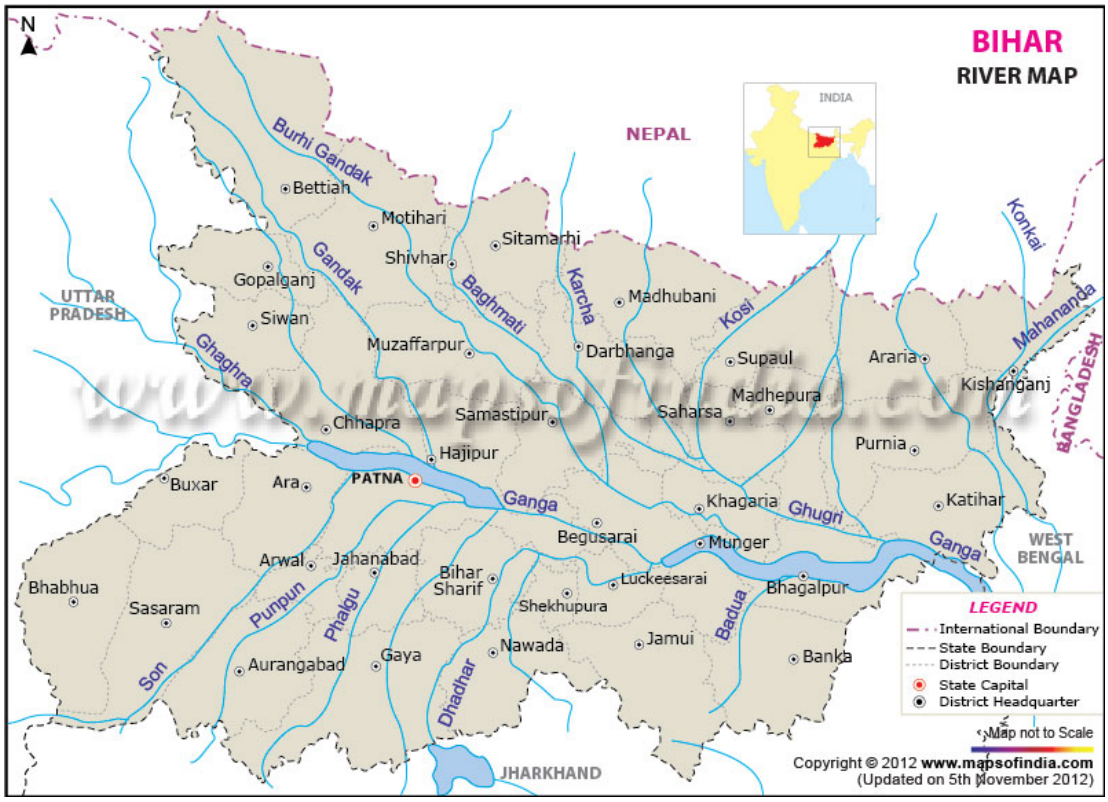

Fig. x: Map of the major rivers of Bihar (Source: www.mapsofindia.com)

Bihar's major rivers include the Himalayan rivers Ganga, Ghagara, Gandak, Burhi Gandak, Bagmati, Kamala, Kosi and the Mahananda. The Sone river rising in the Vindhyan ranges and the smaller Punpun, Phalgu, and Kiul-Harohar originating from the Chota Nagpur plateau, flow from the south into the right bank of the Ganga. The Sone is the largest perennial southern tributary of the Ganga.

The Ganga and its northern tributaries mostly carry fine silt and fine sands (Sinha et al. 2014). Sand-mining in these rivers is dominated by terrace mining which involves bar excavation and scalping, dry pit mining, and river bottom dredging for navigation. The Ganga River upstream of Patna has high levels of floodplain and terrace mining, as the river flow in this stretch is less than the downstream sections (Singh et al. 2007). At Patna, after the Ghaghara, Gandak, and Sone rivers join the Ganga, its discharge increases significantly. Dredging in the Ganga river (called National Waterway No. 1 from Allahabad to Haldia) is mostly concentrated at meander nick points, where embankment effects and channel geometry together lead to high sand deposition. Further downstream, the Burhi Gandak, Kosi, and Mahananda rivers join the Ganga, and the total river discharge unto upstream of Farakka is the highest in this stretch.

Geomorphological and Hydrological Impacts: The major effects of extensive SM with the use of mechanical earth excavators has led to bank erosion and flash floods, rivers changing their courses and the water levels in several irrigation channels being lowered. The noted environmentalist and present Chairman of the Bihar State Pollution Control Board, Dr Ashok Ghosh, has said "There have been instances where rivers changed their course due to illegal sand mining. The government should ensure that guidelines issued by the NGT are implemented in toto." Many villages of West

Champaran district faced disastrous flash floods, an unnatural phenomenon in the region that was caused by illegal mining in Kataiya river.[15] The Karamnasa and Deval bridges on Karamnasa river are facing severe damages due to heavy mining.

Ecological Impacts: The known impacts of SM-DR on river biodiversity and fisheries in Bihar are low to moderate at present, but are likely to increase significantly in the near future. Sand mining is, however, known to be severe along certain sections of the Sone (e.g. Koelwar; Sinha & Sharma 2003) because of its high quality sand for construction purposes. River interlinking and waterways are planned on all the major rivers, which are likely to increase dredging in some stretches. Fisheries and floodplain agriculture are likely to be affected by the present levels of terrace mining, embankments' construction and dredging.

Social Impacts: In Gaya district, drowning of two children in water filled sand mining pits in 2016 agitated villagers who torched vehicles of the contractors and police team.

Illegal Mining and Governance: In Bihar, sand and gravels from the Sone river basin are highly preferred for construction purposes. Sand mining is known to be severe along certain sections of the Sone (e.g. Koelwar; Sinha & Sharma 2003). According to news reports, in spite of an NGT ban, illegal sand mining from the Sone river and its trade continued in 12 districts. [16] The scarcity of this sand during the monsoon season has pushed up its price to as high as Rs15000 to Rs 18000 per truck load.

Inspite of several complaints and administrative actions, the sand mafia remains fearless. In areas like Khalilchak, Pein, Nemdarganj, miners are forcibly digging farmlands. Inspite of agitation from the villagers, no police complaint is filed. In addition to the existing issues, the problem of stock piling of sand before monsoon has gained momentum. In the Lerua, Kanchanpur, Amra areas, sand is procured during evening and night hours then stored in dumpyards and sold at high prices during monsoon. Such stockyards along NH-2 were frequently visited by senior official but not enough actions were taken to stop the illegal trade. This has resulted in huge revenue losses for the state government.

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[15] https://www.firstpost.com/india/illegal-sand-mining-part-3-bihar-govts-attempted-crackdown-has-sent-prices-soaring-officials-face-axe-as-rivers-in-ruin-6008351.html

[16] https://sandrp.in/2016/12/28/river-sand-mining-in-india-in-2016/

Fig. X: Aerial view from Koelwar bridge of boatmen extracting sand from the Sone riverbed. (Photo: Siddharth Agarwal, August 2016)

New Policy: In response to the large-scale illegal mining and sand scarcity, the Bihar Cabinet approved the draft Bihar State Sand Mining Policy in August 2019. This move was made with a prime intention to increase the revenue generation of the state. The new policy reduced the sand mining districts to 15 from the earlier 25 districts but number of mining sites within each district was increased. As per the policy, a single person or a registered company, partnership firm or a cooperative society could obtain license for a maximum two sand blocks/ghats or 200 ha of sand mining area, whichever is lower. While the ban on mining during monsoon was a welcome move, failure to check storage and price hikes caused revenue loses. In addition, the CM Nitish Kumar asked the officials to undertake surveillance using drones and satellite imagery to protect the historical monuments from the damages of illegal mining. Several pleas were registered claiming the new policy to be inconsistent with the SC guidelines and containing several loopholes which were exploited by the mining mafias. If such activities continued, the mining situation in Bihar was bound to worsen. [17] In September 2019, the govt issued Bihar Minerals (Concession, Prevention of Illegal Mining, Transportation & Storage) Rules, 2019. Despite strong opposition, the Bihar Government approved the Bihar Mining Plan in November 2019.

On Dec 12, 2019 the NGT dismissed a batch of applications filed against the government policy which allowed artificial bifurcation of homogenous stretches of river bed in terms of sand mining. The NGT bench said that the "Bihar Sand Mining Policy, 2019" was in conformity with the directions given by the SC and the "Sustainable Sand Mining Management Guidelines, 2016". It also rejected applicants' argument that restricting grant of leases up to only two to an individual in the "2019 Policy" was in violation of the provisions of Article 19 (1) (g) (right to practice any profession

[17] https://sandrp.in/2020/07/22/bihar-sand-mining-2020-ruining-rivers-aggravating-floods/

or to carry on any occupation, trade or business) of the Constitution of India, saying that the NGT was not the right forum to decide such a matter.[18]

Judicial Action: In Aug 2019, the NGT agreed to look into allegations of illegal sand mining along the Son river. This investigation was begun to take actions against large private firms. One of the petitions alleged M/s BroadSon Commodities for illegally undertaking sand mining on the Son river bed to depths greater than the authorized 10 feet limit along with construction of temporary bridges. Similar allegations were made against several private firms operating in that area. The NGT directed the State Environment Impact Assessment Authority (SEIAA), geology and mining dept, the Bihar State Pollution Control Board (SPCB) and the District Magistrate, Bhojpur to jointly inspect the area. It also directed the SEIAA and SPCB to take appropriate action against the private limited company if the allegations were found to be correct. They were also asked to submit an action-taken report and inspection report before the next date of hearing on Aug 30, 2019.

In February 2020 the NGT constituted a fresh committee of a CPCB scientist, a scientist nominated by MoEF&CC and an Expert nominated by the Indian School of Mines, Dhanbad to probe the allegations of illegal sand mining in Son river by using heavy machines that are damaging the environment. The CPCB was made the nodal agency for coordination and compliance to submit report within two months. The SPCB was asked to provide necessary assistance to the Committee, next hearing was to be on May 22, 2020.

The tribunal was hearing a plea filed by Bihar native Mohd Imran Khan Kadri alleging illegal sand mining in Son river in Aurangabad and Rohtas districts by using heavy earth moving machines inside the river, damaging the ecology.[19] The NGT passed the order after perusing a report filed by SPCB which said that no sand mining was being carried in Aurangabad and Rohtas districts. NGT said that the Patna High Court (HC) had noted that sand mining was being carried out and SPCB findings were in contravention of HC with inherent contradictions in the report. besides causing air pollution due to the use of heavy trucks.

B.2 West Bengal

West Bengal covers an area of 88,752km^2 and is divided into 20 districts. It is the only state in the country that has extent from the Himalayas in the north to the Bay of Bengal in the south. Such topographic and climatic diversity makes it a land of rivers with around 29 drainage basins. The main flowing through the state is river Ganga which divides the state into North and south Bengal. There are around 17 major rivers and their tributaries flowing through various regions of the state. The rivers are divided into five groups, namely: i) the rivers of North Bengal; ii) the Ganga-Padma system; iii) the Bhagirathi- Jalangi-Churni system; iv) the western tributaries to Bhagirathi and v) the tidal creeks of Sundarban. [20]

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[18] https://www.outlookindia.com/newsscroll/ngt-dismisses-plea-against-bihar-govts-policy-on-sand-mining/1684091 (12 Dec. 2019)

[19] https://www.moneycontrol.com/news/india/ngt-constitutes-fresh-committee-to-probe-illegal-sand-mining-in-bihar-4984181.html (27 Feb. 2020)

[20] https://sandrp.in/2017/03/28/west-bengal-rivers-profile/

Ecological Impacts: Sand extraction is extensive along the Hooghly and Ganga in West Bengal, whereas in the northern part of the state sand, gravel and pebbles are regularly mined in the Himalayan rivers, especially the Teesta, Mahananda, Balason, Jaldhaka, Sankosh, Leesh, and many others (Ohdedar 2017, Wiejaczka et al. 2018, Rai et al. 2019). Gravel mining is likely to have affected fish species along the Terai tracts of North Bengal (Barman & Das 2014). In the Ganga and Hooghly, sand mining and dredging are frequently seen. The Gangetic river dolphin population in the Hooghly may be around 230, and the river has massive vessel traffic, dredging, as well as sand mining in many stretches (WII 2018). In the tidal and estuarine sections, sand mining is relatively lower than in the upriver sections, because sea sand or salinized sand are less preferred for construction materials. Fishing activity is significantly affected by SM-DR and vessel traffic along the Hooghly around Tribeni (Das et al. 2013). "Sand mining not only erodes river banks but also degrades the river's ecosystem, affecting fishes and dolphins. Besides this, depletion of sand in the streambed deepens rivers and estuaries and enlarges river mouths and coastal inlets – leading to the intrusion of saline water from the sea," says BC Barman, deputy director (hydraulics) at the River Research Institute in Nadia. Many fishers have also taken to sand-mining for additional incomes along the Hooghly. Heavy metal pollution (e.g. of Nickel) is also high in the Hooghly and Jalangi rivers, and in many other rivers of eastern India (CWC, 2014). The Damodar river is also subject to heavy sand mining, with adverse impacts noted on its water quality and channel morphology (Ghosh et al. 2016, Maji 2019).

Fig. x: Major rivers of West Bengal (Source: www.mapsofindia.com)

Social Impacts: A 10-year-old boy, Eyas Oraon, tripped while playing with friends on an islet of the Leesh river in Jalpaiguri, fell into a 15 feet by 30 feet illegal sand mining pit and drowned on July 8, 2019. According to police sources the pit was illegally dug to extract sand and rocks for use in construction work. Officials in the administration, however, declined to comment on the incident, maintaining that steps were being taken to stem illegal SM in the region.[21]

Two rival gangs with alleged links to the ruling Trinamool Congress clashed in Birbhum district with bombs and guns on April 21, 2017 killing at least eight people. Police officials told media persons that the toll could be higher as villagers reported more bodies lying in the fields. Local people said that Darbarpur village – about 180 km to the North-West of Kolkata – had turned into a battlefield for hours over control of sand beds, wounding several women and children. Clashes over control of

[21]https://www.ndtv.com/cities/jalpaiguri-west-bengal-10-year-old-boy-drowns-in-illegal-sand-mining-pit-in-west-bengal-says-report-2066016 (08 July 2019)

dry river beds, the bedrock of a thriving illegal SM industry – are not uncommon in these parts of Bengal but the scale of the Darbarpur violence stunned the administration.[22]

Rampant mining of sand and excavation of boulders was threatening the Patal-Bari — a heritage building on the banks of the Hooghly at Chandernagore, besides several other residential buildings in the town – including the office of the Red Cross Society – according to Biswajit Mukherjee, a former chief environment law officer of the West Bengal Pollution Control Board. "All the three major river basins of the state – the Bhagirathi-Hooghly basin, Damodar basin and Teesta basin – are being threatened by this illegal industry. The authorities, including police personnel, know what's happening but do little to stop it," an irrigation department official told a Hindustan Times correspondent. The Chief Minister, Mamata Banerjee, had to ask the concerned authorities to monitor the sand mining activities as they were threatening the ecology of several rivers in West Bengal.

Many Himalayan rivers in northern West Bengal are rich sources of boulders, sand and stone chips for illegal miners, who excavate and transport the raw material to places within the state as well as Bihar and Bangladesh. As the operation is entirely illegal, authorities have little idea about its quantum. In 2016, local people in the know estimated that there were at least 500 quarries in Darjeeling, Jalpaiguri and Alipurduar and Cooch Behar districts alone. Experts told the HT correspondent that the real estate boom in West Bengal and nearby states was aggravating the problem. Cracking down on the illegal units would hit the common person with higher costs for construction material and also lead to less cash flow to political parties.[23]

Illegal Mining: With numerous rivers and one of the world's largest delta, West Bengal is a hub of illegal sand mining. Apart from the rising demand for sand, the lack of employment opportunities is driving the people towards this activity. In fact, the backward districts of West Midnipor and Birbhum are the major contributors to the state's revenue collection among the 11 other districts where sand mining is rampant. Though it is claimed that the revenue is generated from licensed sand miners, there is a drastic increase in the illegal mining. Several local people have reported the presence of large number of huge trucks and excavators on the Ajay riverbed near Santiniketan or Damodar river at Kamalpur and many more sites. [24]

District officials claim that digging beyond 200 cubic feet of riverbed is illegal. In reality, the illegal local sand miners are openly violating these norms and exploiting the rural Bengal. The excessive mining have created large sand pits on the riverbeds which have become common sights of accidents. In 2019, a 10 year old boy slipped into a 15 feet by 30 feet trench and lost his life while playing near the Leesh riverbed in Jalpaiguri. Several such incidents have been reported all around

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[22]https://www.hindustantimes.com/kolkata/8-dead-in-bengal-s-birbhum-after-gangs-with-alleged-tmc-links-battle-with-bombs-guns-over-sand-beds/story-gEDPnBSFNkr3xFDlp0F0dM.html (21 April 2017)

[23]https://www.hindustantimes.com/india-news/green-hopes-run-dry-as-rampant-mining-goes-unchecked-in-bengal/story-JrLcS1qhF2DiCLwKcSZjhL.html (11 July 2016)

[24] https://sandrp.in/2019/02/21/east-india-sand-mining-2018-will-ngt-order-help-restore-subarnarekha-river/

the state[25]. Illegal mining in the Subernarekha river have affected the farmers to a great extent. The mafia along the borders of West Bengal and Odissa have been extractiong sand from the middle of the river using pumping machines. This has significantly reduced the flow of the river, and the farmers are left with very little water to irrigate their lands.

In addition to water shortage, the foundation of houses built in the riparian zones have shown signs of damage and consecutive rupture. It is claimed that hundreds of high power pumps function along the riverbed lading to its rupture. Such drastic effect on the ecology, life and property of the people compelled social activist and convenor of Jaleswar Bikash Manch Sudarshan Das to move the NGT-Kolkata against the Collector and SP of West Midnapore. Despite NGT's order to seize the machines of mafia and take steps stop the sand mining, the Collector and the SP made no such effort. Sudarshan Das further appealed to the principal bench of NGT, but the West Bengal administration made excuses to postpone the hearing. After reapeated appeals, proper investigation was conducted by the court. It revealed that gorges as deep as 30-40 feet was formed in the entire area with zero efforts to restore it. Finally, NGT ordered West Bengal and Odissa authorities to recover the cost of environment restoration and compensate affected people. The excessive minng in the Subernarekha River, if not controlled can lead to sea water ingress which will increase the problems of farmers in the region and case scarcity of drinking water.

B.3 ODISHA

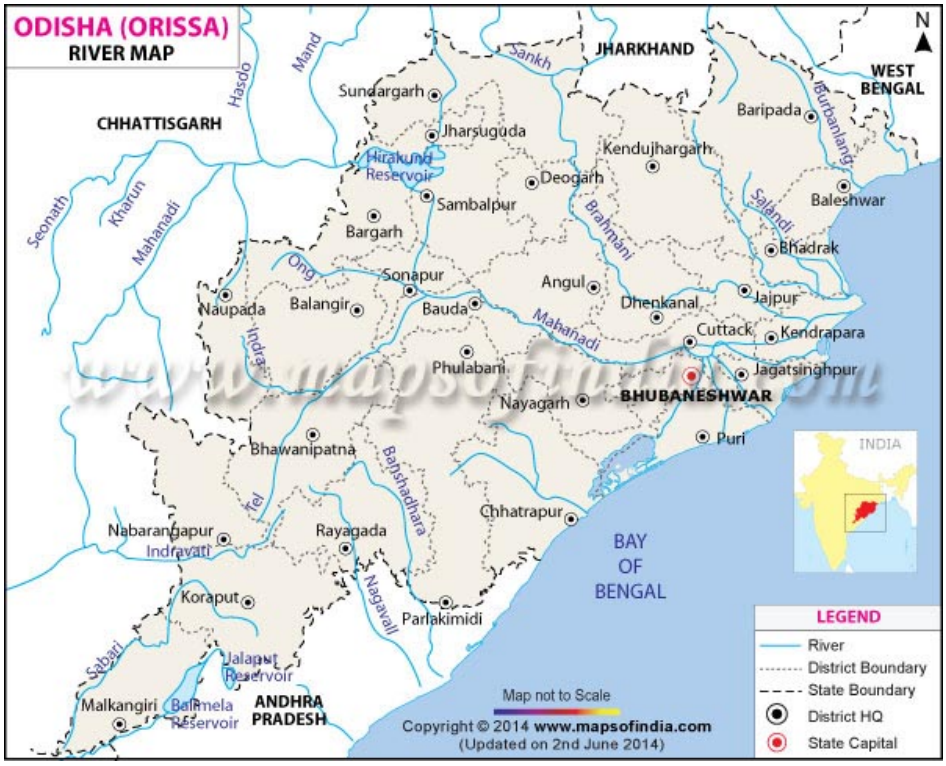

Figure 4 river map of Odisha (source: www.mapsofindia.com)

[25]https://www.ndtv.com/cities/jalpaiguri-west-bengal-10-year-old-boy-drowns-in-illegal-sand-mining-pit-in-west-bengal-says-report-2066016

The eastern coastal state of Odisha represents 4.74% of the area of India, i.e., 155,707km^{2}. The climate is tropical with an average rainfall of 1450mm. Odisha is known for its natural resources, be it minerals like copper, iron, chromium etc or the rich forests or rivers or coasts, Odisha has it all. A population of 41.9 million resides in the 30 districts of the state. Odisha is drained by 11 major rivers and their tributaries, sperated by ridges. River Subernarekha drains the north of Mayurbhanj district whereas Budhabalang river drains the Balalsore district. The Brahmani river flows though the districts of Sundargarh, Debgarh, Angul, Dhenkanal, Jaipur and Kendrapara. The Mahanadi river drains the districts of Sundargarh, Jharsuguda Sambalpur, Baragarh, Sonepur, Balangir, Nuapara, Cuttack, Jagatsinghpur, Khurda and Puri. The districts of Nabarangpur, Malkangiri and Korapur district drain into Kolan and Indravati rivers while Rayagara and parts of Gajpati districts drain into Vansadhara and Nagavalli Rivers. All these rivers travel though the steep slopes and finally drain into the Bay of Bengal.

In Odisha, the Mahanadi River is the most affected by sand mining, and is also the river with the most threatened biodiversity, having gharials, freshwater turtles, and nesting sites of Indian skimmers, and black-bellied terns. Other rivers affected by high sand mining are the Brahmani and Baitarani,Ib, Kathajodi, Subarnarekha, and Vamsadhara rivers.[26] Khaoash et al. (2018) calculate an average deficit of approx. 34% between the geologically available reserves of sand from 15 sites along the Mahanadi and Kathajodi rivers, and find that reduction in river flows by dams have also contributed to excessive sand mining.Choudhury et al. (2012) summarize conflicts over river sand mining as emerging from poor flows and pollution in the dammed Brahmani and Baitarani riversin Odisha's Kendrapara district.

Such extensive network of rivers has lead to several illegal sand mining activities. The illegal sand extraction has caused ecological imbalance of the rivers in addition to negatively impacting life and property of people. Over the past decade the incidences of protests and violence against the sand mafia have seen a gradual increase in the past decade.

Illegal sand mining has caused resentment among people who are greatly dependent on the rivers for livelihood. Villagers of Bholasingi and Pundal village organized a rally to demand a ban on the sand mining from the Bahuda and Sona river. The residents of Pudal village also staged a road blockade and demanded enforcement of CrPc Section 144 at the mining site. They highlighted the fact that, Pundal ghat was not leased for mining sand and that the mafias have violated the norms. Similar cases have been observed in the other districts as well. The rampant sand mining has lead to rapid erosion of the river banks, posing a threat to the riparian population. [27] In addition to river banks, the embankments in the Mahanadi river have also started to get damaged as a result of excessive erosion due to the rampant sand mining.

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[26] https://sandrp.in/2020/10/29/odisha-river-sand-overview-2020-another-mining-ravaged-state/

[27] https://sandrp.in/2019/02/21/east-india-sand-mining-2018-will-ngt-order-help-restore-subarnarekha-river/

Figure 5 The embankment of Mahanadi river damaged in a village in Jagatsinghpur district. (Photo | EPS)

The illegal mining in Odisha has also spurred in the recent years due to illegal brick kilns. A large amount of soil/sand is consumed in the brick kilns which are directly mined from the riverbed or encroached government and pastureland. The mushrooming growth of brick kilns in the Keonjhar district and neighbouring areas have contributed to the degradation of air quality as well as warming up of the atmosphere in the region.[28]

With the onset on lockdown, police officials were mostly devoted in managing strict regulations. The sand mafia and unthorized brick kilns took the benift and increased their activities. Rampant illegal mining was observed on the banks of Mahanadi, Kathajodi, Chitrotpala, Luna, Devi and Birupa violation the State Government's lockdown order. The Udala tehsil near Mayurbhanj and Nilagiri, were facing a loss of Rs 50,000 daily as the sand mafia took advantage of preoccupation of government officials during COVID.

The locals living along riverside like near the Mahanadi river, Devi river, Daya river and many more have repeatedly mentioned about the existing nexus between the sand mafia and politicians. Inspite of numerous complaints, officials seem to turn a blind eye towards the illegal activities in most districts.

The sand mafia in the state has gained a lot of power and resort to unlawful activities to stop people from exposing them. It is quite clear as a result of series of cases of violence in the state. In May 2019, journalist named Pratap Patra was attacked and severly injured by mining mafia due to his report on illegal sand mining a few days back. In January 2020, a young activist named Mantu Tarei was crushed to death as he tried to stop the sand smugglers on the banks of Jambhira River in Susumari village. In a similar event, a RTI activist named Rajan Kumar Das was found dead in Kendrapada in February 2020. Das was known to raise his voice against the illegal sand quarrying, brick kilns and some allegedly venal NGOs in the area. The mafias didn't even spare an elderly woman protesting against the sand mining.

[28] https://www.orissapost.com/brick-kilns-spur-illegal-sand-mining/

Figure 6 Pratap Patra, a reporter of leading Odia daily Samaj was allegedly attacked by the sand mafia in Balasore.(HT PHOTO)

The lack of admininstrative actions compelled the villagers to interwine against the sand mafia. The locals in the Kolidaspur village staged a demonstrartion in the Hinjli police station of Ganjam district. Upon arrest of 6 people, the agitated villagers pelted stones. The police then resorted to lathi charge.

The government of Odisha in an attempt to reduce illegal sand mining decided to set up a separate regulating agency. The agency is expectd to take strict acticts and undertake robust monitoring mechanism using technology to prevent the illegal lifting and theft of minor minerals. By August 2019, the state government of Odisha set up a Directorate of Minor Minerals. It is functuning under administrative control o revenue and disaster management department. The state government also intiated steps to formulate a new mining policy for the state. The effective implementation still remains a big question!

Meanwhile, the National Green Tribunal in October 2020, restrained sand mining along the Brahmani river bed in the Kendrapara district. It ordered the Chief secretary to take action against the Kendrapara Collector and Sp for filling incorrect documentation. The protests of the villagers of the Panchughanta complaining against the severe air pollution and environmental damage were heard by NGT. The NGT's Principle Bench verified the allegations and banned sand mining in the Subernarekha River in August 2020. Under all norms, usages of heavy machineries are prohibited and violation continues. Though the government support and actions are negligible, the proactive steps taken by several locals do give us the necessary hope. [29]

[29] https://sandrp.in/2020/10/29/odisha-river-sand-overview-2020-another-mining-ravaged-state/

B.4 JHARKHAND

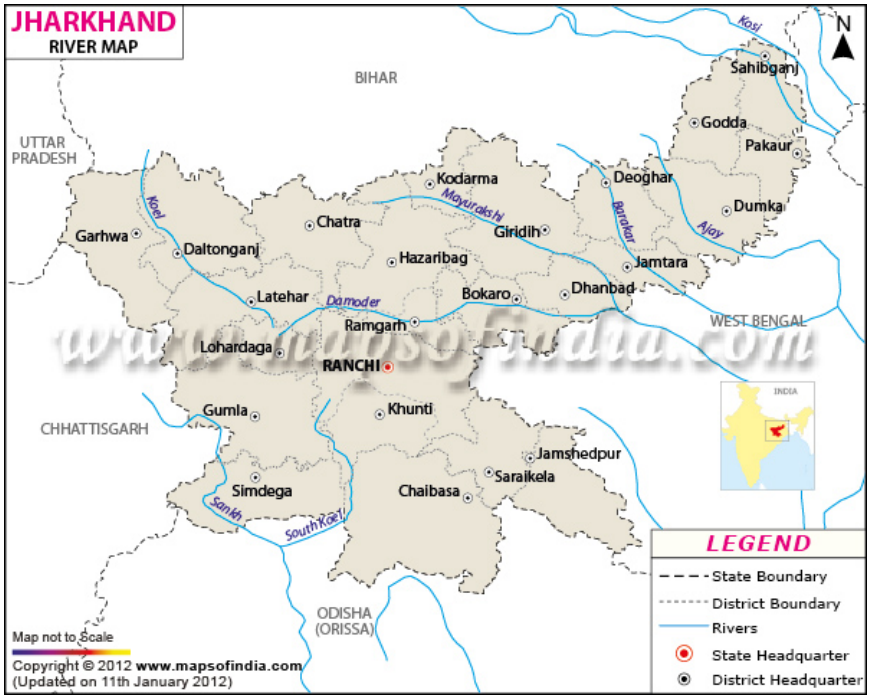

Figure 7 river map of Jharkhand (source: www.mapsofindia.com)

Jharkhand state has the North and South Koel, Damodar, Mayurakshi, Ajay, Barakar, Sonith, and Subarnarekha rivers. The Sahibganj district of the Jharkhand state is the only district with the Ganga River flowing through. The Sahibganj stretch of the Ganga is affected by frequent river dredging, as it is located on National Waterway No. 1. The stretch is also being developed as a multi-modalhub terminal and major river port. A water withdrawal project is also being constructed near Sahibganj, which will divert Ganga river water to the Adani thermal power plant at Godda, Jharkhand. The other area with significant sand mining is near Rajmahal along the Ganga further downstream of Sahibganj. All other rivers have witnessed significant sand and gravel mining, which have had several hydrologic and geomorphologic impacts (Maji 2019). As Jharkhand is also a state with several mines and coalfields, sand and gravel mining is a significant issue.

The problem of sand mining along the rivers of Jharkhand is quite rampant. Most of the important river ghats are mined for sand. Though the sand mafia is quite proactive in the region but the villagers along with some of the officials have come forward to stop the illegal sand extraction. Some of their efforts did reduce the illegal sand mined while the others led to violence. Such an incident happened in the Jatpura district where three men of the same family were shot dead by the mining mafia when they protested against the illegal activities.[30] Ina similar incidence, 14 villagers were injured ina clash over lifting sand from the Koyal river in Pratappur. The villagers claimed that, the village headman misused his power and allowed illegal sand mining instead of restricting extraction for local requirement only. In addition to standing up against sand mafia, the locals from the Gumla district held a Circle Official captive for not taking proper action the illegal miners.

The administration in few districts of Jharkhand has also tried to take some steps to curb the problem of illegal sand mining. In the Garhwa district, the administration blocked the road leading to the river bank by digging trenches while some of the forest officials in Parasapani Kala village cut off a road along Kanhar river to prevent the illegal mining. Some officials also had to face the wrath of the

[30] https://www.theguardian.com/world/2017/dec/30/india-sand-mining-conflict-deaths-building-boom-environmental-damage

mafia while trying to take steps against them. Repeated threats to family and administrative transfers are quite common. In such an incidence, the illegal sand miners stated to pelt stones at the team of officials led by Nitish Kumar Singh while raiding the banks of Damodar river[31].

Despite the continued actions by the police and mining department, the illegal mining and transportation of sand did not stop. The state also announced its first state owned sand mine in Khunti district and plans on opening several others such state owned ghats around the state. While the state is planning on auctioning sand ghats to private parties, the requests of lease for the Steel Authority of India Limited (SAIL) are kept on hold. The SAIL claim that absence of sand affected the coal production as well as the safety of workmen. Sand is very important for backfilling or stowing of the mines.

The changing ecology of the rivers resulting from illegal mining and lack of actions from the state authorities forced NGT to take strict actions and banned mining in the state during monsoon. Sadly, the ban wasn't effective to stop the mining mafia and other illegal activities. Villages claim that mining mafias drive the tractor, trolleys and trucks inside the river in Subernarekha in Jamshedpur. The situation is similar in the Seraikela area and Baharagora area. The authorities also paid no heed towards strict implementation of the ban. While the blanket ban in Jharkhand wasn't a success, it did increase the price of the commodity causing shortages for the ongoing projects. Many claim that the on-going construction work under the Central Government's flagship schemes like Pradhan Mantri Awas Yojanan, Swachh Bharat Mission etc. contributed majorly for the failure of the ban.[32]

B.5 CHATTISGARH

Chhattisgarh state includes three river basins: the Mahanadi, Indravati, and Rihand (Son) basins. The main system considered here is the Mahanadi basin (see Introduction). In Chhattisgarh, owing to the large areas under forests and coal mining blocks, and Naxalite activity, many rivers may have low levels of sand or gravel mining. Most mining is likely concentrated near the larger coal and iron ore mining blocks. The Mahanadi, Rihand, Hasdeo, Sheonath, Kharun, and Arpa rivers are known to have gravel and sand mining (Mishra 2016). Not much is known regarding the impacts of SM-DR on river biota. Threatened fish species are likely to be locally affected.

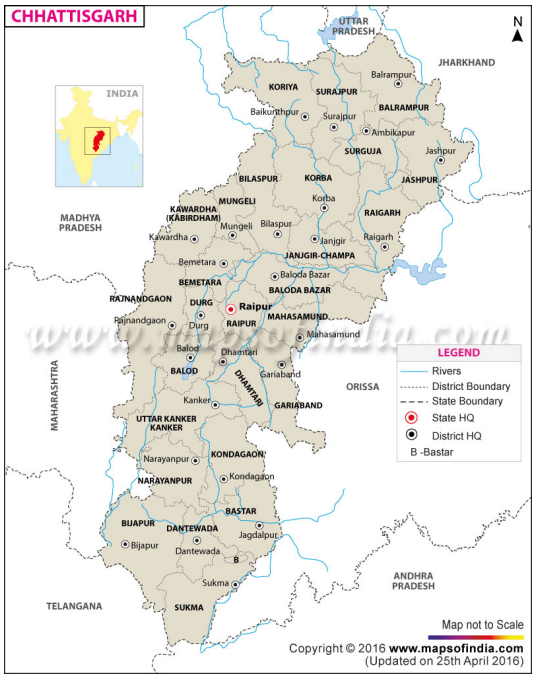

Figure 8 river map of Chattisgarh (source:

However the some instances of brutal violence on journalist has been reported recently. In Bastar region, the editor of a regional newspaper named Bhoomkaal was publicly beaten and slashed with sharp weapon for

[31] https://sandrp.in/2020/10/30/riverbed-mining-2020-east-north-east-india/

[32] https://sandrp.in/2017/12/19/illegal-sand-mining-2017-rivers-continue-to-loose-mindless-mining-battle/

reporting against the sand mafia just 100 meters away from the Kanker Police Station. He was rescued by a group of journalists. But no strict action was taken by the police. He then started a campaign for journalist protection law. Similar cases have been reported in various region of the state.

The sand from the Shivnath river is openly extracted by the sand mafia. It a small tributary of the Mahanadi river and the sand is openly looted from various places like Ratapaayli, Ghorda, Medha, Sukhri, Barsantola, etc. activists claim that the government support and oppose the activities depending on their benefits at the given time.

The state government in an attempt to reduce the misuse and political nexus, baared the panchayats from controlling the extraction and trading of the sand in February 2019. The right was given to the village government under the three-tier Panchayati Raj Act. However, repeated reports of illgal mining and misuse of provisions forced the state government to forfeit the rights.

B.6 ASSAM

Cradled in the bosom of the Himalayas,the northeastern state of Assam is situated along the Brahmaputra and Barak River valleys. The state of Assam covers an area of 78,438Km^2 most of which falls within the drainage area of Brahmaputra river system.

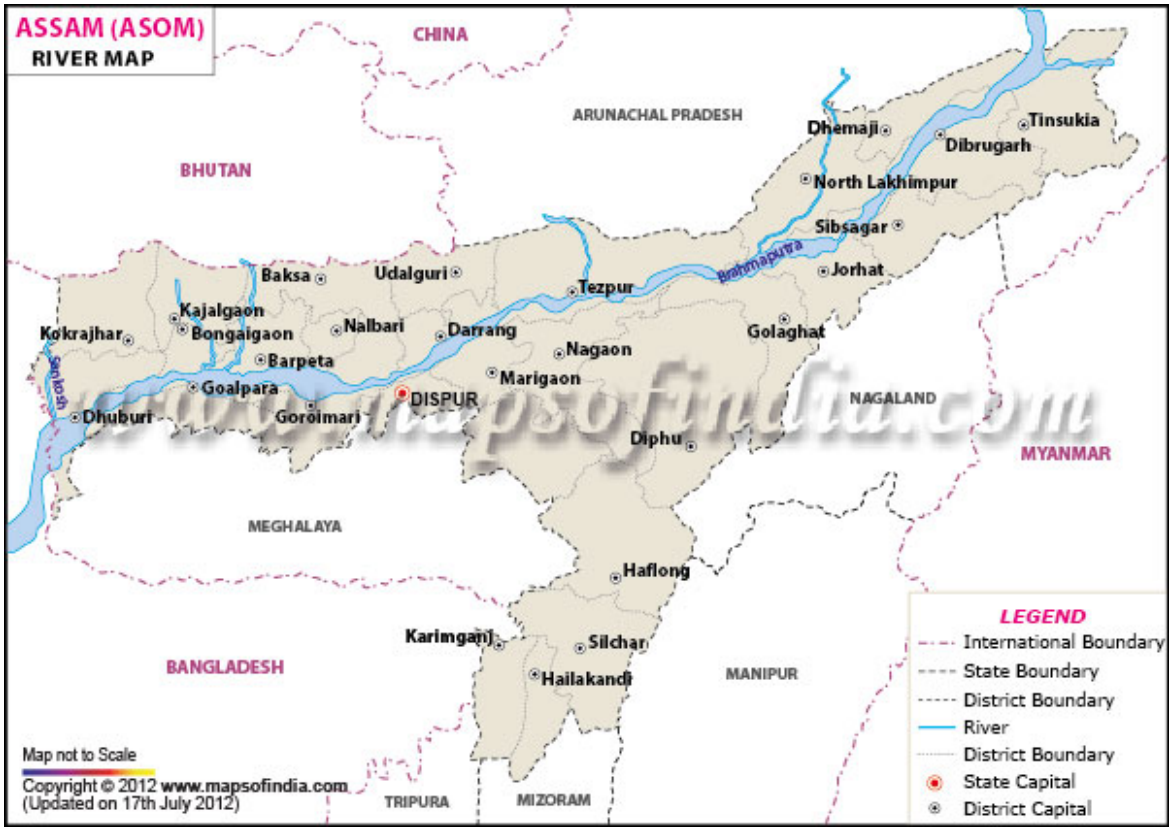

Figure 9 river map of Assam (Source: www.mapsofindoa.com)

Therefore it is needless to say that the Brahmaputra and Barak Rivers along with their tributaries heavily influence the geomorphology of Assam. Some notable tributaries of the Brahmaputra are Laikajan, Dibru, Dumduma, Dangori, Jiabharali, Sadharu, Sarikoria and Gai. Blessed by such a high drainage density, Assam also has to face the problems associated with it. Annual extensive floods wreak havoc in the state on a yearly basis, water pollution becomes a serious threat as the rivers pass through densely populated town or cities (the Bharalu River, BasisthaRivers passing through Guwahati in Assamarehighly polluted) and the ever increasing ecological threat caused due to illegal river bed sand mining .[33]

Due to the large number of rivers flowing through the state the potential risk for unchecked sand mining and associated illegal activities is also high.

On the banks of Kharkhari River, a distributary of the Kulshi River (which is a tributary of Brahmaputra), famous for being the habitat for freshwater dolphin, more than 40 villages face acute shortage of water due to lowering of the river bed. The primary cause for this has been attributed to be unregulated large scale sand mining. Such unscientific and unsustainable mining practices have taken a heavy toll on the paddy production which is the principal crop for the farmers of the villages in the locality [34].

Apart from this there have been many reports of illegal sand mining in the Kamaljhari area of Assam [35]. Also there have been reports of officials aiding and abetting the illegal sand mining activities.[36]

Reports of mining of sand and gravel at alarming proportions in the hilly districts of KarbiAnglong have been made. Through this district many rivers pass. KarbiAnglong alone provides for the sand resources needed in Dimapur (Nagaland) and parts of Manipur and thus a black market for sand has developed in this region which has become a lucrative job option for the local youths.

Other similar reports of illegal mining activities have been made from the Hailaakandi district of southern Assam[37], in the Kaziranga National Park area where it was reported that along the southern boundary of the area more than sixty illegal stone quarries were operational [38]. In the Balipather area of Bokajan, illegal mining activities with the helpof suction machines are carried out in broad daylight. Such mining activities not only disrupt the local ecology but amount to millions of Rupees

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[33] https://sandrp.in/2017/06/13/north-east-india-rivers-profile-brahmaputra-basin/#more-24499

[34] https://bit.ly/2Co0wRC

[35] http://www.assamtribune.com/scripts/detailsnew.asp?id=mar2118/city067

[36] https://timesofindia.indiatimes.com/city/guwahati/forest-official-held-in-sand-mining-racket/articleshow/64271910.cms (22 May 2018

[37] http://www.uniindia.com/~/suspension-of-sand-mining-operation-in-southern-assam-district/States/news/1240795.html (24 May. 2018

[38] https://www.downtoearth.org.in/news/mining/assam-bans-mining-in-kaziranga-after-supreme-court-order-64299 (02 May 2019

loss in terms of revenue as no royalty is paid to the Forest or the concerned Department[39]. Illegal mining on the Brahmaputra river bed pose a serious threat to the destabilization of the Dibrugarh Town Protection (DTP) dyke. But still, truckloads of excavated sand come from Maijan, Mohanghat and Jokai area daily [40].

While tackling these issues and trying to put an end to illegal sand mining the biggest hurdles come in the form of the officials and the law enforcers themselves. Reports of Police officials being bribed to give pass to sand traders [41], forest officers issuing fake challans to run the mining operation, not only tarnish the credibility of the institution but also directly fuel these illegal mining practices. Still, timely actions of officials have proved to be effective in places. Acting on information regarding illegal mining, a team of Sonapur forest officials demolished around 20 illegal miing sites in the Kamlajhari area, seizing mining equipment and sand transporting trucks. This was the fourth of such operations carried by the Sonapur Forest Range as the sand mafia seem to be able to rebuild their operation after every such raid [42]. Following a probe under the direction of the minister for environment & forest and the Deputy Commissioner, Hailakandi, four sand mining units were temporarily shut down in Hailakandi district[43].

In another action against illegal traders, forest officials seized 9 trucks laden with illegal sand mined from Sonaikuchi, Kamalajari and Jugadal areas by digging sand from cultivable fields or from the Digaru River. Along the NH-39, huge mounds of illegally excavated sand can be seen openly but very little is done to enforce regulations and stop such wanton exploitation. Allegedly this practice is done under the knowledge of the forest department.[44]

Figure 10 trucks carrying illegal sand seized in the Sonaikuchi, Kamalajari and Jugadal areas

[39] https://www.sentinelassam.com/north-east-india-news/assam-news/sand-mining-goes-unregulated-in-karbi-anglong-with-uncontrolled-mining-from-river-beds-and-agricultural-lands/ (03 June 2019

[40] https://nenow.in/north-east-news/assam/assam-illegal-sand-mining-poses-threat-to-dibrugarh.html

[41] https://www.eastmojo.com/assam/2019/08/01/assam-cops-caught-red-handed-taking-bribe-for-illegal-sand-mining (01 Aug. 2019

[42] http://www.assamtribune.com/scripts/detailsnew.asp?id=mar2118/city067 (21 March 2018

[43] http://www.uniindia.com/~/suspension-of-sand-mining-operation-in-southern-assam-district/States/news/1240795.html (24 May. 2018)

[44] https://www.sentinelassam.com/north-east-india-news/assam-news/sand-mining-goes-unregulated-in-karbi-anglong-with-uncontrolled-mining-from-river-beds-and-agricultural-lands/ (03 June 2019).

In the form of Judiciary action to combat illegal mining activities, the Supreme Court in April 2019 banned all mining and related activities in the Kaziranga National Park. This came following a report of the Central Empowered Committee on the status of mining in the Park and KarbiAnglong Hills. On compliance with this hearing, on 5th September 2019, the state gaverment asked the director general of the Police to make sure implementation of the ban was upheld and no illegal mining is done. Following this the DGP issued notice for all mining equipments and installation of GPS on said mining equipments. The Forest department was also instructed to digitize transit passes and be accountable for all transportation vehicles carrying mined materials from KarbiAnglong, Golaghat and Nagaon districts. Despite all efforts illegal mining activities are still underway in the KarbiAnglong region. Apart from this, the Forest and Environment Minister ParimalSukalbaidya in 2018 announced all that leases for stone quarries and all other minor mineral mining areas will be bought under an e-auctioning mechanism. This decision was made to bring about transparency to the mining activities. The Government also planned for using an app based GPS technology to monitor mining activities and streamline the mining process. As per official records, in 2017-2018, the forest department earned revenue of Rs 160 crores of which 90 percent came from mining of minor minerals. This fact alone is enough to testify the importance of the need for regulated sand mining in the area (https://sandrp.in/2019/02/19/north-east-india-sand-mining-2018-emerging-threat-to-rivers/).

B.7 MANIPUR

The northeastern state of Manipur is home to many rivers. The state covers an area of 22,327 km^2 and is divided into 16 districts. The state comprises of two major river basins, namely: the Barak River Basin and the Manipur River Basin. The Barak River originates from the Manipur hills and flows through Assam then to Bangladesh. It is joined by several tributaries like Irang, Maku, Tuivai etc before entering Assam. The rivers are young in nature and most of them are harnessed for hydroelectric projects. The Manipur River Basin rises from the Kangpokpi in the Senapati district and is joined b the Iril River from the south and Thoubal River from the east. Other major rivers include, Imphal, Nambul. Sekmai, Chakpi and Khuga. Most of the rivers in this basin are mature and deposit the load in the Loktak lake[45].

The large sediment deposits have lead to sand mining in the river banks. Among the several rivers draining Manipur, the Thoubal river sand mining has been in limelight. The unabated sand mining has caused large scale erosion and pollution of the waters. The extraction of red sand degraded the condition of the Thoubal River and also endangered the surrounding forest area. After a surprise inspection of the area, the District forest Officer RK Amarjit banned all types of sand mining from the river as well as the hills.

Inspite of the ban, the sand mining activities continued in the state causing further damage to the river. An inspection was conducted by a team of team of journalists and press perSonnel along the banks of Yairipok to Itham Moirangpural. They found that istead of red sand now black sand was

[45] https://investinmanipur.nic.in/gp_drainage.htm

mining extensively using heavy machinery. The locals played a very important role in checking the red sand mining but all in vain. In February 2019, several conservationists along with the locals staged protests at various locations in Thoubal district to draw the attention of the government towards the protection of the river. The lack of effective measures as well as response from the government agitated the people. The committee formed for the conservation of the Thoubal River, called for a 24-bandh in the Thoubal district.

Figure 11 river map of Manipur (www.mapsofindia.com)

The residents living in the Thoubal district have been demanding for a pollution free river. A public meeting was held by the Thoubal River Conservation Committee(TRCC) to demand actions for river conservation. The meeting attended by a large number of people demanded actions from concerned authorities to stop illegal sand mining, usage of heavy machineries and cut the clearance permit for sand mining in addition to stopping residents from dumping garbage into the river. They also demanded the creation of new district environment impact authority for looking after this matter.

The issue of the Thoubal River was also raised during the Zero Hour of February 2019. The opposition MLA Surjakumar Okram drew the attention of the people towards the water pollution problems faced by the people of several constituencies. It was also highlighted that red sand was declared unfit for the construction purposes by the PWD, yet, sand mining is continued in the region.

Figure 12 picture of protestors asking the Manipur govt to save river Thoubal. (Image Source:NN)

In response to all the petitions filed by the Thoubal River Conservation Committee(TRCC), the State High Court led by chief justice Ramalingam sudhakr and justice Kh Nobin Singh passesd the interim order banning all unauthorized sand mining and stone quarry and other pollutiong activities near all rivers of the state. The TRCC highlighted the fact that Thoubal River is the lifeline of several villages in the state and the pollution in the river is drastically affecting the locals. The HC then expanded the ban to all the major rivers in the state like the Imphal River, Chakpi River and others.

The ban on stone and sand mining created unrest among the quarry workers. They were left unemployed as a result of the ban on sand mining. The workers demanded an alternate site for mining as it was the only source of income for them. To protest against the ban, the workers and transporters banned the supplies of sand and stones for all the government and private construction sites as well the import of sand from other states. The workers also called for a 14-hour bandh to get attention of the government. [46]

Admist such unrest, the Manipur Government decided to issue legal mining permits in certain areas for the sand and stone mining. A committee was set to look after proposals and identify potential quarry sites with less environmental damage. A temporary permit of 2 months was provided by the Public Works Department to certain private firms adhering to all the norms.

The problem of sand mining in the rivers of Manipur remained the same. The committee claims that even after 2 years of protests and petitions, the State government have failed to take any action, infact caused further degradation of the river. These lacks of actions have severely affected the local communities who are directly dependent on the river for their livelihood. In order to save the river, the locals even gathered and forced trucks to unload sand and stones along the Thoubal river. The activists of TRCC also tried to raise awareness among common people by conducting meetings and walks along the polluted river. Finally, the Manipur High Court took a suo moto PIL based on the complaint issued by the TRCC activist A Guneshwar Sharma. [47]

Though it might be a difficult fight against the sand mining industry, but the strong support and enthusiastic participation of the people in Manipur may bring positive changes with regards to saving the river.

B.8 NAGALAND

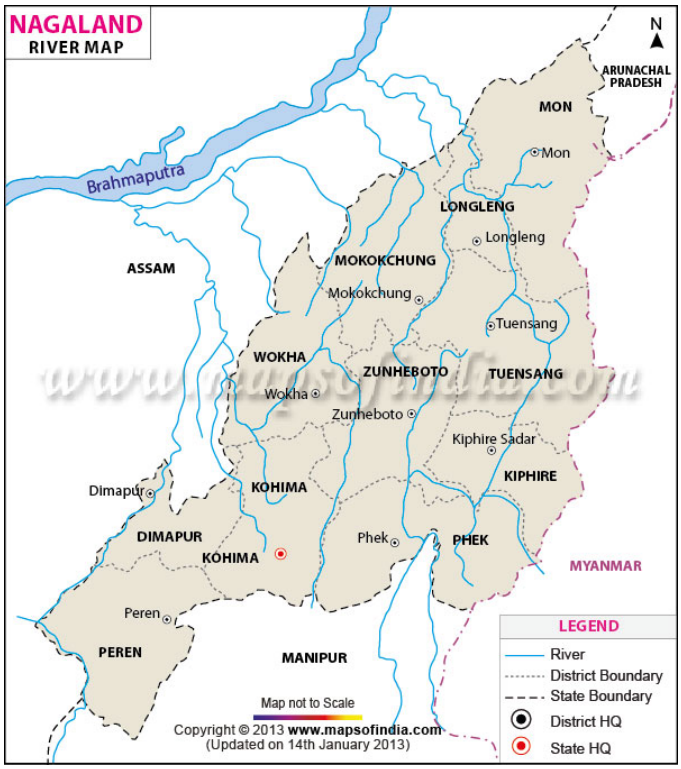
Nagaland is the smallest hilly state situated at the extreme north-eastern end of India. With an area of 16, 579 sq. km, the state is divided into 12 districts. [48]. Nagagland shares its boundary with Assam on the West and North, Mayanmar on the East, Arunachal on the North and Manipur on the South. Nagaland is dissected by a Number of seaSonal and perennial rivers. The major rivers of Nagaland include Doyang, Dilhu, Dhansiri, Tizu, Tsurong, Nanung, Tsurang, Tsumok, Menung, Dzu, Langlong, Zunki, Likhimro, Lanye, Dzuza and Manglu. The Dhansiri, Doyang and Dikhu flow

[46] https://sandrp.in/2020/10/30/riverbed-mining-2020-east-north-east-india/

[47] https://sandrp.in/2019/02/19/north-east-india-sand-mining-2018-emerging-threat-to-rivers/

[48] https://en.wikipedia.org/wiki/Nagaland

Figure 13 river map of Nagaland (source: www.mapsofindia.com)



westward to join the Brahmaputra while Tizu flows eastwards and join the Chindwin Riverin Myanmar. Though the rivers carry a lot of sediments, the sand found in Nagaland are not construction grade.

The sand required for various construction activities in the state is shipped from the neighboring state of Assam. However, over the years with strict laws in Assam, the sand suppliers have to face a lot of unlawful taxation[49]. This results in very high prices of sand in the state. The cost of 300 cubic ft of sand in Lungit, Karbi Anlong is Rs 2500 in contrast to Rs 17000 in Dimapur. The transport and business of sand is handled by the Sand Mahaldar and Suppliers Association (SMSA).The skyrocketing prices of sand have enraged the locals but the Mahaldars claim increased labour and transportation costs to be the reaSon for high prices. Furthermore, the ban in Assam on the export of sand has added to the miseries of the local people. Recently, in October 2020 the total ban on sand supply in Dimapur has been lifted. Such ban on import and subsequent price hike is mainly due to the fact the Nagaland have not explored its own resources.

The overall minor resources in the state as estimated by the Department of Geology and Mining Nagaland are about 317 MT. The resources include sand stone, marbles, granite and slates. The poor structural mechanism and lack of regulatory framework of the government is responsible for the lack of extraction and development. Addressing the issue, Nagaland Minor Mineral Concession Rules 2004 was framed under Section 17 of the Nagaland Act 1990. The rules were framed to outline the mechanism for granting of lease for various minor mineral [50]. But the irregularities and confusion among concerned authorities have caused huge revenue losses to the state government.

[49] https://sandrp.in/2020/10/30/riverbed-mining-2020-east-north-east-india/

[50] https://sandrp.in/2019/02/19/north-east-india-sand-mining-2018-emerging-threat-to-rivers/

B.9 SIKKIM

Sikkim is a small Himalayan state in the northeast region covering an area of 7,096 sq. km. The state is divided into 12 districts, most of which is drained by the Teesta River and its tributaries. Along with Teesta river, the extreme southeast of the state is drained by Jaldhaka river. It originates in the East Sikkim and flows through West Bengal parallel to Teesta river to meet the Brahmaputra river. The Teesta river flows in the southwest direction and defines the interstate boundary between Sikkim and West Bengal before joining the Ranjit river- the largest tributary of the Teesta river. Other tributaries of the Teesta river include Rangpo, Talung, Lachen and Lachung rivers.[51]

Figure 14 river map of Sikkim (source: www.maps of india.com)

Though the state has considerable amount of riverbed materials not much information is available on its extraction activities. The cases of violence or protests against the sand mafia have not been reported yet. Some wildlife conservationists have reported the impact of anthropogenic activities on the otters. India currently has three species of otters and are considered endangered due to their decreasing population. In the Himalayan region there habitats come under protected areas. The wildlife conservations claim that made made activites like construction of dams, sand mining and boulder collecton harm the river ecology. Though the activities are conducted beyond protected areas, they harm the connectivity between the aquatic habitats. Some of the locals state that, if the otters visit the river, the river is healthy. Increase sand mining and other activities are impacting these rare species in Sikkim [52].

[51] https://sikkim.pscnotes.com/sikkim-geography/drainage-system-and-river-of-sikkim/

[52] https://sandrp.in/2020/10/30/riverbed-mining-2020-east-north-east-india/

B.10 ARUNACHAL PRADESH

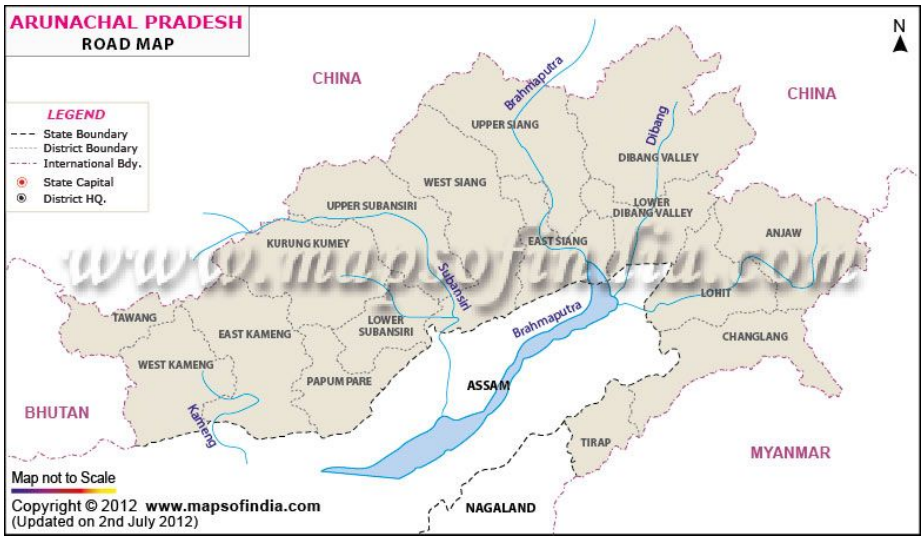


Figure 15 river map of Arunachal Pradesh (www.mapsofindia.com)

The state of Arunachal Pradesh is a strategically important state of the country. It shares international border with three countries namely, Bhutan in the west, Myanmar in the East and a disputed border with China in the north. The state cover an area of 83,743 sq km and is divided into 25 districts. The entire state is criss-crossed by rivers, streams and tributaries of the Brahmaputra river. The major river basins draining the state are Siang, Subansiri, Kameng. Lohit, Tirap, Dibang, Papumpare and Dri streams. The river Siang, Dibang and Lohit joins in the state of Assam at a tri junction to form the mighty Brahmaputra.[53]

The rivers bring in a lot of sediments which are mined throughout the state. Though it is well established that illegal mining is persistent in Arunachal Pradesh, not much information is available on it. Some reports on excessive sand mining in the Twang region surfaced in December 2017. Ina report by Tongam Rina, she highlighted how the rampant illegal sand and gravel mining have affected the migration of black-necked cranes in Twand. Twang is one of the two Indian winter habitats of the black-necked cranes that fly from Tibet at the end of every year. These cranes nest in the freshwater wetlands in high altitude. These birds arrive in Zemithang and Sangti and nest along 3km long stretch of Nyamjang Chhu river. Locals and activist claim that the ongoing mining activities are responsible for the declining number of cranes arriving every year. According to reports, the district authorities fail to take responsibility of the destruction caused by the sand mining. The general secretary of the Save Mon Region Federation, Lama Lobsang Gyatso appealed to the Twang's Deputy commissioner and divisional forest officer to stop the mining so that the wintering site of the black-necked cranes could be saved.

According to sources, there is a huge demand for sand and gravel in Tawang due to ongoing construction projects in China. Gyatso also highlighted that local administration and politicians are involved in the mining activities as one of the mining sites is located just near the administration office. Some of the Monpa Buddhists monks in Tawang also visited Zemithang to request people to stop the mining activities, but in vain. [54]

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[53] https://arunachalobserver.org/2017/09/26/arunachal-pradesh-land-rivers/

[54] https://sandrp.in/2020/10/30/riverbed-mining-2020-east-north-east-india/

Most of the Himalayan states are home to endangered and vulnerable species. If destruction of their habitat is continued, these rich biodiversity hotspots will be destroyed completely.

B.11 TRIPURA

Tripura is the third smallest state of the country covering an area of 10,491 sq km. The state is divided into 8 districts which are drained by 10 major rivers. The major river basin are Langa, Juri, Manu-deo, Dhalai, Khowai, Haora, Gumti, Muhuri, Burima and Fenni. Most of the rivers basins are present within the territorial limits of Tripura except River Fenni and Langai. The river Fenni and Langai drains Tripura, Mizoram and Bangladesh.[55]

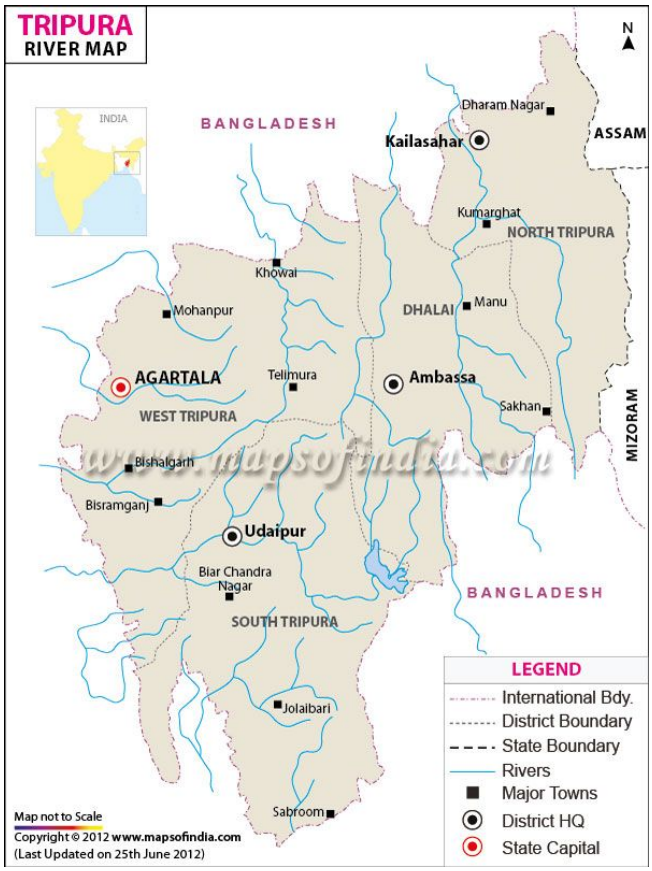

Figure 16 river map of Tripura (source: www.mapsofindia.com)

The sand found in Tripura is mostly referred to as glass sand. The sand mining activities in the state are mainly found in the rivers and streams. Though reports of violence is not common but the environmental impacts are huge. The river banks at several locations are crumbling down due to unabated lifting of sand. The National Highways are damaged due to rapid erosion as result od rampant sand mining. Similar reports have surfaced from districts along other rivers like Haora, Gumti, Deo, Khowai and its tributaries.

Due to the reckless mining the money spent by the government on conservation of riverbanks goes to waste. After the BJP-IPFT coalition government came into power in 2018, it imposed a ban on this illegal practice. The ban was adhered seriously in the beginning but later no steps were taken for its implementation. This illegal sand mining is carried out with full support of both ruling and opposition parties, as claimed by local people. [56]

The heavy machineries and the dust released have created pollution disturbing the residents. In addition the roads are also getting damaged due to the sand carrying vehicles.

The ban on sand mining have made several workers unemployed which forcd the to stage a protest. The workers affected blocked roads at the Agartala Bankumari to protest against the ban. The Forest Minister himself stated that majority of the sand mining activities in the state are illegal and have

[55] http://trpenvis.nic.in/surfacew.htm

[56] https://sandrp.in/2020/10/30/riverbed-mining-2020-east-north-east-india/

violated all the NGT and SC guidelines. He also added that the state government plans to fprm a committee to grant proper license before approving such activities.[57]

B. 12 MEGHALAYA

The state of Meghalaya is known for being one of the wettest regions in the world. It covers an area of 22, 430 sq km and is divided into 11 districts. Most of the rivers in Meghalaya are rainfed. The major rivers in the stateare Daring, sanda, Bugi, Dareng and Simsand in the Garo hills region. Umkhri, Digari, Umngot and Myntdu rivers in the Central and eastern regions of the state.[58]

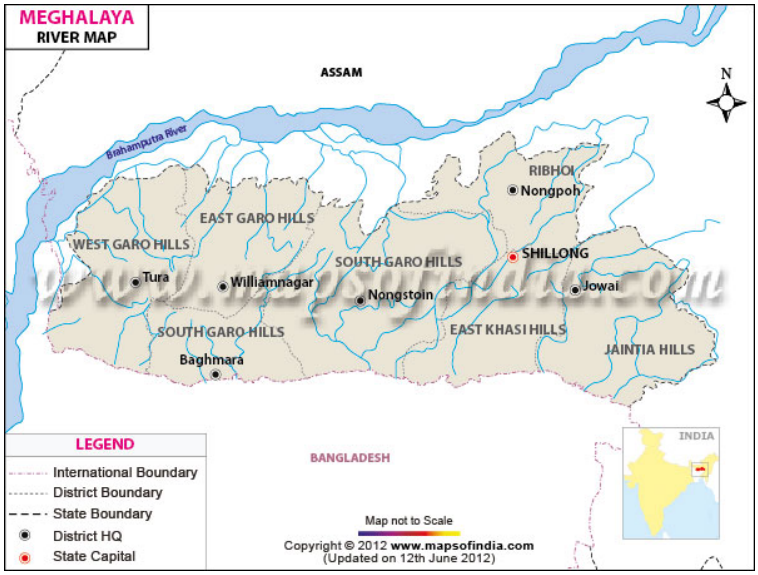

Figure 17 river map of Meghalaya (source: www.mapsofindia.com)

Excessive sand mining in the hilly sate can cause a lot more damage than any other geomorphological location. The Himalayas are in general very fragile and prone to earthquakes and landslides, anthropogenic activities like Hydroelectric projects and sand mining, can weaken the mountains even more. In the Garo Hills region, sand and stone mining is quite rampant. The rapid erosion caused as result of such activities is greatly impacting the ecology of the hills. However, since villagers are dependent on this activity for their livelihood, not much steps are taken to regulate it.

In July 2020, when some members of the All Meghalaya Minority Students's Union(AMMSU) in West Garo Hills tried to protest against the illegal sand smugglers , they were beaten up and had to sustain injuries. The activists tried to stop illegal mining along Jinjiram River near the Ginning Mill area bordering Assam where they were allegedly attacked by the smugglers from Assam.

Considering the environmental impacts of the sand mining, the District Magistrate of Ri Bhoi district, Nongpoh declared to ban sand mining 100meters upstream and downstream of the Umsning BUG bridge. The ban was applicable on the other rivers and bridges in the district. The DC further informed that all activities of sand mining must be conducted with proper permits and documentation

[57] https://sandrp.in/2019/02/19/north-east-india-sand-mining-2018-emerging-threat-to-rivers/

[58] https://meghalaya.pscnotes.com/meghalaya-geography/rivers-drainage-system-meghalaya/

as per the Meghalaya Minor Minerals Concession Rules, 2016. Also, sand mining won't be permitted during the breeding seaSon i.e. from the month of June to August. [59]

Addresing to the loss of livelihood due to ban in sand mining, Chief Minister Mukul Sangma suggested for measures to create a balance. He said that mining will be allowed in a restrictive manner and will promote the villagers to opt for alternative livelihood options. He also added if quarrying in the state is not reduced, Meghalaya might face similar catastrophe like Uttarakhand. [60]

3.0 KNOWLEDGE GAPS AND IMPLICATIONS OF SM-DR IMPACTS FOR ECOLOGICAL POLICY

There are numerous knowledge gaps in our current understanding of the impacts of SM-DR on ecology. These gaps range from understanding specific organismal responses, as well as complex and cumulative socio-ecological impacts. A good start would be to classify rivers according to the current and projected future levels of sand/sediment mining and dredging, and rank them as per their biodiversity attributes to assess relative risk. There is also a need to correlate the different levels of preference for river sand and sediment with the preferences exhibited by a few selected species of riverine invertebrates and vertebrates. Such exercises are indeed critical in the near future, to get a more accurate and finer sense of the impacts of SM-DR on riverine species of conservation significance, and in turn, on human livelihoods dependent on rivers. The present compilation provides a lead-in with regard to the potential hypotheses that could be tested in future studies, given what we know in general about the impacts of SM-DR on rivers. Most importantly, the evaluation of thresholds above which sand mining may not be permissible needs research inputs from river hydrologists, sedimentary geologists, and ecologists (Torres et al. 2017). SM-DR thresholds may need to be set at the scale of individual river stretches (rather than at the district level), but cumulative impacts need to be assessed at the basin scale (Koehnken &Rintoul 2018). At present, sand mining investigations are mostly at the reach scale, and cumulative impacts of multiple operations are rarely examined. Finally, experimental studies based on testing dose-response effects are critical in resolving the complex outcomes and impacts of SM-DR on species and ecosystems (Fisher et al. 2018).

Analysing the socio-ecological impacts of SM-DR in a coherent and interdisciplinary framework is crucial (Torres et al. 2017). Over and above their legal or illegal status, it is important to recognize the mode and manner in which SM-DR operations can affect river ecology, biodiversity, ecosystem services, hydrological attributes, and riparian environments at large. Measures to regulate sand mining mostly involve suggestions for spatial zoning or restriction of sand mining to low-biodiversity or human-impacted areas, granting licenses conditional on environmental standards being maintained, or licensing norms based on assurance of ecological restoration post sand-mining (Gavriletea 2017). Currently, sand mining policy guidelines (MoEF-CC 2016)involve multiple

[59] https://sandrp.in/2020/10/30/riverbed-mining-2020-east-north-east-india/

[60] https://sandrp.in/2020/10/30/riverbed-mining-2020-east-north-east-india/

procedural (who should apply, how to apply, whose jurisdiction, etc.) and environmentalregulation measures (how much area to be mined, how many cubic meters of sand allowed, how to mine responsibly, etc.).But these measuresmay not be related to the specific nature of mining operations and the local species involved. As this section has attempted to show, these details are probably critical for spatially varying biodiversity and environmental conservation priorities.

Sand mining has also been an artisanal livelihood and part-time occupation for many riverside communities, including fishers. In Uttar Pradesh, for example, fishing groups have claimed traditional rights for manual mining of sand or gravel from river floodplains (Doron 2013). In West Bengal, fishers have turned towards sand mining, as fish productivity has declined in most rivers due to dams and pollution (Chowdhury et al. 2016). It is assumed in conservation literature that small-scale or manual sand mining may not be ecologically detrimental. NE Indian states areplanning to promote manual sand mining with this assumption [61].However, this may be true when artisanal sand mining involves measures and intensities least detrimental to local ecology, e.g. small-scale sand mining through surface skimming. But the positive effects of small-scale and local mining may be diminished by the negative impacts of multiple claims for rights to sand mining. Sand is at the centre of ecological distribution conflicts over mineral resources in India (Bisht & Gerber 2017). Such complexities can only be addressed through a riverscape approach to management and conservation involving sound ecological knowledge and decentralized decision-making.

4.0 CONCLUSION:

[61] https://www.oneindia.com/india/northeast-states-want-manual-sand-mining-to-be-allowed-1313800.html

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