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Social, Economic and Environmental Effect of Sand Mining

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Abstract:
Our earth is blessed with innumerable goods which are essential for our survival. Every society utilizes such natural resources for its development and for the welfare of its members. Since these goods are available in abundance, we undervalue these resources and use them carelessly. Sand is one such good which is used for construction and industrial purposes. The impact of economic growth powered by the emphasis on the development of physical infrastructure, rapid industrialization triggered by the globalization and expansion of world trade and the boost in construction sector including the real estate segment of the economy have raised the demand for sand multiple times. Improved standard of living, better income and employment opportunities, new technology, greater road network and the increased awareness of the people on the need to build a strong and lasting shelter for living coupled with the scarcity of the traditional construction materials have added a strong push to the otherwise increasing demand for sand. This led to the extensive and intensive sand mining across the world much beyond the natural replacement level.

1. Demand for Sand

Among different countries, China, U.S and India hold the first three position of construction business with residential building, business establishments including Malls and offices and infrastructure constructions like bridges, flyovers, roads and so on.(Down to Earth, 2012). It estimated that globally, between 47 and 59 billion tonnes of material is mined every year(Steinberger, Krausmann, & Eisenmenger, 2010)of which sand and gravel account for the largest share (from 68% to 85%) (Krausmann, et al., 2009). Unfortunately, we do not have any reliable data on the quantity of sand or gravel mined globally or even at national level. Only in recent years even the Developed countries started to maintain such data. This makes the task of assessing the global demand or extraction of sand or the different use to which they are put to or the environmental impact assessment very difficult and inaccurate. An indirect way of estimating the demand for sand is through the assessment of the product for which sand is an input. It is estimated that in 2012, around 3.7 billion tonnes of cement is produced globally as reported by 150 countries. Cement is used for the production of concrete and on average cement and sand is combined in the ratio of 1:6 to 1:7. Thus globally 26 to 30 billion tones of sand is used for the year 2012 alone for concreting—an amount of concrete sufficient to construct a wall of 27 meters high and 27 meters broad across the equator.(Orr & Krumenacher, 2015)

India is ranked as the third highest consumer of sand with an estimated mining of 2.28million tonnes of sand in the year 2009-10(Down to Earth, 2012). This statistics is no way close to the real figures as the official estimations fails to account for the illegal mining activities across the country. As per the report of Centre for Techno-Economic Mineral Policy Options, approximately 200 Kg of sand per person per year is consumed in India(Down to Earth, 2012). Andhra Pradesh (39%), Gujarat (17%), Rajasthan (14%) and Maharashtra (13%) are the leading producers of sand in India. (Down to Earth, 2012). The targeted infrastructural and power development during the 12th Five Year Plan alone indicate that India need at least 240 million tonnes of sand for construction activities in road and power alone. In Kerala, a small state in the southern India, it is estimated that on an average, every year 466400 cubic meters of sand is removed from the [1]riverbeds alone. It was also estimated that in latter half of 1990s, 32 Million MT of sand per year was mined across the states.(Binoy, Varghese, & Paul, 2013)

Increased demand for sand has positive impact on the livelihood of the dependent people enabling them to have higher income and better living condition. Construction sector experts are of the opinion that every one rupee investment mining of sand causes 0.80increment to GDP where as it is as low as 0.2% for agriculture sector and 0.14 for manufacturing sector. (Down to Earth, 2012) . Sand mining, transportation and other related work have increased employment and income to many households both in rural and urban areas. In addition, there are Thousands of indirect employment opportunities generated through sand mining. As in the case of the quantity of sand mined we do not have even an approximate data regarding the income or employment generated through sand mining.

1.1. Sources of Sand

It is estimated that 20 % of the earth's surface is occupied by sand in various form. The formation of sand and sand bed are associated with natural activates which takes place thousands of years. Sand is usually found at oceans shore, rivers, streams, flood plains, hills, mountains and deserts. Rivers and their floodplains are the most economic source of sand and gravel as there is regular natural replacement occurs—limited to the natural replacement capacity (Kori & Mathada, 2012).

1.2. Sand Budget

The difference in geographical features, the location of the sand bed, the climatic condition, the amount of rain the region get, the extent of water flows, the catmint area of the river etc. determines the extent of sand one can mine from a particular sand bed. The sand budget, in simple terms denotes "*the amount of sand that could be removed from the area without causing undue erosion or degradation, either at the site or a nearby location, upstream or downstream"*.(Kumar & Sukumar, 2012).Topographic, hydrologic and hydraulic information are the pre-requisite to determine the sand budget. Interestingly, there are hardly any efforts taken to determine the sand budget of a mining region both by the authorities who issue the sanction and by the agencies involved in the mining.

2. Environmental Value of Sand and Impact of Sand Mining

The benefit of sand mining can be traced in economic terms whereas the cost can be calculated only in the form of potential environmental impacts (Orr & Krumenacher, 2015). Sand is created naturally through the various environmental activities related to water fall. Sand in the river is concentrated through a process that takes thousands of years(John, 2009).Though it is used directly for construction purposes-including making of concrete buildings, filling roads, brick making and related construction work, sand is also used an important raw material for glass making and sandpaper production. Traditionally sand is also used for reclamations and other related work. Other than the man-made purposes, sand performs a number of environmental functions. It is essential in protecting the environment as it is the habitat for crustacean species and marine organism. Sand bed acts as a buffer against strong tidal waves and storm.

Sand mining is not a recent activity unique to any particular region or country. Our epics and other religious writings hold enough evidence to prove that sand was used in some way or other for different purposes. From time immemorial sand was mined across the globe for various activities.

Once flood due to sand accumulation in the river banks was frequent and was a problem across different parts of the country in India around 30 years before. For example, the flood in the river basin of Neyyar River in Kerala, India, in the year 1978, made severe destruction in the region was due to the sand accumulation. Traditionally scientific and environmental friendly methods of sand mining were followed. The sand thus mined was replaced in the rain that followed. As the local demand for sand increased due the increased demand from the construction sector, the sand mining was undertaken indiscriminately.(Shaji & Anilkuar, 2014)The river banks are now digged out to meet the increased sand demand, destroying the entire ecosystem causing serious environmental damage beyond repairable level.

Sand mining, though not a recent activity, has been on the rise to keep pace with the ever increasing demand for sand. There has been indiscriminate mining across the world especially in the developing countries in the past couple of decades. Unscientific mining has caused degradation of land, disturbances in the water table resulting in topological disorder, changes in the biotic and abiotic system, severe ecological imbalance, environmental damage beyond repair and changes in the land use pattern are some of the immediate consequences. These environmental changes have aggravated the changes in the social, cultural and economic life of the human beings.

To predict the consequence of sand mining beyond the replenishment limit is not possible in a short period of time. The impact of indiscriminate mining, lasts for centuries with problems and imbalances, not visible in the immediate future but aggravating as the years go by. Moreover, the effects of in stream sand mining may not be visible immediately because it requires continuous monitoring and takes a decade or more to surface and propagate the effects along the river channel in measurable units. In other words, mining may continue for years without apparent effects upstream or downstream, only to have geomorphic effects manifest later during high flows. (Swer & Sing, 2004)

The Campaign for the Protection of Water Resources—Tamil Nadu, a movement conducted to draw the attention of the government and the common man on the hazards of sand mining has pointed out that due to sand mining, people of the region suffer from lesser availability of drinking water, depletion of different water sources including ground water for industrial and agricultural purposes, destruction of agricultural land leading to loss of livelihood , reduction or loss of employment to farm and industrial workers, damage to road and bridges, destruction of the ecosystem and human right violations. (Saviour, 2012)

Indiscriminate sand mining has been going on across the state of Kerala for the past couple of decades. Now People in the state, with 44 major rivers and thousands of streams and brooks are facing severe water crisis. Almost all rivers are dry by mid-January and the ground water levels are dangerously low across the state. People in the Kolar district in the state of Karnataka, are also facing water shortage due to indiscriminate illegal sand mining. Life and livelihood of the neighbouring districts in the state of Andhra Pradesh also have undergone changes due to decrease in the ground water level. (Raj & Azees, 2011)

2.1. Changes in Bed forms and Sediment Characteristics

The changes in the flow energy and sediment discharges lead to a natural modification of the river bed forms. But anthropogenic activities, including indiscriminate sand mining lead to the changes in bed forms other than natural process. The mining will result into the changes in grin size characteristics of river bed in the long run. Bed materials form an important abiotic component of a river system. A change in the abiotic component will result into changes in the biodiversity of the river system.(Padmalal, Maya, Sreebha, & Sreeja, 2007)

2.2. Changes in Water Quality / Quantity

Surface and ground water level is seriously affected by the indiscriminate sand mining from active channels and floodplains of river system. Ground water levels are increased during monsoon season through the process of recharging. Further, sand in the riparian areas serves like a spongy layer. This helps the recharge of ground water through percolation of water from different layers of sand.(Down to Earth, 2012). But due to the intensive mining activity, vertical and lateral movements of water is checked, the water recharge does not take place but get drained leading to very quick depletion of water level(Dinesan, 2012).This also increases the salt water to flow to the land which ultimately increase the salinity of the ground water affecting the water quality. Increased salinity has its impact on the agricultural land making it uncultivable. (Orr & Krumenacher, 2015).This further affects the livelihood of the people of the region.

2.3. Aquatic Vegetation

Aquatic vegetation is necessary for maintaining and improving the health of the river environment and for bio-purification of organically polluted water. The vegetation is also needed to keep the food chain and act as a catcher for different species of fish. But indiscriminate sand mining destroys this vegetation seriously affecting the river environment and water quality. The existence of different aquatic species is threatened by the indiscriminate and illegal sand mining.

2.4. Biological Impact

There is no second opinion that indiscriminate sand mining can pose marked changes on the biological environment of a river. As a result of sand mining, the supply of organic detritus is reduced and will increase turbidity. It also can aggravated saltwater ingression in the riverbanks and further result into the loss of breeding and spawning grounds to living organism like fish. All these changes will cumulate to changes in the population density and distributional pattern of many aquatic organisms in and around sand mining regional and across the sand mining river. (Sheeba, 22)

2.5. Economic Impact

Extensive sand mining has both economic and social impact. On the positive side, it has become a source of livelihood for many, source of additional income and has helped the poor household to raise to a higher standard of living. It has become a source of regular employment to many. In addition to the direct employment, the indirect employment sand mining generate are also innumerable. But the increased demand for sand and the very limited legalized supply sources has resulted into a mushrooming of illegal sand mining sites. The prices of this illegal sand vary from six to ten times higher than the legally mined sand depending on the location, need and availability of sand. The cost of construction has increased many times in recent years as sand is an essential raw material for construction. The long delay in getting legally mined sand also resulted in unwanted delay in the construction process and resulted into financial losses and burdens associated with this.

3. Social Impact

The intensive and extensive sand mining lead not only to economic or environmental impact to the region but also has many social effects. The sand mining is viewed as a source of lucrative income with minimum effort and very little investment. This attracted a large number of people, especially the younger generation to this business. The land mining rules and regulations were overlooked or bypassed during this process.

3.1. Increasing Conflict

Increase in the number of conflicts between people engaged in sand mining, between the owner of the land and the person who has secured the right to mining, between local people and people engaged in mining are reported from different countries. In developed countries while these conflict lead to litigation, in under developed countries the conflict often lead to physical violence followed by police case and litigation.

3.2. Increased Illegal Activities

Sand mining is regulated and controlled by rule in different countries. But being a source of quick income, the sand mining attracts many to break rules and undertake illegal mining. This illegal mining also breeds to a number of illegal activities and result into large scale corruption and foul play between the law breakers and people responsible for law enforcing.

3.3. Increased Number of Death Due to Drowning

The deep pit formed in the river and riverbanks have caused a number of deaths due to drowning. Though these deaths are accidental in nature, the root cause behind the death is the illegal and irresponsible sand mining. The impact of the death is not just loss of one

life alone. Many a time it can be the bread winner or the sole child in the family. The consequences of such deaths can never be put in black and white.

3.4. Changes in Social Environment

Each action, economic or non- economic has its effect on the entire society but quantifying the social and economic effect of any action is difficult. Social effects are a hybrid form of environmental, social and economic factors. Though there is a positive economic impact for those who are engaged in sand mining, how far they are sustainable is questioned. This quick income for a short period is at the cost of the serious, non-repairable damage to the environment which affect the entire local population including the livelihood. Even the drinking water, once abundant can become a scare commodity. All these affect the social order and social life of the people.

4. International Practice

There is no second opinion that mining activities of any nature including sand mining generate environmental problem including environmental degradation. But mining is inevitable part of economic development. Hence there is a need to have a safe tradeoff between environmental loss and economic gain.

In a federal setup where different levels of governments are in operation, "Matching Principle" are used to determine the "*level of government—federal, state, or local—and the nature and geographic extent of the environmental risks"*.(Miley, 2014)The principle advocate for one regulating authority rather than many would result into higher economic efficiency and better environmental conservation. Further in issues such as sand mining, local or state government regulation rather than the rule enacted by the central – federal—government is more apt and adaptable to suite the need of the locality.

4.1. Environmental Impact Assessment (EIA)

In countries like Ghana (East Gonja District), environmental impact assessment is carried out even if the sand mining is done in a private property and by a private agency (Musah, 2009). This will help to determine the extent to which sand mining can be done with minimum damage to the environment and also the amount of compensation/ royalty to be paid to the property owner.

5. Way forward

There is no second opinion that construction activities are essential for economic development, but it should not be at the cost of environmental damages. For the economic and environmental conservation the following steps are recommended:

5.1. Awareness Creation

Creating awareness among the different players including the beneficiaries can be viewed as one of the most effective ways of regulating sand mining. If people as a whole are aware of the environmental hazards associated with the ruthless sand mining, they themselves will take responsibility of protecting the environment as a whole by reducing the sand mining to the ecologically viable extent.

5.2. People participation

Active participation of the people especially those who live near the mining region for conservation activities are found to be very effective in the case of other natural resources. The same can be adopted in the sand mining process.

5.3. Sand Budgeting

Assessing the sand budget of every river bed by competing authority each year can help to determine the extent of sand that can be mined.

5.4. Reduce Sand Wastage

The study conducted by American Concrete Institute (ACI) shows that Indian construction industry waste about 30% of the sand it uses which comes to a tune of 10-12 million tonnes per year(Down to Earth, 2012). This estimate does not include the loss during mining, transportation and processing or waste generated during other uses of sand. Lack of skilled workers, technological lag, use of traditional methods of construction and other factors are responsible for this waste. If this wastage is reduced, millions of tonnes of sand can be saved.

5.5. Use of Alternatives

Promoting the use of other substitutes for sand and materials that used sand for their manufacture can lead to the reduction in the demand for sand. M-sand, Fly ash- a byproduct of thermal power sector etc., are said to be suitable inputs for construction of durable housing. Switching over to artificial sand where the use of sand is inevitable can also be adopted.

6. **Conclusion**

Sand is essential for construction activities associated with physical infrastructure development. But indiscriminate sand mining poses irreparable environmental damage which affects even the very existence of human being. Weak and corrupt government may often tent to overlook the socio- economic significance and impact of sand mining. Laws and policy makers need to realize the importance of maintaining the sand bed and regulating sand mining for the greater welfare of the society in the long run rather than focusing on

the economic growth of a short period. Mining can be undertaken to the extent the environmental cost does not exceed the economic gain. During this process of cost- benefit analysis, a due weight must be given to the environmental cost as it affects the long term development of the society and threaten the ecosystem as a whole.

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