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ENVIRONMENTAL POLICY

ENVIRONMENTAL IMPACT OF SAND HARVESTING IN NIGER STATE, NIGERIA

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ABSTRACT

Purpose of the Study: The main purpose of the study was to evaluate the environmental impact of sand harvesting in Niger state, Nigeria.

Methodology: The study used a desk top review of literature.

Result: The findings were; Sand mining activities have contributed to land use and land cover changes that are impacting on ecosystem goods and services. Of primary concern are impacts on plant and animal species, soil degradation that reduces the ability of biological system to support the needs of the local communities. Natural plant communities get disturbed and the habitats become impoverished, mostly resulting in retarded plant growth, reduced vegetation cover, erosion of soil and pollution of air and water.

Conclusion: Without considering the precise gift provided by nature, commercial exploitation for short term gains by pumping out the sand indiscriminately from the rivers, dunes and beaches will destroy whole environment.

Recommendation: For individual projects, where harvesting is allowed, there then needs to be an environmental impact assessment which would highlight what mitigation measures need to be put in place to minimise damage.

Keywords: *Sand harvesting, Environmental impact, sand mining, land degradation, Pollution.*

INTRODUCTION

Traditionally, sites for sand harvesting are rivers and beaches; however, sand is mined from river mouths, banks and even at inland sand deposits. Many inland sand deposits, which are lateritic in nature, are under immense pressure due to various kinds of human activities among which indiscriminate extraction of sand is the most disastrous (Kondolf, 2019; Sayami & Tamrakar, 2017). Typically inland sand mining operations begins with the removal of overburden from the top of the sand formation using scrapers or tracked excavators and off-road haul trucks. The overburden is often hauled to the perimeter of the mine site and piled into berms. Once the

overburden has been removed, the sand is excavated. Depending upon the geological formation, blasting may be used to make the sand containing material more amenable to excavation. Large tracked excavators or rubber-tired front-end loaders typically perform excavation. In most of the inland sand mining sites in Ogun state, the excavated sand materials are loaded on trucks by hired labourers using shovels (Ugochukwu, Onuora, Kurumeh, Mbakwe, Okolo & Onuorah, 2021).

Rapid urbanization is a major cause for sand demand and is responsible for unsustainable extraction of sand from the many illegal inland sand mining pits found in many parts of the country. The interaction between sand mining operators, citizen neighbours, and government becomes more confrontational as result of more sand excavation sites located in urban and residential areas. Literature is prolific which indicates that economic development and human development efforts are increasingly constrained by environmental concerns, including degradation of forests and fisheries, lack of fresh water resources, and poor human health as a result of air and water pollution, largely resulting from human activities (Banister 2018; Chu & Yu 2021). Intensified crop and livestock production combined with misdirected incentives have contributed to increased production of chemical and organic wastes, natural resource and biodiversity loss, and soil erosion. Lack of an adequate supply of clean water, the explosive growth in population, and the artificial methods of cultivation are the most severe environmental problem in many developing countries.

Collins (2019), states that the effects of sand and gravel harvesting is; extraction of bed material in excess of replenishment by transport from upstream which causes the bed to lower (degrade) upstream and downstream of the site of removal. Bed degradation can undermine bridge supports, pipe lines or other structures, it may change the morphology of the river bed, which constitutes one aspect of the aquatic habitat, degradation can deplete the entire depth of gravelly bed material, exposing other substrates that may underlie the gravel, which could in turn, affect the quality of aquatic habitat. If a floodplain aquifer drains to the stream, groundwater levels can be lowered as a result of bed degradation. Lowering of the water table can destroy riparian vegetation. Bruce (2020), observes that river system is replaced with an unstable, difficult to restore and relatively unproductive ecosystem, often with vastly different characteristics from the natural river. The loss of this ecosystem affects the overall environment in many and far reaching ways. Food sources are obviously impacted. The basic result of in-stream mining is the removal of the natural river system. They naturally rely directly, or in part, on food sources in the river to survive. Depriving these fauna of their food sources not only drives them to other areas to attempt to feed, but places a greater amount of stress on other fauna that may be more dependent on those other places for their food.

Up to 50 billion tonnes of sand and gravel are mined each year to meet soaring demand from construction and land reclamation – making it the largest extractive industry on the planet. Yet most people have never given it even a passing thought. And nor have most decision makers and river managers. And they really should because not only is the world's economy built on sand and gravel (or aggregate) but unsustainable sand mining also poses a risk to rivers across the globe – and to the people, economies and nature that depend on them. Concerned by the potential impacts on the wold's rivers, WWF commissioned a review of the available scientific evidence as well as relevant government reports and media articles. Published during World Water Week 2018, the Impacts of sand mining on ecosystem structure, process and biodiversity in rivers outlines the vast scale of the industry and details some of its significant impacts on rivers. Global demand for sand and gravel – technically aggregate mining but commonly referred to (including in this article) as sand mining – has increased rapidly over the past two decades, largely driven by growth in the

Asia Pacific region, particularly in China but also increasingly in India. Astonishingly, China consumed more sand between 2017 and 2021 than the US did in the whole of the 20th Century.

In Nigeria, most rural people engage in agricultural activities as means of livelihood. They cultivate and harvest crops and by so doing, removes some of the nutrients from the soil without replenishment. They make land to suffer nutrient depletion and become unusable for further farming. At least 12 million rural dwellers engaged also in other livelihood activities that rely heavily on natural resources for parts of their livelihood which include animal rearing, mining of sand, gravel, rock mining and tree felling. Through these activities, over-cultivation, overgrazing, deforestation and over excavation occurred over time (IFAD, 2018). Mining of sand and gravel on agricultural land is one of the alternative livelihood activities of the rural people in Nigeria which is now becoming an environmental issue. There is increase in demand for sand for construction and other purpose as communities grow because construction at present requires less wood and more concrete, which sprout a demand for low-cost sand. Mining of sand on farms and fallow agricultural land is becoming common and this is having noticeable impacts on the soil structure, vegetation and local wildlife in the rural areas.

Sand mining activities have contributed to land use and land cover changes that are impacting on ecosystem goods and services. Of primary concern are impacts on plant and animal species, soil degradation that reduces the ability of biological system to support the needs of the local communities (Dongmo, Messanga, Oluchukwu, Lele, Ekengoue & Tientcheu, 2021). How does sand mining affect the environment? A lucrative business, sand mining from rivers done illegally and unscientifically is found to affect riverine ecology. Sand is in high demand in the construction sector. Sand mining is one of the main threats to the rich biodiversity alongside our perennial rivers and ephemeral water courses. It can destroy riverine vegetation, cause erosion, pollute water sources and reduce the diversity of animals. The beach and dune system habitat along the coastal zones also victims. Off-shore sand mining pumping biota with sand and damaging coastal ecosystem. Sand aquifer helps in recharging the water table and sand mining causes sinking of water tables in the nearby areas (Dongmo et al., 2021). Apart from threatening bridges, sand mining transforms the riverbeds into large and deep pits; as a result, the groundwater table drops leaving the drinking water wells on the embankments of these rivers dry.

Most sand and gravel is used for construction (aggregate makes up 80% of concrete and 80% of asphalt) but substantial quantities are also swallowed up by land reclamation. Intent on continuing to expand its land area, Singapore remains the world's largest importer (Gedela, Subhani & Bahurudeen, 2021). Sand mining is already putting unprecedented pressure on rivers, floodplains and deltas – and demand is only set to grow as development, urbanisation and gargantuan infrastructure projects, such as the Belt & Road Initiative, consume more and more sand. And the impacts are certainly cause for concern. Reviewing existing scientific papers, the WWF's research highlighted numerous physical impacts attributable to sand mining from changes in the shape of river beds and floodplains to alterations to instream habitats, groundwater reserves and water quality (Hackney, Vasilopoulos, Heng, Darbari, Walker & Parsons, 2021). In addition, sand mining can result in a reduction in diversity and abundance of fish in mined areas and changes to riverside vegetation. Other impacts are hard to directly link to sand mining since rivers are affected by so many different factors, including dams, but it is clear that by sucking too much sediment out of the world's rivers, unsustainable sand mining will contribute to bank erosion and shrinking, sinking deltas with the loss of agriculture land, houses and infrastructure, including failure of roads, dikes and bridges (Hackney et al., 2021). The problem is that these benefits of the natural

sediment flow in rivers are usually 'hidden' from decision-makers. Coupled with poor governance and a lack of enforcement of regulations in many countries, this blinkered approach to the impacts of sand mining leave many rivers at the mercy of sand miners.

STATEMENT OF THE PROBLEM

Sand harvesting is widespread, highly unregulated, uncontrolled and is being carried out at an alarming rate in Niger state. The gravity of the situation beyond the affected communities and the region at large is enormous and poses a threat not only to the environment but also to food security. Land owners give out land for monetary gains and caring less about the effects of the mining activities on the people and the environment. Although sand harvesting contributes to the construction of buildings and development, its negative effects include the permanent loss of sand in areas, as well as major habitat destruction. Sand dust production is another land-related livelihood activity, which the respondents ranked to be 'severe'. The dust from sand harvesting does not only affect the agricultural activity of the population of Niger state, it pollutes air as well as affects their health. It is important to note that dust from sand harvesting sites is a major source of air pollution, although the severity will depend on factors like the local microclimate conditions, the concentration of dust particles in the ambient air, the size of the dust particles and their chemistry. The air pollution is not only a nuisance and possible effects on health, in particular for those with respiratory problems, but dust can also have physical effects on the environment and surrounding plants, such as blocking and damaging their internal structures and abrasion of leaves and cuticles, as well as chemical effects which may affect long-term survival.

Environmental degradation as a result of sand harvesting and the associated resource depletion have been shown to sometimes create or exacerbate conflict between groups competing for these increasingly scarce resources (Homer, 2019; Schwartz, et al. 2018; Kahl, 2019). Ambient air pollution is a common cause of adverse health conditions, contributing to the occurrence and severity of respiratory diseases and infections. Children, being one of the most sensitive subgroups of the population, can be highly vulnerable, and high air pollution can end up affecting children's daily school performance. Several studies have identified the effects of ambient air pollution on hospital admissions, mortality rates, absenteeism and cognitive deficits in children. The environmental degradation is a direct result of human activities such as sand harvesting. These effects have devastating effects not only on the environment, but also on students learning and overall academic performance. Oyoo (2021) postulates that sand harvesting leaves behind a trail of environmental destruction, eliminates several organisms and destroy fish spawning and nursery areas, all of which ultimately change aquatic community composition and affects education supporting resources. This poses a challenge to the environment in general. It is against this background that this study derived the impetus to examine this developing problem of sand harvesting given its apparent impact on environment in Niger state in Nigeria.

THEORETICAL FRAMEWORK

Development of the social system is considered a process of interactions between the economic subsystem and the cultural-institutional subsystem. The former consists of activities combining economic resources (labor, capital, and natural resources) through technology to produce goods and services useful for human living. These economic activities are coordinated and controlled by the latter, which consists of institutions (the rules of society) and culture (people's value system). A model is developed to conceptualize how technological and institutional changes interact with each other, how they respond to changes in resource endowments, and how such responses are

governed by cultural traditions. Harvesting of sand is a socio-economic activity that is almost identified with the people who live along the river.

The theoretical framework Driving force Pressure State Impact Response (DPSIR) shows the linkage of sand harvesting activities and its socio-economic effects. The driving forces are the changes in social, economic and institutional system that directly and indirectly trigger pressure on the environmental state. The driving forces towards sand harvesting is to engage in socio-economic activity to satisfy human needs that include food, health, shelter, clothing and education. In addition, the driving force is to get raw material (sand) for construction industry to build roads, utility poles and buildings (He, Wang, Chen & Yan, 2021). The drivers put a lot of pressure on the environment that is physical environment, biological environment and human environment. The pressures include uncontrolled sand harvesting, physical damage, deforestation, waterborne diseases, and vehicular emissions. The pressure exerted by society may lead to unintentional or intentional change in the state of the human environment that is the living conditions for humans are affected leading to socio-economic issues e.g. inadequate funds, reduction of sand quantity, sickness, unemployment and illiteracy. The impacts are changes of environmental functions affecting socio-economic dimensions, which are caused by change in state of system. (Change in environmental function such as sand resources assess, water, and health). The socio-economic effects of sand harvesting include: natural resource depletion, ill health, economic losses, social changes, resource use conflict and school drop outs.

EMPIRICAL REVIEW

A study by Palma, Dias and Freitas (2021) in Acero archipelago Portugal found out that sand harvesting impact social and economic growth of archipelago in 20th century particularly in last quarter of the century resulted to accelerated coastal development which included the construction of communication infrastructure and buildings all of which required large volume of sand .Given the local geological constrains, natural and suitable for aggregate in construction is a scarce natural resource. Construction therefore used beach and dunes as principle aggregate source, exploiting the weakness of legal constraints to these types of harvesting activity as well as the in existence of proper coastal management plans.

Globally, sand harvesting is in great demand due to increased demand in the construction industry and should be of great economic benefit to the people who live in the area through accessing better education for their children. Globally, sand deposits are actively harvested on every continent except Antarctica (Naveen, 2019). In the United States sand harvesting has been carried out in California, Monterey bay area, Georgia, Florida, Virginia and New Jersey. In Australia sand harvesting is carried out in kurnell peninsula where the harvesters use the money to invest in business activities and take their children to school while contributing to the construction of buildings. Though as much as it has contributed to the improvement of the people's lives it has also led to the development of negative effect of sand including the permanent loss of sand in areas as well as habitat destruction (Naveen, 2019).

Mensah (2020) in his study in Ghana noted that sand harvesting is causing child labour of children aged 14 yrs. assist their mothers in sand harvesting. For Mensah to some extent sand harvesting is increasing employment opportunities, Mensah also noted social economic factors are the main reasons why people undertake sand harvesting. In the coastal area people are unemployed and underemployed which compels them become sand carriers, sand loaders, and tally clerks in order to make ends meet. The uncontrolled sand harvesting, the sand contractor fetch minimal daily

wages rate of US $ 55.47 per day, while sand carriers, sand loader make daily net income of US $ 1.54 and US $ 2.16 respectively. This is high profit margin showing the contractors earn more than the loaders. Mensah also found out that the demand of sand and stones are caused by high housing and construction works in nearly all urban centers.

In Nigeria, the study by Ugochukwu, Onuora, Kurumeh, Mbakwe, Okolo and Onuorah (2021) indicated that the human health and ecological risks resulting from exposure to polycyclic aromatic hydrocarbons (PAHs) in the Ekulu River sediments were estimated in this study. The Ekulu River receives pollutants potentially containing polycyclic aromatic hydrocarbons (PAHs) from runoff from automotive workshops and abandoned coal mines. The study found that mine drainage, in particular, could be responsible for the relatively high concentration of benzo[a]pyrene (1.266 mg kg−1) in parts of river where sand is harvested on a commercial basis. Sources of the PAHs at The Gate and Damija were petrogenic. The consensus-based quality guideline for freshwater sediments using threshold effect concentration and probable effect concentration was the basis employed for evaluating the ecological risks, which were highest at The Gate, because of the presence of fluorene and phenanthrene. Toxicity equivalency (TEQ) at Damija and The Gate did not indicate health risks; however, those at Waterfall were high (1.39 mg kg−1), indicating potential health risks. The hazard and risk indices indicate insignificant human health risks.

Guerrera, Martín-Martín, Tramontana, Nimon and Essotina Kpémoua (2021) evaluated the socio-economic effects of sand and gravel mining in Lome Togo and found out that quarrying industry and associated other transport and related services industries have had an important role in the local economy of Togo for many years. On national basis quarrying has traditionally been probably second only to agriculture as a source of rural employment. The industry is one large employer identified a lot of jobs associated with quarry ranging from manager labourers and truck drivers. The harvesting of sand and gravel in Togo has created job for youth. The revenue gained is used in most part to meet basic needs of the family including food, to pay tuition for children. The labourers work in primitive conditions with the use of archaic tools (Shovels, hoes, buckets) and no guarantee of support in case of accident. They earn average 3,000 CFA francs per day and the revenues are used to meet basic needs food, rent, medical care and children schooling. On health diseases such as malaria, stomach disorder, hernias as well as sexual and physical weakness due to difficult working condition were common. The study found out that of 68 respondent, 60% attested to having consulted a doctor but the purchase of the prescribed drugs was almost impossible because of the poverty level.

River sand is one of the words most plentiful resource (20 % of the Earth's crust is sand) and has the ability to replenish itself. River sand being a natural resource has utility and it can be extracted by humans to help them in earning a living. Natural resources are out there regardless, of whether or not human beings choose to use them to improve their lives. They are "neutral stuff" that make up the world, but they become resources when we find utility in them (Hunker, 2020). Therefore river sand is vital for human well-being and for sustenance of rivers. Sand harvesting in South Africa and Botswana is done in small scale and large scale using heavy machineries (Madyise, 2019). Musa (2020) observed that in West Africa sand harvesting was being done in parts of Nigeria and Ghana as well. The popularity of sand harvesting in the region has been attributed to the socioeconomic contributions that accompany the activity both to the local community as well as the national economy. Controlled and regulated sand harvesting has been associated with more socio-economic benefit as opposed to illegal sand harvesting (Langer, 2021)

RESEARCH RESULT AND DISCUSSIONS

Sand resources are finite natural resources that exist on earth as a result of earth's processes that include degradation, erosion and fragmentation of landscapes. Natural sand resources occur in river channels, flood plains, lake deposits, beaches. Sand from river beds is the most explored to meet the demand arising from the construction industries as compared to the other non- river sources thus raising sustainability concern on sand from the rivers. The cutting down of indigenous species adversely affects the ecological balance. The Process also diminishes and endangers the supply of natural resources available to the local communities and thereby increasing their poverty levels, affects the natural topography, scenic beauty, hydrological functions, water quality and increases soil erosion in the area. The vegetation loss reduces the absorptive capacity of the soil. Most of the rainwater is therefore lost through surface runoff and reduces the water storage capacity. The removal of vegetation cover and sand also allows pollution of fresh water by solid impurities and any other contaminant carried by surface runoff. Underground water aquifers are exposed to direct sun heat and wind that increases water evaporation rates causing water yield reduction.

Sand extraction is done by open cast mining method. In this method, the ground vegetation is cut to clear the land. The topsoil is then removed. Pits are then dug into the ground to reach the quality sand deposits. Finally, the sand is loaded into Lorries for transportation and trading purposes. Off road movement of trucks and other vehicles in the area causes further damage to the vegetation and ecology of the area hence, a large extent of the land is degraded and denuded of vegetal cover not only by mining but also by the associated vehicular movement. Once the sand deposits are mined and exhausted the mines are abandoned without any rehabilitation. The sand mines are located near natural waterways and the permeability of the material in the floors and walls increases their filling with water. The water in these mines is greatly increased during the rainy seasons and attracts concentrations of livestock in search of water around the mines. The populations of livestock overgraze the sand mining areas that leading to plant species depletion.

Sand mining activities have contributed to land use and land cover changes that are impacting on ecosystem goods and services. Of primary concern are impacts on plant and animal species, soil degradation that reduces the ability of biological system to support the needs of the local communities. Natural plant communities get disturbed and the habitats become impoverished, mostly resulting in retarded plant growth, reduced vegetation cover, erosion of soil and pollution of air and water. Other impacts are social in nature, as mining requires the use of land for which there is mostly, competing community demands. The natural vegetation recovery on abandoned sand mines is often problematic due to the nature of mining that removes all the sand up to the bedrock level. It may take several decades or more for the vegetation to recover on these sites. These large de-vegetated areas are a major threat both ecologically (e g. both flora and fauna) and economically (e.g. less attractive for tourism). Human interventions to re-vegetate the sand mines are facing flooding challenges enhanced by surface runoffs especially from higher grounds during the rainy seasons.

CONCLUSION AND RECOMMENDATION

Minerals are part of a nation's natural wealth. The nation is to advance industrially and economically by the proper development and exploitation of these resources. It has to be remembered that the sand once removed cannot be replaced in the next generation. It will take centuries for replacement. Sand sustains the rivers and the percolation of water to far off distances

both for the growth of trees to sustain drinking water and raise cultivation. It is almost a lifeline to the human existence. Without considering the precise gift provided by nature, commercial exploitation for short term gains by pumping out the sand indiscriminately from the rivers, dunes and beaches will destroy whole environment. People employ huge machineries like cranes and other pumping mechanism causing untold natural calamities and loss to the society. In order to maintain the balance between the environment and sand mining, the Governments should regulate the mining.

For individual projects, where harvesting is allowed, there then needs to be an environmental impact assessment which would highlight what mitigation measures need to be put in place to minimise damage. What has been missing from all assessment reports so far is real-time monitoring of sediment plumes, how they are affected by the wind, waves and tides, and what would trigger harvesting activities to be postponed or altered to avoid damage to nearby sensitive reefs. During sand harvesting, there is induced agitation of the system, which results in more nutrient elements being contained in the sediments. The increased nutrient concentration can result into increased nutrient concentrations in the river water.

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