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Cover Page Footnote

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Grains of Gold - Excavating the Perils of Sand mining

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ABSTRACT: The human population and the global economy have been growing rapidly, increasing resource consumption. This paper evaluates the extent to which sand mining has an impact on the environment. Through a case study and regulatory analysis of India, this paper has attempted to underscore the consequences of excessive sand excavation while highlighting the case of the Indian "sand mafia". This secondary research evaluation finds that mining of sand resources is a common practice that leads to the destruction of the environment which adversely affects commercial and non-commercial living resources. While studies do point out that economic activities requiring sand as a material have been taking place in the developed countries, this paper shows how developing countries are also beginning to play a much bigger role in the global economy, thus having increasing impacts on natural resources and the environment.que volo optatur, corepudit velibus.

I. INTRODUCTION

Often mistakenly considered as an infinite natural resource, that can be found anywhere – beaches, deserts, river beds or mountains, records of the quantum of illegally mined sand are never maintained (Weiner 1963). The World-Wide Fund calls it the 'largest extractive industry on the planet' (Noronha 2001). Sand mining is an under researched and a lesser-known environmental hazard, that mostly takes place in isolated areas (Gavriletea 2017). Sand is a fundamental mineral in a society that serves as a buffer against tidal waves and storms, provides a habitat for a number of species and marine organisms, is used for making glass and concrete (Weiner 1963). These golden grains are a crucial ingredient in geopolitics (Weiner 1963) and are utilized for all kinds of economic and environmental projects like artificial islands, coastland stabilization and land reclamations. Recently, there has been a rise of a criminal network called the "sand mafia". Specially felt in India where the stockpiles of sand have been diminishing, mining of sand has been giving way to a growing black market and a thriving mafia-trader-politician nexus (Gupta, 2020).

II. LITERATURE REVIEW

Sand mining across the world

Around the world, and also in India, the main driving force behind sand mining is infrastructure[1]. The housing and infrastructure boom in India in the recent

1 https://www.downtoearth.org.in/blog/mining/why-unlawful-sand-mining-in-india-needs-good-governance-78773

years has built a massive demand for sand. According to the findings of India Water Portal (2018), extensive environmental damage is caused due to extraction of sand and gravel, exceeding the rates at which they are generated through natural procedures.

Apart from India, countries including Singapore, the United Arab Emirates and China consume exorbitant amounts of sand for domestic construction. China's domestic infrastructure policy aims to accelerate urbanization (OECD 2009)[2] by connecting remote areas to highly developed cities in the Southeast of China, along the Yangtze River and other coastlines. On the other hand, Singapore has increased its city size by 20% since the 1960s according to Singapore Department of Statistics (2020). Singapore was also accused of waging 'sand wars' in 2010[3] with neighboring states by paying smugglers to steal entire beaches overnight. This was the result of bans that were levied on sand exportations from Indonesia, Cambodia and Vietnam (Wilson 2015). Thus, a growing decline in supply gave rise to smuggling of sand and eventually, sand mining is becoming a secret war for natural resources.

The UAE along with other Gulf states like Bahrain, have also been undertaking enormous land-reclamation projects to try to build some of the world's highest skyscrapers according to the Middle East land reclamation data (Sengupta et al. 2017). Currently they are purchasing sand from Australia to feed the rising demand. The western industrialized states of Germany, Canada and the UK, along with other countries like Brazil, Nigeria and Indonesia, have also been flashing a growing construction industry[4]. This is further exacerbating the global demand for sand. According to BBC[5] (2016), the worldwide construction boom in the recent years – with the mushrooming megacities from Lagos to Beijing is eating up unprecedented amounts of sand. In Dubai, huge land-reclamation projects and skyscraper buildings have exhausted all nearby resources of sand. In the United States of America, sand mines are blamed for beach erosion, air and water pollution, starting from the California to the Wisconsin lakes (WWF 2018). Sand mining has wiped out at least two Indonesian islands since 2005. Most of the remains of these islands ended up in Singapore, that needs huge amounts of sand to continue funding its artificial territory, reclaiming land from the sea (National Geographic 2019 [6]).

Sand mining in India

When sand is removed, the physical barriers protecting communities from flooding are being destroyed too (Arbogast and Knepper 2000). Environmental problems that arise from sand mining are extremely severe in the state of Kerala, in southwest India (Sreebha et al. 2008). Its rivers are small and have limited river bed resources. Exponential rise in socio-economic standards and developmental activities in the State are leading to over exploitation of the river bed. According to Sreebha et al., (2008) the rivers draining the hinterlands of the Vemband Lake are suffering from indiscriminate sand extraction in order to level up to the demand of construction activities in the fast developing urban-industrial Kochi City along with its satellite townships. Presently, it is predicted that the construction sector will grow at 8 per cent per year for the next decade, according to a recent trade report by the Construction Industry Development Council.

2 https://www.oecd.org/china/42607972.pdf

3 https://www.smh.com.au/world/sand-wars-singapores-growth-comes-at-the-environmental-expense-of-its-neighbours-20160225-gn3uum.html

4 UNESCO: https://unesdoc.unesco.org/ark:/48223/pf0000377250

5 https://www.bbc.com/worklife/article/20160502-even-desert-city-dubai-imports-its-sand-this-is-why

6 https://www.nationalgeographic.com/environment/article/sand mining-cambodia-the-lost-world-film

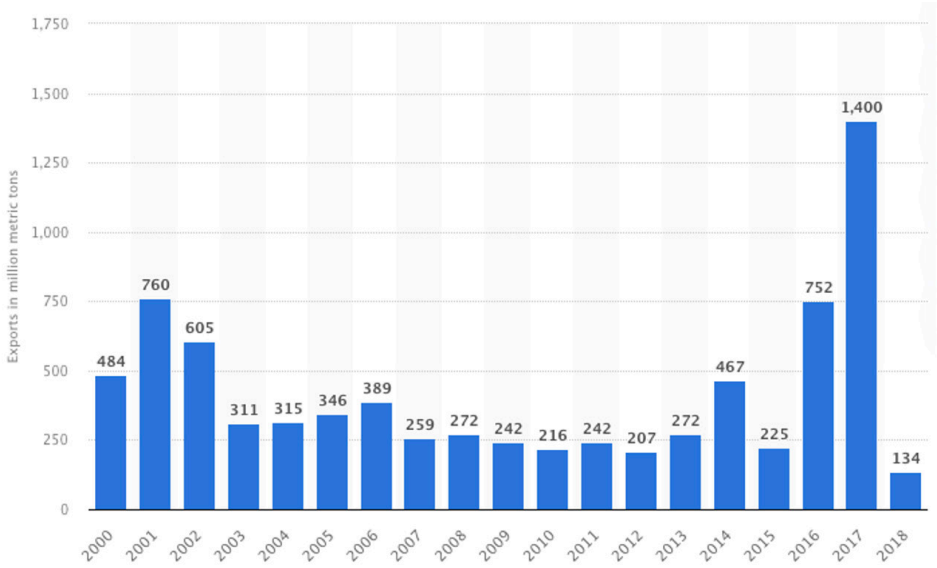

Figure 1: Export of sand world-wide from 2000-2018 (Source: Statista)

In 2017, a ship laden with 56,000 tonnes of sand from Malaysia arrived at a port in the state of Tamil Nadu, in India[7]. The first ever imported consignment of river sand to arrive in India, brought India's sand shortage problem to the public eye. India has a 7500 km coastline and dozens of major and minor rivers, tributaries and deltas. Excessive mining over years, official bans and limitations have reduced the amounts of sand available for construction (Padmalal et al. 2008). Today, criminal gangs in at least a dozen countries, Jamaica and Nigeria and others, dig up sand to sell in the black market[8]. Half of the amount of sand used in Morocco is illegally mined[9]. One of the most notorious gangsters in Israel, started his career by stealing sand from beaches, similarly the struggles for sand is very violent and brutal in India (Vaishnav 2011).

7 https://timesofindia.indiatimes.com/city/chennai/river-sand-from-malaysia-stuck-at-karaikal-port/articleshow/70624792.cms

8 https://www.wired.com/2015/03/illegal-sand mining/

9 https://issafrica.org/iss-today/illegal-sand mining-threatens-moroccos-coastline-and-tourism

III. METHODOLOGY

Utilizing secondary research methods, this paper has attempted to synthesize existing data through a systematic approach in investigation. The research design utilizes organization, collation, and analysis of existing data and scientific research that have been previously conducted in India and across the world. Existing data has been carefully sourced from the following:

- Peer-reviewed scientific analyses
- Textbooks
- Government archives
- Newspapers
- Online data
- Data from Libraries

Upon careful consideration of the information found from the above-mentioned sources, established patterns have been studied in accordance with recent news and updates regarding sand mining and interviews that were conducted by newspapers and TV journalists with families of victims of sand mafia attacks. The hypothesis of the research is to try and

understand that to what extent is sand mining a hazardous activity for the natural environment.

Hence, this secondary qualitative research also draws upon first-hand accounts of primary research through interviews and surveys. Through detailed literature review, the paper has tried to utilize the existing levels of knowledge and literature in sand mining to develop the results and carry out a detailed analysis on the findings in order to answer the following research questions that will be answered are the following:

1. What is the existing situation for sand mining regulations in India?
2. What are the regulations and judicial interventions against sand mining in coastal states of India?
3. How, if so, will sand mining impact the environment and cause harm to the existing environmental conditions?
4. Should sand mining be banned in countries where it has bred criminal activities?

V. RESULTS

India has the third-largest construction sector after USA and China. And it is expected that in the next 20 years, this sector will be worth 256 billion U.S. dollars according to a Forbes Magazine study. Currently, the available legal sand has been limited by the Government of India. However, this builds ripe conditions for organized crimes to take place (Tilly 1985). As the legally available sand is not sufficient, it needs to be acquired through different means, often by illegal extractions.

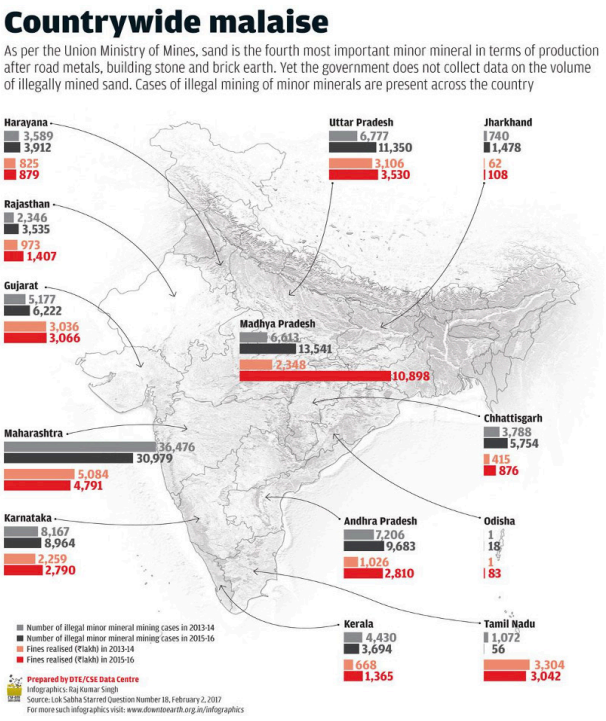

Figure 2: Illegal sand mining practice areas in India (Source: DownToEarth.org)

The black-market for sand exists because of the regulatory caps that are put on quantities of sand, that an extractor is given access to (Vaishnav 2011). Illegal sand mining got a lot of attention after a civil servant and Indian bureaucrat named Durga Shakti Nagpal[10] was suspended when she launched a campaign against these activities and corruption in 2013. Her suspension not only led to a public outcry but also attract the attention of the masses towards the perils of sand mining.

Sometimes the mafia uses violent tactics, where activists who oppose to illegal sand mining have either been crushed under vehicles used for sand mining or brutally assaulted as in the case of 26-year-old

10 Refer: https://timesofindia.indiatimes.com/city/noida/it-was-worth-it-says-ias-officer-who-took-on-sand mafia-in-noida-9-yrs-ago/articleshow/88842725.cms

Brijmohan Yadav[11]. Yadav had noticed suspicious activities going on in the Betwa and Ken rivers in Bundelkhand, in Central India. He alerted the authorities and is now still suffering the consequences of his activism along with his family. He has been attacked by enforcers of the illicit trade. Upon filing a police complaint against the attackers, he was receiving threat calls from gangs who threatened to kill him if he did not withdraw the charges. This distressing situation is becoming a common occurrence in India, as construction demands and lack of accountability help sustain one of the country's most infamous industries – illegal sand mining (Verniers 2014). While alternative materials do exist, they are not economically viable (World Resources 2000). Legal formalities and mining lease from the government seems a tedious procedure, and hence illegal mining is increasing. The Union Environment Ministry however, has drafted guidelines for sustainable sand mining in India, including rules to seize equipment from non-leased mining areas.

VI. ANALYSIS

Mining Regulations in India

All Indian rivers are still being plundered of the alluvial soil because of a large-scale demand in lieu of the construction boom. Sand miners keep digging to great depths, even extracting the soil from the earth right beneath the river bed[12]. On-site and off-site ill effects keep increasing while highly fragile habitats of animals are gouged out along with their homes (Hammer et al. 1993). According to Kumari et al. (2019) in most regions of the earth, underground geological resources overlap with above the ground biological resources, such as forest cover, and this is particularly more conspicuous in India. Thus, mining operations involve habitat destruction, biodiversity erosion and deforestation. The widespread excavation of sand has led to greater levels of environmental pollution (Hughes 1994). As per Article 1 of the Indian Constitution, India is a Union of states. That means there is a clear demarcation of powers between the Union and the State Legislatures, as set out in Article 246 of the Constitution. This is accompanied by lists which are mentioned in the Seventh Schedule:

- Entry 54 of List 1 reads as: '54 (List 1): regulation of mines and mineral development to the extent to which such regulation and development under the control of Union is declared by the parliament by Law to be expedient in "public interest".
- Entry 23 of List 2 of the State List to the Schedule VII to the Constitution of India reads as: "regulation of mines and mineral development subject to the provisions of List 1 with respect to the regulation and development under the control of the Union".

Rivers, minerals, forests and other such natural resources constitute a nation's natural wealth. Every generation has a responsibility and duty to the succeeding generation to develop and conserve its natural resources, thus promoting sustainable development (Bruckmeier 2005). Hence the Indian Parliament has declared that it is in expedient 'public interest' that the Union is in the control of regulation of mines and development of minerals. This was done with the Mines and Minerals (Development and Regulation) Act, 1957. Regarding the "minor" minerals (sand is a "minor" mineral according to the Indian Constitution), the powers have been conferred upon the State governments to make rules for regulating the grants for licenses and mining leases. Now, the Parliament has declared that the regulation and development of mines be under the control of the Union, owing to

11 Read the story at: https://www.vice.com/en/article/ney7z8/how-indias-sand mafia-pillages-land-terrorizes-people-and-gets-away-with-it

12 https://www.downtoearth.org.in/blog/mining/why-unlawful-sand-mining-in-india-needs-good-governance-78773

'public interest', to the extent of such declaration, the jurisdiction of the powers of the State Legislature is excluded. There are a large number of legislations and rules concerning mining in India.

Being the world's second most populous country the demand for affordable amounts of sand remains unabated. India's Supreme Court has issued a warning that indiscriminate sand mining is eroding bridges and disrupting aquatic ecosystems, slaughtering fish and birds. India is taking steps to bring illegal mining under control (Chauhan 2010). The National Green Tribunal, a federal court for environmental matters has now opened facilities for citizens to file complaints regarding illegal sand mining. But India is a vast country of more than 1 billion people and serves as a hotbed for thousands of illegal sand mining operations. Regulations are scant and the will to enforce such regulations is even more scant, especially in the developing countries (Chauhan 2010).

Existing Regulations and Judicial interventions against sand mining in coastal states of India

1. Kerala – The Mines and Minerals (Regulation) Act, 1957, regulates the extraction of all mineral deposits in the country (Padmalal et al. 2006). The Kerala State Government had also framed the Kerala Minor Mineral Concession Rules, 1967, in exercise of powers states specific regulations for minor minerals such as river sand in the state. The Kerala Protection Act of River Banks and Regulation of Removal of Sand Act, 2001 (Act 18 of 2001), is an Act to protect river banks from large scale excavation of river sand.
2. Maharashtra – Reckless and indiscriminate exploitation of sand was having adverse effects on the river bed. A Committee of experts suggested that it would be better to confine and limit the areas of exploitation in order to maintain a balance between the needs of the river to flow without obstruction and the local needs of sand (Divan and Rosencranz 2001). An affidavit was filed on behalf of the State Government that indicated some guidelines that needed to be strictly followed. However, there has been no further direction for this [13] matter.
3. Tamil Nadu – Sand mining on the banks of the Kusasthalai river, was severely damaging river beds and railway tracks, also violating the rules of lease deeds. Agricultural lands were being flooded and the break in linkages between river channels were being noticed (Kondolf 1997). The mangrove and the agricultural system were collapsing due to erosion. The groundwater table also started going down affecting agriculture adversely. Public roads were also being seriously damaged. The Tamil Nadu State Government cancelled all leases as reports stated that unauthorized sand mining was continuing because of the money power and political influence.
4. West Bengal – Currently there are two sources of sand in India – riverine ecosystems and dams and reservoirs. Sand, a natural resource, is a minor mineral as defined under S 3(e) of the Mines and Minerals (Development and Regulation) Act, 1957 ("MMDR Act"). Under the MMDR Act, the legal and administrative control over minor minerals vests with the State Government, which has the powers to make rules to govern minor minerals. The State Government through this policy intends to govern the excavation, transportation, storage, sale and consumption of sand. The State Government intends to appoint the West Bengal Mineral Development and Trading Corporation Ltd. ("WBMDTCL") (a fully owned undertaking of the Government of West Bengal) as the designated agency, in order to effectively achieve the above mentioned objectives[14].

An interesting and noteworthy mention in this case

13 Mukthi Sangharsh Movement vs State of Maharashtra. 1990 Supp SCC 37.

14 Read more at: https://wbxpress.com/west-bengal-sand-mining-policy-2021/

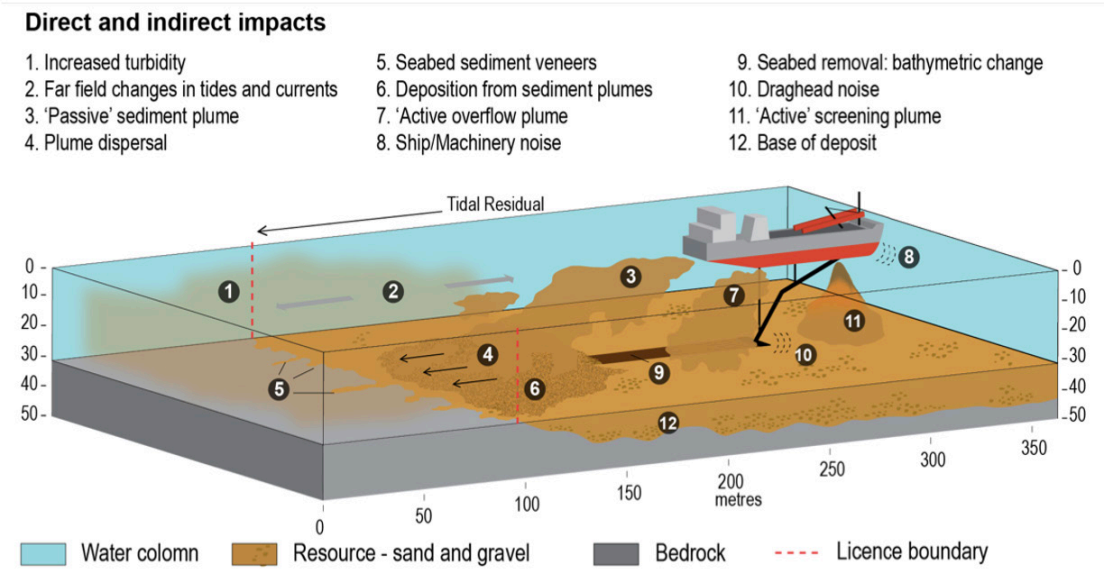

Figure 3: Showing impacts of sand mining (Source: UNEP 2014 [16])

would be that of the Noumea Convention[15] (1990) for the protection of the natural resources of the South pacific region. Article 16 of the Convention clearly mentions the significance of an environmental impact assessment while Article 17 discusses the importance of scientific and technical cooperation. Maintaining technical data and ensuring that assess follow and stay well within the ambit of technical guidelines, is an important measure that has greatly benefitted sand mining in the south pacific region. Additionally, the Convention also highlights the importance of engaging global, sub-regional and regional organizations to carry out scientific research, environmental monitoring and exchange of scientific data. Hence, drawing inspiration from the Convention, one can understand how important it is for collaboration and coordination to occur while devising methods to monitor sand mining.

How will sand mining impact the environment?

People have used sand for construction since the time of ancient Egyptians. Back in the 15th century, an Italian artisan had figured out how to turn sand into transparent glass. Sand is used for detergents, solar panels, toothpaste, silicon chips, basically every building consists of tons of sand, cement and gravel (Mossa and Autin 1998). Nearly 70 per cent of all the sand grains on earth are Quartz, that is formed by weathering of rocks. Rivers carry countless amounts of these grains and accumulate them in beds, on their banks. Apart from water, sand is the second most consumed natural resource (Wang et al. 2003). According to the Global Construction 2025, emergence of construction markets will grow from 3 percent to 6 percent per year (Chauhan 2010). The countries most affected by the growth in construction include Indonesia, India, Mexico, Cape Verde, Malaysia, Jamaica, New Zealand, Kenya and many other island states in the Indian and Pacific Oceans and the Caribbean.

15 Read the Noumea Convention (1990) here: https://www.sprep.org/att/IRC/eCOPIES/pacific_region/201.pdf

Since desert sand cannot really be used the amount of gravel sand is being increasingly excavated. The main problems created by sand mining are:

- Turbidity – Dredging activities and wash-water discharge causes increased turbidity in streams (Van Dolah and Knott 1984). It is generally greatest at dredging sites or wash-water discharge points. Turbidity decreases according to downstream distance and can be controlled by containing run off and also by filtering fresh water. Water temperature and dissolved amounts of oxygen often change when in-stream mining causes water velocity to decrease.
- Bird-habitats – Sand mining tend to cause physical disturbance that involves noise pollution, destruction of nests, exposure to toxic elements and human disturbances. This also increases predator consequences for birds (Sreebha and Padmalal 2006).
- Stability of structures – Sand and gravel mining are damaging to both public and private property (Swer and Singh 2004). Channel incisions can often erode bridges and expose buried pipelines and other infrastructure. Excavation of mining pits and active river channels increase the flow-capacity of the channels. Bed degradation also occurs when saline water intrudes into fresh water bodies through excavation pits.
- Flora and fauna – Many hectares and acres of fertile lands are lost due to sand mining. Degraded stream habitats result in loss of fisheries productivity and biodiversity. Degraded channels also reduce aesthetic values of lands (Ghose and Kumar 2004). Human activities quicken the procedures of bank erosion, forest clearing and instream mining. Complete removal of vegetation disturbs the existing soil profile, thus destroying habitat both above and underground.
- Groundwater – The groundwater table drops leaving the drinking water wells, and rivers dry. Instream degradation and elevation of streamflow and floodplains eliminates flow depth of rivers. This causes a sediment deficient flow which increases the river bed degradation process (Vanoni 1975). This also causes shallowing of the bed causing a braided flow. The river channels become shallow and deeper pools fill up with gravel and other sediments, thus reducing habitat complexity.
- Climate – In natural conditions, various thermodynamic processes stabilize radioactive minerals and emissions coming from the coasts. Ilmenite and silica are two elements that play a big role in reducing the levels of natural radiation (Ghose and Majee 2000). When sand is mined, radioactive emissions are revitalized. This increases the local temperatures which also contributes to global warming and the energy budget of the planet.
- Destruction of riparian vegetation – Heavy tools and equipment cause soil compaction, which increases soil erosion by increasing levels of soil infiltration. This disturbs the natural hydraulic system of the riparian zone (Jacobson ad Pugh 1997). This significantly impacts the lives of these species that are reliant on such events for their long-term existence (Warren and Pardew, 1998).
- Water quality – Instream sand mining activities have to have an adverse impact on water quality. Short term turbidity due to resuspension of sediments, leads to stockpiling and organic particulate matter (Ashraf et al. 2010). Bank erosion and riverbed erosion increase suspended solids in the water that affects water users and aquatic ecosystems. This impacts specifically the downstream water users thus abstracting water for domestic use. Water treatment costs also increase due to suspended solids.
- Health hazards – The silica blanket reduces the natural radiation from the natural radiation of the radioactive minerals (Ghose 1989).

Researchers refer to these as "evolutionary hotspots". Background radiation increases mutation in the human DNA, mining in sites will only lead to ailments and ill health. The changes that increased radiation will cause in flora and fauna is still not known.

V. CONCLUSION

Unscientific mining processes have been causing consequential mine fires, disturbance of water levels and ecological imbalance (India Water Portal, 2018). Which is why, it is a necessity that certain rivers and beaches be given legal protection from the sand mafia. These protected corridors will also ensure the regeneration and preservation of the ecosystem (Yang et al. 2002). Simultaneously, immediate steps need to be taken to encourage eco-friendly research which will lead to discovery of economical and easily available alternatives for sand for the construction industry.

Socio-scientific research along with awareness is the need of the hour. Scientists, environmentalists, administration and those impacted by sand mining must be a part of this research team. Moreover, the socio-economic significance of sand mining is often overlooked and thus there is a need to protect the economic and social benefits of sand mining. Certain mining activities should be legalized and regulated by the government, so that the government can charge fees from the miners and that remuneration can be in turn utilized to regulate and supervise the sand mining activities to check if they are being carried out sustainably. Hence, only a more environmentally conscious and inclusive policy approach from the Government can successfully protect these "Grains of Gold" and mitigate the perils of sand mining using best practice.

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