SAND MINING AND ITS IMPACT ON ECOSYSTEM CHANGE

A CONCEPTUAL FRAMEWORK

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PURPOSE

THIS paper establishes the impact of sand mining on ecosystem change. It intends to expose both benefits and negative impacts accrued from sand mining, and their implication on ecosystem change. The paper further reveals man's position in the ecosystem and his influence on its stability, while providing the importance of the ecosystem stability to human health and a sustainable global environment.

Design/Methodology/Approach: *This is a research based paper, build up on extensive literature review and analysis from sand mining processes, ecosystem concept, and drivers of ecosystem change.*

Findings: *Various studies reveal tremendous impact to the ecosystem due to sand mining. These include; loss of biodiversity, injury and death to human in the mining process, pollution at various scales, land degradation, and loss of agricultural lands. Change in land use has also increased poverty amongst people. It was further discovered that a stable ecosystem is maintained by its proper management, conservation, and restoration of threatened ecosystems.*

Research Limitations: *There are a lot of unrevealed facts about the sand resource, its use and its mining impact to all aspects of the ecosystem. Above all, this paper doesn't exhaust everything about ecosystem change mechanism. It keeps to the topic only.*

Practical Implications: *The paper entails both local and international sand mining communities. When sand mining is conducted with caution to the future of the ecosystem, human health, and environment will be safe. The society will further be informed that, it is a part of the complex ecosystem, and, therefore, destroying the ecosystem, is destroying oneself. This will make the ongoing sand mining activities friendly towards the ecosystem.*

Originality/Value: *This paper is recommended for small scale and large scale sand miners in both developed and developing countries, also local and central governments worldwide, because changes made to the ecosystem impacts human health and both local and global environment.*

Key Words: *Biodiversity, Degradation, Ecosystem Change, Sand Mining, Technology.*

Introduction

An ecosystem is a dynamic complex of plants, animals, and microorganism communities along with the non-living environment, which interacts as a purposeful unit. Humans are an integral part of ecosystems (Jorgensen, 2006). It is meant to be stable for human and environment sake. Most of the benefits offered by the ecosystem are enjoyed by human beings, who in turn destroy this system. The

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ecosystem stability is needed for both man and other species survival (Lymn, Glasener, & Wagester, 2007). A study conducted by Pintova (2011) states the issue of environmental migration caused by floods, which in Slovakia and many other countries is a living topic over the years. Gyorgy & Sandor (2010) stated that the reduction of the load on environment is one of the most important challenges for the economy. Sand is one of the ecosystems that provide services and it is a part of the complex ecosystem. It falls under the non-living component. It is used in all kinds of ventures such as construction activities, coastline re-nourishment, in industries, and in the making various equipment (S & H Industries, 2015). Demand for sand is always increasing as the human needs increases beyond sand's renewal. This has impacted most of the ecosystems worldwide (Puko, 2016). The great determinant is the ever increasing population and advancing technology. Sand mining economic benefits accrued to sand use, are more exposed and worshipped by most of people than its grave consequences (Rubin, 2001). The impact created by sand mining occurs when the rate of sand extraction exceeds the natural sand generating processes. These consequences are responsible for the ecosystem changes. The best option to recover the ecosystem is to go for environmental degradation mitigation measures (Pielou, 1966).

Conceptual Framework

The conceptual framework in figure no. 1 is based upon the model developed by Cleland (2012). Ecosystem change is particularly brought by anthropogenic factors when compared to natural factors such as floods, drought, and climate change. Cleland (2012) associated ecosystem stability with the Diversity Stability Theory which was reviewed by Ives & Carpenter (2007). The theory proposes that, there could be multiple relationships between diversity of species and stability of the ecosystem. Sand mining disturbs diversity of species because most of species die and other migrate to new environments due to a disturbed environment caused by sand mining. With this problem at hand, the ecosystem is going to disappear while leaving behind no hope for recovery of the original ecosystem. Hence, it is very important to find a permanent solution for this problem.

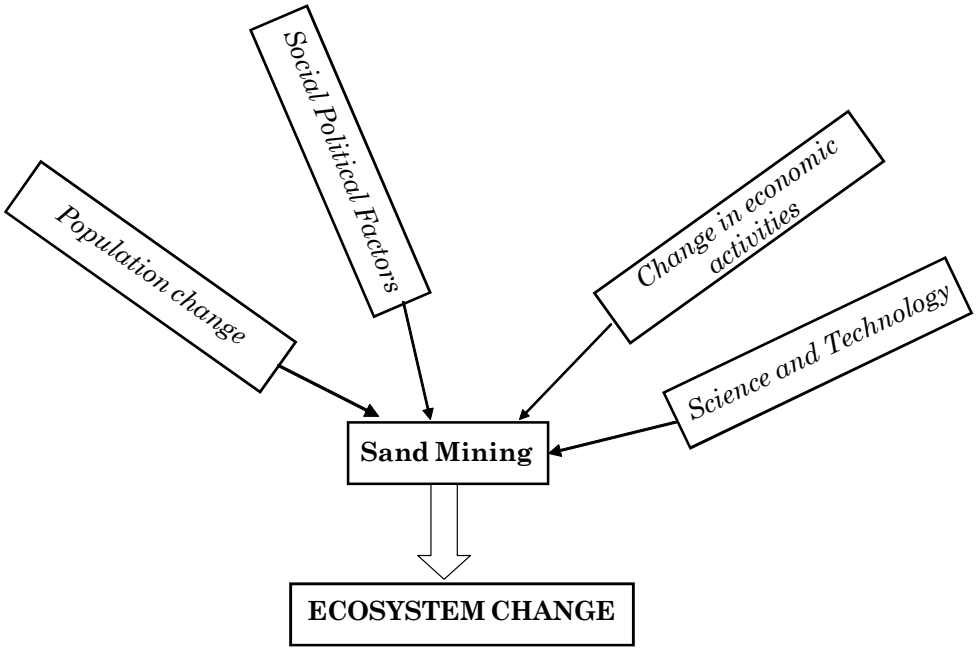

Figure No. 1: Conceptual Framework depicting factors contributing to Ecosystem Change
***Source**: Cleland, (2012).*

The arrangement in this construct is based on how each variable influences other variables. Ecosystem change, illustrated in figure no. 1 is influenced by sand mining. Sand mining is an anthropogenic activity which, is triggered by drivers above mentioned as; change in economic activities, population

change, science and technology, and social political factors. Population change which involve population growth and migration. This change will further demand for employment to calm the changed population as well as raw material for shelter and other needs. This factor, therefore, pushes the sand mining activity to take place so as to settle all those needs. This is done irrespective of the future of the sand mining activity. *Change in economic activity,* always goes with the growth of per capita income and, therefore, opening rooms for higher demands of sand which in the end may impact the future of the ecosystem. *Socio-political factors* do expose the environment into a multilateral environmental agreement, some of which are not in favor of the environment but to please Politicians and the society. In this sense, sand mining is done in that respect. *Science and Technology* attracts the society to engage in mining activity with the arrival of advanced machinery in sand harvesting. This in turn contributes on degradation of most of ecosystem goods and or services, leaving behind a changed ecosystem. Ecosystem change, can be avoided if everyone is informed of how important the ecosystem stability is to everyone.

Nature and Extent of Sand Mining

Sand mining is a process of extracting sand, mainly through an open pit. It can be mined from beaches, inland dunes or dredged from ocean beds and river beds as well (Side Event, 2012). It is packed with economic benefits that makes one forget about the other side of coin. With this societal outlook, sand mining has now become an environmental issue (Ghose, 1989).

Sand can be extracted from various sources, such as rivers, beaches, deltas, sand dunes, and lagoons. This paper will only introduce sand extracted from rivers, beaches, and lagoons. Normally mining is done by digging and picking the sand via various types of vehicles and ferry it to where the market is (Naima, 2014). Once depleted, the renewal is only determined by the type of sand deposits. Some deposits renew themselves annually due to floods storms or other acts of nature, that move large volumes of sand, while other deposits don't renew themselves. That is why sand conservation is the most important option (Maya, Santhosh, Padmalal, & Kumar, 2012).

River Sand Mining

One of the world's most plentiful resources is river sand and it has the ability to replenish itself. River sand is vital for human wellbeing and for sustenance of rivers. Sand mining in rivers was traditionally done mostly for construction purposes and the impacts were less when compared to the present. But the high demanding market for sand has depleted all the deposits in the river (sediment sand) leading to the point of invading the river bed sand and river bank sand as shown in figure no. 2 (Naiman & Bilby, 1998).

Beach Sand Mining

Beach sand mining involves the removal of sand from the beach. This sand is suitable for concrete making for construction purposes (Hellwig, 2015). The uniqueness of beach sand is in its use. Beach sand can be used to make lithium-ion batteries (Li-ion batteries) that last three times longer than current models. It is a low-cost, non-toxic, environmentally friendly way to produce high performance lithium-ion battery anodes (shown in figure no. 3). One big advantage of Silicon sand used in the makeup of these batteries is that, it can store about 10 times more energy than other batteries. The only set back is that it is difficult to produce it in large quantities and degrades quickly.

Lagoon sand Mining

Sand mining is also done in lagoons (figure no.4). Lagoon sand mining is also called coral sand mining, especially when mining is done in an atoll lagoon, which is protected by coral reefs (Oxford Dictionary, 2013). Their salinity differs from that of the sea or the ocean and may vary between light and super saline depending on precipitation, evaporation, mixing with salt water during storms, which explains the different organisms inhabiting them.

Figure No. 2: River Sand Mining and a Degraded River Bed

Source: Coastal Care, 2014.

Figure No. 3: Beach sand on the left (b) and purified sand in the middle (c). The right side image (d) shows glass vials containing the former two sand samples, and a third vial containing nano-silicon made of synthetic industrial heated once beach sand which will be used to make the battery.

Source: Popular Science, 2014.

Lagoons have a different environment from other coast lines. They often contain some fresh water from the rivers as they are detached from the main water body the (sea/ocean). In this aspect, they contain sand deposits as due to their basin nature they are the appropriate depositional points (Schmalz, 2016). Sand mining in this place impacts most of riparian unique life. With constant supply of sand deposits, lagoons turn to be victims of illegal sand mining (Odunuga & Thaddeus, 2015).

Figure No. 4: Sand mining in a lagoon in Nigeria. A true picture of how poverty has no ears, for environmental management

Source: National Geographic, 2015.

Sand mining is currently a global agenda, because of the ongoing worldwide campaigns against unsustainable sand mining (Wired, 2013, Coastal Care (SOS), 2014, Pereira, & Ratnayake, 2013). Both developed and developing countries are involved in this activity. Sand is produced, then processed and exposed into a multitude of uses. The most leading nations in this kind of mining are United States of America, Australia, Austria, Belgium, Brazil, India, Spain, Nigeria, Kenya, and South Africa (Draggan, 2008).

With the cheap and readily accessible nature of sand, many companies, both legal and illegal, are attracted and involved in sand mining, irrespective of the damage they leave behind on the environment (Madyise, 2013). The mining process is done both locally and in a more mechanized way using more sophisticated machines like, bulldozers, tractor scrapers, front end loaders, and stone crushers. The results are always abandoned open pits that impact both the environment and the ecosystem itself (DNR, 2016 and Hua, 2000).

Demand for sand is always increasing as the human needs are increasing beyond its renewal. The great determinant for the increased demand is the ever increasing population and advancing technology (Gillis, 2014). It is forecasted that the global demand for silica sand between (2016-2021) will shoot up to 4.4% annual increase, hitting to 278 million metric tons, valued at $8.5 billion (Ooijens, 2012). This demand predicts seriously changed and damaged global ecosystems.

Drivers of Sand Mining

There are a number of factors which trigger sand mining. Among those, urbanization and industrialization do matter. Others are those suggested by Rubin (2001) namely population, standard of living, and technology. Also, hydraulic fracturing using sand is a driver to sand mining. Other drivers are job seeking and sand uses.

Rapid urbanisation induced by population growth, have exposed the sand resource into constant use. Urbanisation is accompanied with pushy plans for construction of roads, runways, schools, colleges, factories, office space, power stations, bridges, residential buildings, and multi-storey buildings. These leave the sand sources depleted with lost habitats, disappearance of several species, and completely changed ecosystems (Mushaija, 2014). Industrialisation also consumes tons and tons of sand and the demand keeps on increasing as technology advances. These benefits to the society impact the ecosystem network (D & T Trucking Company, 2012).

According to Rubin (2001), population, standard of living, and technology are drivers of sand mining. The more the population grows, the more would be the demand for resources, of which sand is not exceptional. The standard of living is based on the level of prosperity of the population. The more affluent the population is, the more goods and services are demanded, the greater would be the resulting environmental impacts. According to him, technology has an impact on the land use patterns and so is on the sand mining. It is the most critical aspect as it triggers the use to which the resources are to be put through. The above primary factors determine the future land use patterns and the environmental future at large.

D & T Trucking Company (2012) exposed another serious driver for sand mining. This involves hydraulic fracturing using sand. The oil and gas fortune triggers all the sand mining especially in the US and in Mid West. This is because tracking cannot be done without sand, which is the main content in the oil and gas extraction. This impacts the management of the sand resource since as long as oil and gas mining exists, sand mining exists too.

Job seeking is another driver. Availability of sand deposits and absence of job opportunities leaves no other option than sand mining in areas having sand deposits. This is because construction activities are inevitable. This is the global agenda because, even in those countries where there is no enough sand, importing is an option. The rate of harvesting exceeds the sand's renewal and its management especially where caution is not taken (Power, 2013).

Sand mining is also driven by its various uses. Sand, just like most of the other services of the ecosystem, is persistently exploited. This is due to a multitude of use, to which this resource is exposed to (NISA, 2011). It is through these uses that most of the global ecosystems are in danger of being degraded (USGS, 2016). Glancing on its use, sand from bank of a river (bank-run sand) makes a perfect mix in construction and in such aspects as beach nourishment (Villioth, 2014). Electronic devices also use sand in the making of such items as semiconductor silicon computer chips and microprocessors, mobile phones, lightweight alloys, aircraft components (jet engines, aircraft frames), automotive components, and joint replacement (hips ball and sockets) (ScienceViews, n.d. and Pereira, 2012).

Sand is also used as catalyst in improving traction on wet or slippery rails, in sand blasting so as to remove a previous finish on an item or to remove rust, and to prepare a surface in order to receive a new coat of paint. Also to line floors of large open hearth furnaces to control the fire; it holds the cracks and crevices open in petroleum industry while helping in improving icy and snowy driving conditions in cold regions when mixed with salt. Sand is an excellent filter for removing sediment and bacteria from water and in various applications like plastics and sun screen (ScienceViews, n.d.).

Sand is chemically used in the making of various products such as detergent, paints, cosmetics, food colouring, and various biomedical applications (S & H Industries, 2015). Most of machines are made of

sand; focus is seen on watches, chemical processing equipment, marine equipment, pulp and paper processing equipment, pipes and jewellery (IIED & WBCSD, 2002). Sand is also used in the making of heavy minerals such as Rutile, Sillimanite, and Monazite, welding electrodes, ceramics, and foundry (Pereira, 2012).

Sand Mining at Global Level

The mining industry has its history in the USA where it started back in 1920s. It was mostly used in roads construction and in cement aggregate. The growth of science and technology has exposed sand into other uses, which in return causes instability to the ecosystem. Sand uses in USA had then doubled by 2008 to date (Schaetzl, 1990). USA is the world's largest producer and consumer of sand. The country is also the leading global exporter of silica. This is due to the big silica deposits and the technology that USA has. In America, demand for sand is very high. It has even reached a point that more sand has to be excavated, for restoration of sand mining impacted coastlines all the way from the coastlines of Louisiana to New Jersey. It is estimated that sand extraction is a $70-billion industry (Rehm, 2016).

Asia and the Pacific region are leading in the consumption of large share of sand, counting to 56% of the global silica demand which was between 2011 and 2016. This is due to the increased construction expenditures in China and India (Report linker, 2012). It is observed in India that the demand for sand is so high that mining is done even in the prohibited fringes of Bannerghatta National Park in southern India. In spite of fines and various government measures to curb illegal sand mining, the process continues and so is its impact to the ecosystem around it (Fessenden, 2015).

In the Caribbean islands, in Jamaica, in Trelawny on the west of Duncans Bay Beach, and Silver Sands, beach sand mining is taking place, and has brought drastic changes to the original ecosystem (JET, 2014). Jamaica's most famous beaches are slowly vanishing. It was once a palm fringed shoreline known by the name of "Seven Mile Beach". It was a crescent of white sand situated along the turquoise waters of Jamaica western coast. Mining has made the sand in the beaches slip away along with a multitude of bio life (MacFadden, 2014).

In the Philippines, poverty has its own impact as a driver to sand mining. It has forced people to invest their time in sand mining which in the end has left the villagers poor and with no fish as food. Black sand mining along all the coastal barangays in Tagudin and Sta Cruz has impacted fish catch from 50 kilos, twenty years back to 5 kilos or less currently. This has been triggered by the water eaten coast by 40 kilometers for 54 years as from 1960 to 2014 (Anawin, 2014).

In Africa, an increase in construction activities has impacted most of its original ecosystem (Musah, 2009). The original West African coastal landscape has changed too. West African coastal countries are now occupied by worn-out beaches. This has doubled the impact brought to these coasts, by the global warming linked rising sea levels. As a result, the rising sea, wiped out homes, hotels, roads, and harvests (IRIN, 2016).

East Africa is also endowed with sand deposits especially in Kenya and Tanzania. In Kenya the activity has never benefited the community as it was expected. It has instead brought forward destruction of its environment, including drying of riverbeds, which used to support bio-life and other human activities (Kibet, 2014). It has destructed roads and caused societal problems like drug abuse and increased school dropouts. It has further cost lives of dredgers in Machakos District at various sites, most of them being buried alive (Mbuva, 2015).

In Tanzania, Dar es Salaam is one of the cities seriously involved in sand mining activities. Mining was mostly taking place in coastal areas of Kunduchi. It was banned by the environmental team due to a multitude of social economic impacts it has brought to the society (Jambiya, Kulindwa, & Sosovele, 1997). The activity is however still going on and it is being undertaken in areas not designated for such activities and, therefore, creating conflicts between residents and city authorities and eventually

destabilizing principles of urban planning. The impacts are creation of big holes which affect the aesthetic features of the area while worsening soil erosion and, therefore, leading to the loss of productive land and the future of the ecosystem (Elisante, 2003).

Sand Mining Impact on Ecosystem Change

Sand mining has had a large number of impact to the ecosystem ever-since. From empirical studies, it is confirmed that there is a strong interactions between the biotic and abiotic parts of ecosystems. The study cited examples from the life of a tubeworms assuaging habitat around oceanic vents. The presence of this worm has an impact to other species life and the abiotic component too. It was concluded that, any abiotic change leads to biotic change, and vice versa. This calls for the protection of the whole ecosystem (Hall, Baker, Marshall, Tank, & Newbold, 2013).

According to Loki (2015), the US Frac mining, which uses sand and chemicals by injecting them underneath, for oil and gas extraction, impacts the ecosystem and human health to a very great deal. 40,000 gallons of chemicals is injected, plus 8 million gallons of water is used per fracking. 600 different numbers of chemicals are used in the fracking fluid, including known carcinogens and toxins such as lead, benzene, uranium, radium, methanol, mercury, hydrochloric acid, ethylene glycol, and formaldehyde. All these chemicals and liquids are injected at 10,000 feet into the ground through a drilled pipeline. The whole process, though economically profitable, has great impact to the ecosystem and human health. This is because during fracking, methane gas and toxic chemicals leach out from the well and contaminate nearby drinking ground water. There have been over 1000 documented cases of water contamination accompanied with health cases of sensory, respiratory, and neurological damage due to ingested contaminated water. Abandoned chemicals release dangerous volatile organic chemicals that bring back acid rain. They impact the heart and kill almost all living organism around.

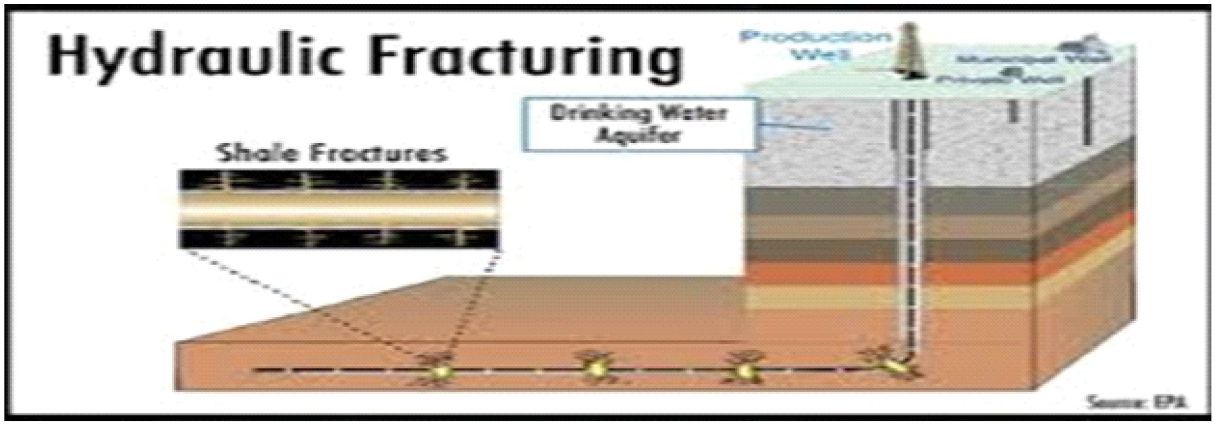

Figure No. 5: Flac-Minining in operation, Underground cross- section (Winscosin)

Source: Degenhardt, 2011.

The Huffington Post (2011) reported various impacts of Tatai river sand mining in Cambodia KOH KONG where mining is operated for 24 hours. In the dredging process, muddy water and fuel discharges are released and turn out to eliminate fish to an 85% dropout and, therefore, forcing the fishing families to set off for another economic activity. The activity changed the original ecosystem to a depleted environment.

Myers, Mittermeier, Mittermeier, Fonseca, & Kent (2000) made a study in India where reference is made to the three villages of Mahad, Toradi, and Bankot threatened by sand mining. These villages lie along the Western Ghats of India, a place where world's ten 'hottest biodiversity hotspots' lies with at least 325 globally threatened species. Most of these species are faced with the impacts of illegal rampant sand mining which leaves them with no habitat and with most of them eliminated. Most of the dredged

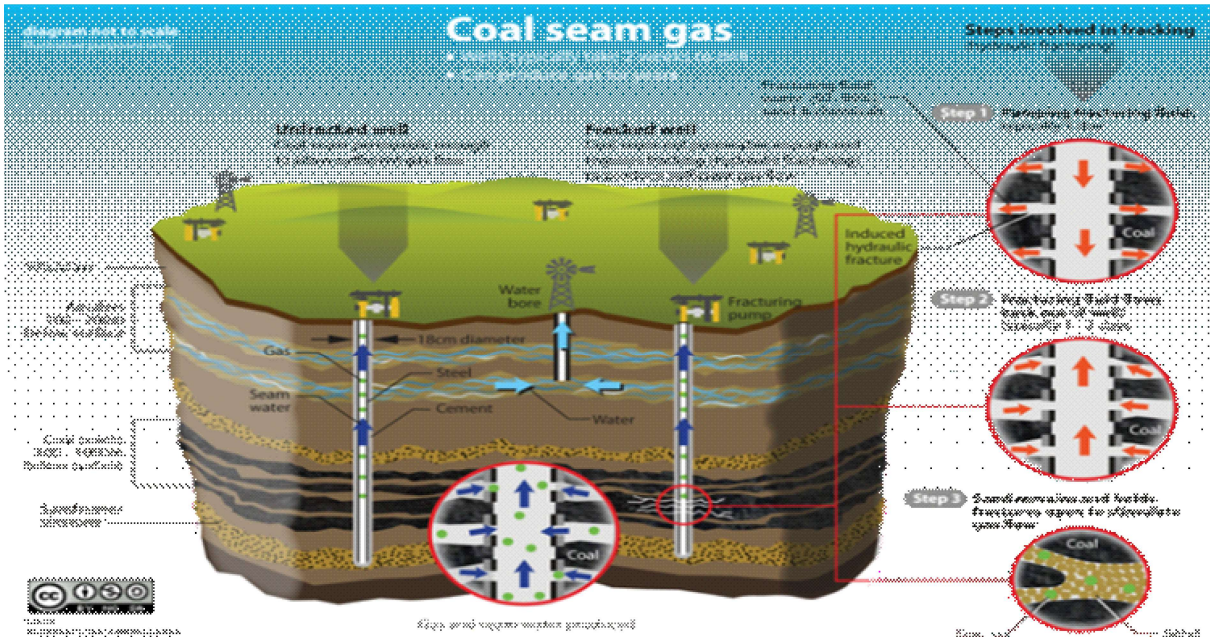

Figure No. 6: Steps involved in fracking (Wisconsin)

Source: ABC Science, 2016.

sand is sent to Mumbai, the financial capital of India. Out of such sand mining activities several ill-effects were noted in the region and they far outweighed the positive impacts on the region.

Illegal and legal sand mining operations in Gauteng North West, Limpopo, and Kwazulu –Natal south Africa; have impacted the top soil which is non renewable and the wetlands around, and, therefore, impacting the beauty of pristine protected areas in the province and consequently impacting species diversity and total disappearance of some flora and fauna.

Other impacts were presented by Kondolf, Smeltzer, & Railsback (2001). According to him, in-stream sand mining degrades the natural equilibrium of a stream, because of a significant distortion of the natural river channel. The distortion is obviously caused by the removal of sediments from the active channel bed which interrupts the continuity of sediment transportation through the river system, and, therefore, disrupting the sediment mass balance in the river downstream. This may eventually induce channel adjustments usually through incision. This impacted the bio life of the area leaving behind a broken degraded river bed with no signal of life.

Researchers like Byrnes, Hammer, Thibaut, & Synder (2000), Hoering (2008), Myers (1999), Young & Griffith (2009), Viswanathan, (2002), and Kondolf *et al.* (2001) have remarked on ecological impacts of sand mining. They argued that when mining is done unscientifically it may increase shoreline erosion rates while decreasing the shoreline from sea water especially during ocean disasters and, therefore, exposing human life in danger. The mining itself impacts breeding places for various species leading to their total disappearance.

In China, sand mining was conducted in Lake Poyang. Dredging began in April 2001.There wasn't a clear picture of how much sand was harvested, until when satellite pictures were used. It was discovered that, Poyang lake mining site might be largest worldwide. The ecosystem in it had been impacted by sand dredging machines, dirty water that won't support aquatic organisms, habitat degradation, disturbance in breading places, and death of species. There is no room for biodiversity and the sand mining process has completely changed the historical ecosystem (Leeuw, Shankman, Wu, Boer, Burnham, He, Yesou, & Xiao, 2010).

Luku, sand mining site in North Central Niger, is endowed with sand mining activities that have become a threat to the environment and human health. The activity was still going on by the time the study was conducted, due to the countries great demand for sand. Mining impacts were observed and laboratory analysis of soil samples was conducted to see the impact of sand in the study area. Result of the field observations revealed landscape destruction, reduction of farm land, and grazing land, collapsing of river banks, deforestation, and water pollution. From the laboratory, the results showed higher concentration of chemicals in soil which would harm plants and animals in the area, while causing brain, kidney diseases, lung irritation, cardiac abnormality, and event death to plants and animals. All these results are a threat to the ecosystem, as it is not easy for all species to adapt the new environment in just a short period of time.

Table No. 1: Laboratory Results in PPM Concentration, An Evidence of Ecosystem Change in the Luku Sand Mining Site Own Construct

Elements discovered	Pb	As	Cu	Ni	Cd	Hg	Ag	Zr
Concentration in PPM	47.8	4.17	50.9	32.7	2.48	0.1	0.8	496.1

Source: Ako, Onoduku, Oke, Essien, Idris, Umar, & Ahme, 2013.

Chevallier (2014) made a study in the Thekwini Municipality, South Africa, where river sand mining was the order of the day. He discovered that, when sand mining is done beyond the capacity of the ecosystem, changes occur. It started with the degraded river whereby species habitats and food webs were destroyed because of sand dredging. The dredging of the river bed reduced the river deposited load. In return the load-free river increased its speed and ultimately eroded the river banks. He also said that, the degraded river thereafter acted like a sponge which recharged water tables nearby. In the end sinking water tables were made from recharged water tables leaving behind dried wells and other water holes. Lastly, the transported sand was deposited on the shoreline adding more harm to marine species and their habitat.

There are still a lot of unexposed impacts of sand mining on the ecosystem. There is still a gap between man and the ecosystem as he considers it as something out of his sight. Man has to change his attitude and open his eyes to see himself within the system. The ecosystem has lost so many human beings with ignorance and carelessness. Man has to be there to sustain the ecosystem instead of destroying it. Education and a new outlook about the environment would keep the ecosystem stable; otherwise the impacts will be as many as shown in table no. 2.

Summary and Research Gap

Various studies suggest that, ecosystem change is mostly influenced by anthropogenic factors which triggers sand mining activities to happen. In the course of sand mining, problems such as the loss of biodiversity, various health problems to the society, and land degradation prevail (Rubin, 2001 and Musah, 2009).

Most of the studies done so far, show the causes of ecosystem change with less information on solutions. There are, therefore, gaps which need further research, so as to come out with permanent solution for ecosystem change. These are as follows: research on sustainable measures against impacts created by sand mining, research on alternatives to sand in construction and other industrial needs, research on techniques to harvest sand sustainably, and research on advanced techniques of recovering the lost biodiversity and degraded land.

With the filling of the above mentioned gaps, the ecosystem stability will be perpetual.

Table No. 2: The Extent of Sand Mining Impact to the Ecosystem

S.No.		Main Impact	Consequences
1.	Air	Increase level of air pollutants concentration	Human health risks
2.	Flora and fauna	Habitat loss	Alteration on fish population
			Increasing level of weed infestation
		Physical disturbance of the habitat	Degradation of aquatic biota
			Alter number of animal species
		Vegetation is destroyed	Reduction of farmlands and grazing lands
3.	Water	Increase water turbidity	Decrease plants photosynthetic activity
			Changes in nutrient parameters
			Disturbing feeding activity for different aquatic animal species
			Reduce light penetration and oxygen levels that can affect aquatic animals activities and composition of phytoplankton
			Affect spawning and hatching
			Affect aquatic animals respiration Cause respiratory distress
			Negative changes in fish population diversity and trends (major decline in population)
			Increase infections and death risk for aquatic animals
			Redistribution of fine particles in the water
		Increase soil and coastal erosion	Seawater intrusion
			Affect infrastructure projects
		Water quality deterioration	Increase water salinity
			Alteration of water sources
			Increase water treatment cost
		Water pollution	Affects the biodiversity
		Sinking and deformation of riverbeds and banks	Drying up wells around the river
			Lateral channels erosion and instability
			Negative effect on groundwater
			Waterways siltation
			Influence the uncertainty of the slope and
		Affects hydrological function	Change in water flows, flood regulation and marine currents
3.	Soil	Decrease soil quality	Increase dark areas (fertile land became unfertile due to lowering groundwater levels
			Changes in soil geochemistry (increase concentration of lead, arsenic, mercury, etc.)
		Soil erosion	Watercourses, wetlands and lakes pollution
4.	Land	Landscape disturbance	Dramatically change of the landscape
			Deforestation
			Loss of bathing beaches
			Decrease sand reserve for natural beach storm response
		Mine-Induced Seismicity	
		Structures stability	Damage of the public and private property.

Conclusions

Sand mining though, very profitable and a necessity for economic development globally, has changed most of the global ecosystems. So many plants and animal species have disappeared with the polluted habitats, water, air, and food due to sand mining. Most of habitats have been turned into farm lands or other land uses after mining. Human health is impacted with dust, gases, and polluted water from mined chemicals. There should be a solution because sand mining is a very productive business. It is there to last. It is highly demanded by number of people, developed and developing, rich and poor, young, and old. It's starting capital is so low that anyone with a shovel and a bucket can start the business. This scenario exposes the sand resource into depletion and degradation. Above all, the side effects to the environment and society are not well known to everyone. The issue of interaction between man and the ecosystem is still new to most of the people, while the United Nations' slogan of sustainable development is still on its infancy to many. There is a need to educate the society about the harmonious relationship, which should exist between them and the ecosystem, also the entire environment. Contrary to that, consequences that come with ignorance will go back to the society.

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