SAND MINING: CURBING THE EVIL TO THE ENVIRONMENT THROUGH SUSTAINABLE SUBSTITUTION AND LEGISLATIVE ACTION

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Abstract: The purpose of this paper is to examine sustainable construction practices with respect to the use of substitutes for sand in construction and the enforcement of the same through legislation. It is a well-known fact that the use of riverbed sand for construction purposes has gradually led to excessive sand mining. This has in turn affected the environment and further, the recent lack or high cost of availability of such sand has led to not only various malpractices, but also the need to find an eco-friendly cost effective substitute.

Theoretical concerns: (1) the continuation of sand mining leads to the death of water bodies (2) the complete substitution of riverbed sand with manufactured sand would lead to excessive quarrying and thereby death of mountains (3) the malpractices that may be the outcome of both these activities. The complete substitution would lead to hazardous environmental impact. Thereby, there is a need to provide for a balance between the use of both these sand in construction. Such balance, be it through the additional use of other substitutes, can be achieved only through a legislative approach.

Summary of the concern: This paper provides for an understanding of the necessity of sand mining, its process, and the impact of the same to the environment. The paper examines the effect of lack of availability of riverbed sand or rather, the high cost of availability of the same due to the ill-effects of excessive mining. It goes on to investigate the various cases in which such high cost of availability has resulted in malpractices in construction by various Developers, in particular, the instances of using filtered sand for construction which have resulted in structural deficiencies and in many cases collapse of the structure. In such cases, it is usually the public who is affected, be it as a victim of the collapse of the structure or as the investor in the project.

This paper examines the various substitutes that may be used for sand, in particular, manufactured sand. It is also called crushed stone sand or artificial sand. The paper provides for a comprehensive understanding of the process manufacture of such sand, its properties, justifies its substitutability, and examines the pros and cons of the same. One of the problems that the paper focuses on is the aspect that manufactured sand may also have its own adverse effects on the environment, namely, increase in quarrying and the disappearance of mountains and hills in the process.

Finally, this paper attempts to suggest the possible provisions of such legislation after the examination of various decisions of the Supreme Court, National Green Tribunal, and Committee Reports.

Research methodology

A doctrinal method of research purely based on various published articles in journals, newspapers, magazines, and books has been employed to achieve the purpose of this paper in accordance with the objectives of the Conference.

Main arguments

(1) There is an increasing need to substitute riverbed sand in order to protect water bodies and groundwater. This is evidenced by the various decisions of the Supreme Court and the National Green Tribunal to protect water bodies from the harmful effects of sand mining. Further, it is also evidenced by various articles in newspapers and magazines increasing the awareness about the problems and harms that can be attributed to sand mining. (2) The lack or high cost of availability of sand has led to malpractices such as the use of filtered sand evidenced by reported instances of

structure collapse. (3) Manufactured sand, when used in the right proportion with riverbed sand or other substitutes helps achieve sustainable construction practice which has been evidenced by articles by various scholars.

Keywords: manufactured sand; mining; regulation; sand; sand substitutes

Introduction

Henry David Thoreau, an American writer, said *"What's the use of a fine house if you haven't got a tolerable planet to put it on"* [1].[1] The increase in construction has led to not only excessive but also illegal activities with respect to the supply of the raw materials, in particular sand mining. This activity has affected the course of river flow, the groundwater table, and polluted the water bodies among others.

Many governments have become sensitive to these affects and have taken steps to curb this activity through legislation. The Courts in some countries take a stand to prevent such activities and protect the environment. India is one such country which contains a mixture of both. States like Haryana and Uttar Pradesh have enacted certain legislations that allow for sand mining only in certain areas on the acquisition of a license, further, sand mining along the gulf is banned. In India, the activity of sand mining can be undertaken only after a licence is issued by the relevant State Government, otherwise it amounts to illegal mining which is a punishable offence. The problem of these initiatives is that the legislations are paper tigers. They not lack in implementation but are also loosely framed which allows offenders to go scot-free. Where there is an error on the part of the government in the assessment of the condition of the area of sand mining, the Courts of Law, namely, the Supreme Court, High Courts and the National Green Tribunal, take initiative in preventing sand mining in sensitive areas through various decisions.

These activities continue on an excessive level as sand is an essential element in construction. This has resulted in the need to find substitutes to riverbed sand. There are various substitutes that have been considered like crushed sand, copper slag, bottom ash, etc. [2].[2] So why is it that sand mining activities have not reduced? It is mainly due to the lack of awareness about these substitutes and also the absence of any authority to enforce the use of the same. This is where legislation plays an important role in the protection of the environment and the promotion of sustainable development. The need of the hour is for legislations that provide guidelines for sustainable development and the enforcement of the same.

Sand mining – A necessary Evil

Sand mining is an activity that is undertaken in coastal regions whereby the process of the actual removal of sand from the shore in rivers, streams, and lakes takes place. Sand is mined from beaches and inland dunes and dredged from ocean beds and river beds. There is an increase in demand for sand for construction purposes by individuals and private companies which has placed immense pressure on this resource. The practice of use of sand in construction is becoming an environmental issue as the demand for sand increases in the construction industry. [3][3]

Sand mining refers to the process of the removal of sand from a place of its occurrence [4].[4] Sand can be found in oceans, rivers, streams, flood plains or hills and mountains. The increase in demand for sand for construction purposes has placed immense pressure on this valuable resource. Sand mining is a direct and obvious cause of environmental degradation [5].[5] The demand for sand is on the rise as its importance and role in construction is indispensable. Therefore, the extraction of this important construction aggregate is bound to have considerable ramifications on the environs of its occurrence. An economical source of sand is rivers and their floodplains. Sand is required for a variety of purposes, including the preparation of concrete, backfill for houses footings, and maintenance of roads and landscaping. Although it is of utmost importance, studies show that in-stream

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[1] Thoreau, H. D. (2011). *Familiar Letters.* Brooklyn, NY: AMS Press.

[2] Somvanshi, A. (2013). Concrete without sand?. *Down to Earth.* Retrieved from http://www.downtoearth.org.in/content/concrete-without-sand.

[3] http://www.c-tempo.org/studies/Sand_Mining.pdf.

[4] Langer, W.H. (2003). *A General Overview of the Technology of In-stream Mining of Sand and Gravel Resources, Associated Potential Environmental Impacts, and Methods to Control Potential Impacts*. Retrieved from USGS Open-File Report.

[5] Kondolf, G. M., Williams, J. G., Horner, T. C., & Milan, D. (2008). *Assessing physical quality of spawning habitat*. Retrieved from American Fisheries Society Symposium.

mining of sand can reduce water quality as well as degrade the channel bed and banks [6].[6] The mining of sand on the floodplain can affect the water table and alter the land-use [7].[7]

The natural cycle of erosion and deposition of sand occurs through flooding of rivers and the shift in their courses from time to time. The river and its banks are home to many fauna and flora. In this era of rapid land development, however, people have turned to rivers and floodplains as major sources of sand for the purpose of construction. Sand occurs in a variety of natural settings and is a common material used in the construction industries worldwide. The extraction of sand from rivers, streams, floodplains, and channels conflicts with the functionality of riverine ecosystems. Some of these disturbances stems from the mining methods and machineries used. The most common environmental impact is the alteration of land use, most likely from under-developed or natural land to excavations in the ground [8].[8] Social pressures like population growth can also affect the environment with respect to sand mining.

Sand: What does it consist of?

The composition of sand depends on the local rock sources and conditions, thereby is highly variable, but the most common constituent of sand is silica (silicon dioxide, or SiO_2). It is usually in the form of quartz which, due to its chemical inertness and considerable hardness, is resistant to weathering. The bright white sands found in tropical and subtropical coastal settings are eroded limestone and may contain coral and shell fragments in addition to other organic or organically derived fragmental material. The gypsum sand dunes of the White Sands National Monument in New Mexico are famous for their bright, white color. Arkose is a sand or sandstone with considerable feldspar content, derived from the weathering and erosion of a granitic rock. Some sand contain magnetite, chlorite, glauconite or gypsum [9].[9] ISO [10][10] 14688 grade sand as fine, medium and coarse with ranges 0.063 mm to 0.2 mm, 0.25 mm to 0.50 mm and 0.63 mm to 2.0 mm respectively [11].[11]

Importance of Sand

Sand is a necessary material for construction but this important material must be purchased with all care and vigilance. Sand used for the purpose of construction must be clean, free from waste stones, and impurities. It is important to know the type of sand that is best suited for the purpose of construction as sand is classified into three different forms that make it suitable for specific types of construction [12].[12] Sand is classified as: Fine Sand (0.075 to 0.425 mm), Medium Sand (0.425 to 2 mm) and Coarse Sand (2.0 to 4.75 mm). However this classification of sand is further has types of sand in particular and on that basis only they are being incorporated in the construction [13].[13]

Sand Mining Activities: A global Hazard

In India, rivers, sea, forests, and the environment are being adversely affected by sand mining activities. The lack of governance and illegal mining of sand are largely responsible for the cause of land degradation and it has threatened rivers with extinction [14].[14]

Weak governance and rampant corruption are the factors that are facilitating uncontrolled and illegal mining of sand in the rivers, threatening their very existence. This unrestrained and unregulated activity is posing threats of widespread depletion of water resources which may lead to food shortage and hardships for people. In Madhya Pradesh, major

[6] Kondolf, G. M. (1997). Hungry water: effects of dams and gravel mining on river channels. *Environmental Management Journal*. 551.

[7] Langer, W.H. (2003). *A General Overview of the Technology of In-stream Mining of Sand and Gravel Resources, Associated Potential Environmental Impacts, and Methods to Control Potential Impacts*. Retrieved from USGS Open-File Report.

[8] Steiger,.J, E., Tabacchi, S., Dufour, D., & Corenblit, J. L. P., (2005). Hydrogeomorphic Processes Affecting Riparian Habitat Within Alluvial Channel–floodplain River Systems: A Review for the Temperate Zone. *River Res. Applic. 21,* 719–737.

[9] http://www.c-tempo.org/studies/Sand_Mining.pdf.

[10] International Organization for Standardization.

[11] Shanmugavadivu, P.M., Malathy, R. (2009). A Comparative Study on Mechanical Properties of Concrete with Manufactured Sand. *International Journal of Technology World*.

[12] Alhozaimy, A. M., Soroushian, P., & Mirza, F. (1996). Mechanical properties of polypropylene fiber reinforced concrete and the effects of pozzolanic materials. *Cement and Concrete Composites*, *18*(2), 85-92.

[13] As classified by Bureau of Indian Standards.

[14] Thrivikramaji, K. P. (1993). Utilisation of the river basin: State of the art and Recommendations. Environmental Problems and Prospects in India. New Delhi: Oxford &IBH Publishers.

rivers like Narmada, Chambal, Betwa, Wainganga or numerous rivulets and streams all are being ravaged for sand. The State Government has unwittingly added to this by exempting the grant of Environmental Clearance to be obtained for the purpose of mining of sand, thereby, rendering the provisions made in several Central Legislations on conservation of environment and mineral resources ineffective. A social activist approached the State High Court for quashing of these exemptions so that indiscriminate mining of sand could be put a stop to. Similarly River Bharathapuzha in Kerala has become a victim of indiscriminate sand mining [15].[15] Groundwater levels have fallen drastically in the villages and towns around the river, and wells are almost dry. This is widespread as many other states, like Gujarat, Karnataka, Tamil Nadu, etc. are also victims of the same ill-found activity. Rivers of India are already sick being polluted by industrial and urban effluents, deforestation in their catchments, sequential damming, and degradation because of unchecked sand mining on their banks and beds.

Sand mining activities take place in France in the name of clearing of river mouths. It has been reported that "clearing river mouths" is not all that is being done. Beaches have been mined where there are no real rivers, and more importantly, all sand cleared from river mouths has been trucked away to be used or sold. If clearing the river mouth was all that was being done, the sand could have been more easily shifted to the beach [16].[16]

Impact of sand mining

For many years, sand has been used in the construction of roads and buildings. Today, demand for sand continues to increase in the wake of increase in construction practices. Person who undertake sand mining activities and agencies well acquainted with the resource must work together to ensure that sand mining is conducted in a responsible manner.

Excessive sand mining is one of the causes of degradation of rivers. It lowers the stream bottom, which may lead to bank erosion. Depletion of sand in the streambed and along coastal areas causes the deepening of rivers and estuaries, and the enlargement of river mouths and coastal inlets. It may also lead to saline-water intrusion from the nearby sea. The effect of mining is compounded by the effect of sea level rise. Any volume of sand exported from streambeds and coastal areas is a loss to the system [17].[17] Further, it is a threat to bridges, river banks and nearby structures. Sand mining also affects the adjoining groundwater system and the uses that local people make of the river.

Sand mining also results in the destruction of aquatic life and habitat through large changes in the channel morphology. The ill effects include bed degradation, bed coarsening, lowered water tables near the streambed, and channel instability. These physical impacts cause degradation of the aquatic life and may lead to the destabilization of bridges and other structures. Continued extraction may also cause the entire streambed to degrade to the depth of excavation [18].[18]

When neglected, sand mining may cause severe environmental, social, and economic issues that are irreversible. Due to removal of sand, ground water table in the vicinity of the river will drop, affecting the moisture content in the soils. Due to the drop in river water levels, quantity and quality of water intake for drinking water will be affected badly specially during the dry season [19].[19] Excessive sand mining has destroyed river banks leading to instability in the ecosystem. Water scarcity will affect livelihoods of people- agriculture and commercial activities and cause decline in water availability for dependent plants and animals. In extreme cases it can cause species decline and extinction.

The exposure of the riverbed to solar radiation following deep mining has resulted in its drying up. This has decreased the water volume and caused salt water intrusion in to rivers and ground water.

[15] Kondolf, G. M. (1997). Hungry water: effects of dams and gravel mining on river channels. *Environmental Management Journal*. 551.

[16] http://www.c-tempo.org/studies/Sand_Mining.pdf.

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[19] *Id.* 17.

Continued sand mining has led to obstruction in the free flow of water in the rivers

Alternatives to Natural Sand

COPPER SLAG

Currently, about 33 million tonnes of copper slag is generated annually worldwide, where India contributes 6-6.5 million tonnes of the same. A study states that 50 per cent copper slag can be used as a replacement to riverbed sand in order to obtain concrete with good strength and durability [20].[20] Further, a study carried out by the Central Road Research Institute (CRRI) [21][21] has also stated that copper slag can be used as a partial replacement for sand in concrete up to 40 per cent without any loss of consistency. Further, the compressive and flexural strength of such concretes is about 20 per cent higher than that of conventional cement concrete of the same grade.

GRANULATED BLAST FURNACE SLAG

A report of the Working Group on Cement Industry for the 12th five year plan [22][22] stated that around 10 million tonnes of blast furnace slag is currently being generated in India from the iron and steel industry. A study into this has shown that the compressive strength of cement mortar increases as the replacement level of granulated blast furnace slag (GBFS) increases. The study concludes that GBFS sand can be used as an alternative to riverbed sand from the point of view of strength. Use of GBFS up to 75 per cent was recommended [23].[23]

Supporting the above study, another paper states that a mix of copper slag and ferrous slag can yield higher compressive strength of 46.18MPa, where riverbed sand is completely replaced, while corresponding strength for normal concrete was just 30.23MPa. Though with higher levels of replacements (100 per cent) there might be some bleeding issues and, therefore, up to 80 per cent copper slag and ferrous slag can be used as replacement of sand [24].[24]

BOTTOM ASH

India currently produces 100 million tonnes of coal ash in excess. Out of the total ash produced in any thermal power plant, approximately 15 –20 per cent is bottom ash and the rest is fly ash. Fly ash has found many takers but bottom ash still continues to pollute the environment with no safe disposal mechanism on offer [25].[25] The mechanical properties of special concrete made with 30 per cent replacement of natural sand with washed bottom ash by weight has an optimum usage in concrete in order to get a favourable strength and good strength development pattern over the increment ages [26].[26]

FOUNDRY SAND

India ranks fourth in terms of total foundry production (7.8 million tonnes) [27].[27] Foundry sand, which is very high in silica, is regularly discarded by the metal industry as waste product. Presently, there are no mechanisms developed for its disposal, but international studies state that up to 30 per cent foundry sand can be utilized for economical and sustainable development of concrete [28].[28]

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[21] Highway Research Record. Retrieved from http://irc.org.in/ENU/knowledge/research/Research%20Reports1/Highway%20Research%20Record%20No.%2038%20(2010-11).pdf

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[26] Mohd Sani, M. S. H., Muftah, F., & Muda, Z. (2011). The Properties of Special Concrete Using Washed Bottom Ash (WBA) as Partial Sand Replacement.*International Journal of Sustainable Construction Engineering and Technology,1*(2), 65-76.

[27] 42nd Census of World Casting Production of 2007. Retrieved from http://www.afsinc.org/files/2007census.pdf

[28] Bhimani, D. R., Prof. Pitroda, J., Prof. Bhavsar, J. J. (2013). A Study on Foundry Sand: Opportunities for Sustainable and Economical Concrete.

CONSTRUCTION AND DEMOLITION WASTE

There is no recorded quantification of amount of construction and demolition waste being generated in India. The Municipal Corporation of Delhi states that it collects 4,000 tonnes of construction and demolition waste daily from the city which amounts to almost 1.5 million tonnes of waste annually in the city alone. Even if all the waste which is illegally dump around the city is discounted, 1.5 million of construction and demolition waste if recycled can substitute the demand for riverbed sand in Delhi. Recycled sand and aggregate from construction and demolition waste is said to have 10-15 per cent lesser strength then normal concrete and can be safely used in non-structural applications like flooring and filling [29].[29] For the purpose of this paper, the substitutability of crushed stone sand has been thoroughly considered.

Crushed-Stone Sand: The Substitute

The progress in the building material Crushed stone sand, also called manufactured sand is considered to be a viable substitute for sand used for construction purposes. Crushed stone sand has been defined under Clause 2.1.2 of IS 383-1970 [30][30] "as fine aggregate produced by crushing hard stone." It is primarily the residue of quarrying that takes place for various other purposes, it can also be stone that is put through a process which crushes the stone into the required gradation.

MANUFACTURING PROCESS

The manufacturing process is a simple three step crushing process: cutting, screening, and washing. The raw material used is either granite or basalt rock. The process is similar to the river sand generation that happens as a natural phenomenon in nature. The principle of rock on rock collision at a high velocity shaping the sand particles is applied to manufacture the sand [31].[31]

The quarrying process typically begins with drilling and blasting the rock into smaller pieces. Bore holes are drilled in the blast site and filled with explosives. The blast breaks up the rock into smaller pieces that are loaded and hauled to the plant. Manufacturing of Sand process involves three stages, crushing of stones in to aggregates by VSI (Vertical Shaft Impact) crusher, then fed to Rotopactor to crush aggregates into sand to required grain sizes (as fines). Screening is done to eliminate dust particles and washing of sand eliminates very fine particles present within. The manufactured sand has to satisfy all the requirements of IS:383 [32][32] and only then can be used in concrete and construction.

It is an accepted fact that sand plays an important role in the production of concrete. The features of workability, strength, and durability are directly dependent on the properties of the sand used in the production of concrete. There major differences between riverbed sand and manufactured sand. Due to the natural process of attrition, riverbed sand tends to have a smoother surface texture and better shape. It further carries moisture that is trapped in between the particles. These characters provide for better workability of concrete. However, impurities like silt and clay, which is carried by riverbed sand, can be harmful to concrete, affecting its workability. The obtaining of the required grading with a fineness modulus of 2.4 to 3.1 as required for concrete mix is another issue with respect to riverbed sand. It has been found that, at various locations across Southern India, it has become increasingly difficult to access riverbed sand of consistent quality in terms of grading requirements and limited silt or clay content. It is because there is no control over the natural process. [33][33]

In case of manufactured sand, the process of attrition through VSI and washing makes the sand particles good enough to be compared with the shape and surface texture of natural sand. With well-designed screening system the required grading (Zone II) and fineness modulus (2.4 to 3.1) (as provided for in IS 383 – 1970 for Selection and Testing of Coarse and Fine Aggregates) can also be achieved consistently in the case of manufactured sand. Properly processed

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International Journal Global Research Analysis (GRA), 2(1), 60-63.

[29] Marie, I., & Quiasrawi, H. (2012). Closed–loop recycling of recycled concrete aggregates. *Journal of Cleaner Production*, *37*, 243-248.

[30] Indian Standard Specification for Course and Fine Aggregates from Natural Sources for Concrete (1993) issued by Bureau of Indian Standards, New Delhi, India.

[31] http://www.robo.co.in/technicalperspective.htm.

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[33] Dr. Elavenil, S., Vijaya, B. (2013). Manufactured Sand, a Solution and an Alternative to River Sand in Concrete Manufacturing. *International Journal of Civil Engineering Research and Development, 3*(1), 01-07.

Table 1: Comparison between Riverbed Sand and Manufactured Sand

Features	Riverbed Sand	Manufactured Sand
Source	Fragile river beds	Produced with machines
Shape	Rounded	Cubical
Quality	Contains marine/organic impurities	Zero impurities
Purity	Contains deleterious materials	Clean
Economy	Expensive	Competitive
Availability	Uncertain	On demand

Table 2: Advantages of Manufactured Sand

Advantages of Manufactured Sand	Impact on Concrete
Cubical particle shape	High Compressive strength
Internal gradation IS 383	Reduction in voids and increase in workability
Surface texture	Reduction in moisture absorption/lower water cement ratio
Greater durability	Longevity of structure/higher resistance to an aggressive environment
Zero impurities (marine and organic)	Reduction in wastage and increase in economic value

manufactured sand can improve both compressive strength and flexural strength through better bond compared to river sand. [34][34] Table 1 clearly provides for differences between riverbed sand and manufactured sand in a gist and table 2 indicates the various advantages of manufactured sand and its impact on concrete production. [35][35]

Problem of Complete Substitution

The most logical solution to prevent sand mining and to protect water bodies would be the complete replacement of riverbed sand by manufactured sand. While this would save the water bodies, but would bring with it a new set of problems. The mining sector in India has already contributed to environmental degradation; the complete replacement of riverbed sand would result in excessive quarrying. Among other problems, an increase in quarrying results in the following: [36][36] (a) Displacement of the population, marginalisation of local communities, and economic disparities in mining areas (b) Rehabilitation of closed and abandoned mining sites (c) Air, water, and land are polluted and affected due to the activities of mining, not to mention the health and safety of the workers and the inhabitants around the mining area

Quarrying activities have already incurred the wrath of environmentalists due to the affects to the environment, the complete substitution of riverbed sand with manufactured sand would only result in the increase in quarrying activity, thereby not only causing another natural resource to disappear, but also contribute to the degradation of the environment.

The question then arises as to how this problem has to be tackled. While trying to solve the problem of sand mining, there could be a rise to another evil which is quarrying. The need of the hour is to balance both these natural resources. The use of both these resources in the right proportion to enable sustainable practices along with no affect whatsoever to the quality of concrete.

The Solution: Legislative Framework

Law is the force that is looked at to provide protection to all aspects of the State, its resources, and individuals. It is the fighting force to protect the weak. When there is evidence that there are activities that have been undertaken that affect people and moreover the environment, it is necessary that the legislature takes initiative to prevent such activities. In case of protecting the environment, the legislature

[34] *Id.*
[35] http://www.robo.co.in/technicalperspective.htm.
[36] Mehta, P. S. (2002). *The Indian Mining Sector: Effects on Environment and FDI Inflows.* Retrieved from http://www.oecd.org/env/1830307.pdf

plays an essential role in laying down rules and regulations after the understanding of the environment and human needs and providing a balance between the two.

The following provides for a basic framework for sustainable development with respect to use of sand for construction purposes: (a) Sand mining should be banned in gulf areas considering the immense ecological destruction that takes place evidenced by many reports on the same. (b) Sand mining along riverbeds must be allowed only after the acquisition of a licence. Such a license should be granted after the examination of the riverbed and assessment of whether the water bodies can sustain the activity. (c) Sand mining should be permitted only till a certain level of the riverbed after which no sand mining activity in that area must be undertaken or permitted. (d) License should be obtained to carry out the activity of quarrying where the sole purpose is the production of manufactured sand. In case sand is being manufactures from the waste of previous activity relating to stones, a license to manufacture sand must be obtained. (e) Guidelines to the manufacture of sand including the size, structure, etc. must be provided for (f) A Committee should be set up in order to inspect the working of such industries and to address any discrepancies or deficiencies that may arise. (g) Such Commission should have the power to conduct disciplinary proceedings against companies or industries that do not conform with relevant provisions. (h) The legislature should make the use of manufactured sand compulsory. A study has shown that replacing 60% of riverbed sand with manufactured sand provides better strength and workability. [37][37] Hence, the compulsory use of manufactured sand to the extent of 60% along with 40% of riverbed sand must be made compulsory. (i) The Municipal authorities or the relevant authority that permit the construction of any structure must have the power to implement the above proportion. It should further have the power to conduct disciplinary proceedings against defaulting parties.

One of the most important aspect of making a legislation is to think about all the consequences that may occur due to the rules laid down in that legislation. The above provide a framework that can be employed in order to prevent sand mining where there is damage to the ecology and also provides for a balance between the use of both these resources so that both do not deplete at an excessively fast rate.

Conclusion

Sand mining is a necessary evil. Concrete is the most important element in construction. It is the ingredient that decides whether a structure stays strong or crumbles down to the ground. Sand is the essential element that combines with cement to make concrete. The characteristics of sand help it to bind with cement. It is the quality of sand that provides for the strength and the workability of the concrete. It has been established that the lack or the high cost of availability of riverbed sand has resulted in the creation of the sand mafia, the use of filtered sand or quarry dust, and various other malpractices. This is the point where the need arises to have legislation in place that governs this aspect of construction, not only in order to protect the environment, but also to help citizens procure raw material for construction at competitive prices.

In India, legislations or regulations have already been passed by many state governments for the use of manufactured sand and the ban on sand mining but most of these legislations are paper tigers. Hunter S. Thompson stated in his book *Songs of the Doomed* that "We cannot expect people to have respect for law and order until we teach respect to those we have entrusted to enforce those laws." [11][38] With no power to enforce the laws there is no respect that is accorded to the law or the authorities that are to enforce the law. It is essential that when there is question of protection of a certain thing, the law gives maximum amount of power to the enforcing authorities to implement the law and punish any defaulting parties. The absence of such power will render the authority useless thereby making sure that the legislature has no effect.

It is essential that all the countries of the world look into passing legislations to protect their ecology revolving around water as it is an essential element to the survival of mankind. The framework provided above is one that can be applied in any country in order to prevent any damage to the environment through sand mining.

The future of the planet is the most important issue in every person's life as the existence of the entire population, be it human, animal, or plant, it boils down to a healthy, well protected, and carefully used Earth.

[37] Supekar, V. R., Kumbhar, P. D. (2012). Properties of Concrete by Replacement of Natural Sand with Artificial Sand. *International Journal of Engineering Research and Technology*, *1*(7), 6.

[38] Thompson, H. S. (1990). *Songs of the Doomed*. New York: Simon & Schuster, Inc.

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