UNIVERSITY OF CAPE COAST

ILLEGAL SAND MINING: A STUDY OF THE CAPE COAST-KOMENDA COASTLINE, GHANA.

RIDWANATU OSMAN

2025

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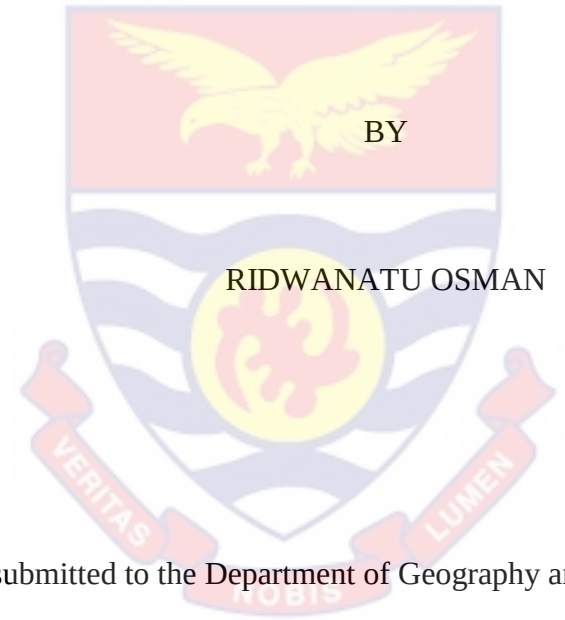

BY

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Thesis submitted to the Department of Geography and Regional planning of the College of Humanities and Legal Studies, University of Cape Coast, in partial fulfilment of the requirements for the award of Master of Philosophy degree in Geography and Regional Planning.

JANUARY 2025

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature …… Date……

Name……..

Supervisor's Declaration

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Supervisor's signature……. Date ……

Name ……..

ABSTRACT

In most countries across the globe, sand is an essential resource for economic developmental activities. Despite the huge costs of processing and recovering materials from glacier deposits, flood plains, and river channels, it is vital to the construction and industrial sectors. The study assessed illegal sand mining along the Cape Coast – Komenda, Ghana. Mixed methods which included quantitative and qualitative methods such as interview schedule survey, interviews, observation and focus group discussions were used to obtain data from three communities along the coastline of the Central Region of Ghana (Bantuma Mbofra-Akyinim, Ankwanda and Ola). The multi-stage sampling technique was used to select these communities while convenience sampling was used to select respondents (388) which included tipper truck drivers, tricycle riders, masons, fishmongers, fishermen and residents who have stayed in these communities for more than five years. Purposive sampling was used to select officials who were knowledgeable in sand mining issues from regulatory bodies such as NADMO, KEEA Municipal, CCMA, MC and the EPA. The study found out that the respondents gave reasons for which they engage in sand mining activities. Some of these reasons included the source of income, free gift of nature, urbanization and population increase. The respondents also admitted that these activities come with some repercussions such as retreat of the shoreline, pollution, introduction to health hazards and the destruction of roads and bridges by heavy duty vehicles. Government agencies also face numerous setbacks such as the limited resources for management, unclear responsibilities among stakeholders, weak coordination against local authorities, inadequate legal framework and interference from high-ranking government officials. This research concludes that illegal sand mining in its present condition is unsustainable and the government agencies are losing their firm grip on the issue.

ACKNOWLEDGEMENTS

To begin with, I would want to thank Almighty God for His mercy, guidance and for providing me strength to sail past the barriers in accumulating data and writing my thesis.

I would like to convey my greatest gratitude to my supervisor, Dr Comfort Adetona Ogunleye of the Department of Geography and Regional Planning for her professional advice and patience with which she channelled this effort. I am grateful beyond measure.

I am truly grateful to Prof. L. A. Dei also of the Department of Geography and Regional planning for his priceless effort to put this work in a better location. Again, I am very grateful to Mr. Aboagye Osei Sampson of the Department of Geography and Regional Planning for his guidance despite his hectic schedule.

Next, many thanks to my friend Reverend Sister Philomena Aboagye Danso for her unyielding support throughout our program.

Lastly, I wish to offer a big thank you to my darling spouse, Mr Zilkifilu Adamu for being so supportive and believing in me.

DEDICATION

To my dear parents in honour of their sacrifices to take me through formal education and to my beloved husband for empowering me to further my studies despite all odds.

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CHAPTER ONE

INTRODUCTION

Background to the Study

Globally, about 60% of the world's population live in the two-thirds of the largest cities, which are largely found along the coasts (Cai et al. 2009). The coastal regions are crucial for ecotourism because they are mostly distinguished by sea water and sandy shorelines. Sand beaches and dunes serve as the coast's sentinels. They act as barriers, taking the brunt of the force of the waves and stopping the violent winds from destroying buildings and crops. They also stop seawater from penetrating wells and ponds. They also protect us from winds that are salt-laden, which may seriously harm the crops and buildings near the coast. In 2020, the global anthropogenic mass exceeded the whole earth's living biomass. Sand, crushed rocks and gravels in totality are called the construction aggregates which constitutes the biggest part of the anthropogenic mass (Torres et al, 2021).

In almost all countries around the globe, Sand is necessary for modern living. For instance, it is a fundamental component of the global infrastructure used to build roads and buildings (Beiser, 2018a; Lempriere, 2017). The most prevalent type of sand mining worldwide is sand mining. Sand is used as unbound material in building foundations or to produce stabilized materials like concrete or asphalt which are essential in the provision of social needs which include housing, industry, mobility and health (Torres et al,2021). Furthermore, communities living close to mines, particularly in developing countries, depend on sand mining and allied industries like construction for a source of income (Husrin et al., 2017; Mngeni, 2016). Sand is becoming more

and more necessary as a result of human endeavours like construction, land reclamation, and technology, thus the dramatic increase in aggregate sand mining since 1950s, for instance, the increasing floor area per capita, is expected to double from 2017 to 2060. Sand has been deposited in vast amounts along beaches in Malaysia, Singapore, and Hong Kong, among other examples of land reclamation projects that have employed sand to increase their landmasses by depositing huge amounts along their beaches (Subramanian, 2018). By implementing this technology, Singapore has extended its land area by 22% over the last 50 years.

In most developed and developing countries, Sand is an essential resource for economic development activities (Draggan, 2008). Although the mining and recovering materials from flood plains, and river channels is expensive, it is vital to the construction and industrial sectors. Growth, improvement, and advancement in business, trade, and economic activities are all parts of the process of development. Therefore, development necessitates the building of new infrastructure and facilities like tarred roads, commercial shopping centres, and housing for the expanding population. There is a chance that the environment will be perturbed as cities expand. The report from the United Nations Conference on Environment and Development (1992) argued for the wise use of the environment to advance development while protecting and restoring natural resources. According to the paper, sand mining for urban expansion is a widespread environmental issue on a global scale. Sand use as a raw material causes resource depletion and has negative repercussions.

As a global economic activity, the extraction of quarry and watercourse sand and gravel affects the environment both positively and negatively. For instance, Schaetzl (1990) pointed out that several American states, including Michigan and California, rely on pit sand for the construction of roads and making cement. The once-abundant supply of sand is dwindling quickly due to several significant sources, which are mostly glacial deposits, have been depleted and are currently occupied by residential constructions. and agricultural land. In the United States of America for instance, Sand is used to make brick mouldings, pavement, golf courses, and industries in Metropolitan areas. Unregulated sand mining, however, can result in habitat degradation, excavation, and the discovery of hidden pipelines. As noted by Bagch (2010) in India, sand mining activities, if unregulated pose significant environmental impact such as changes to river morphology, deep tunnels on riverbeds, and an increase in water velocity leading to eroded riverbanks. In some instances, the reduction in water supplies causes food insecurity and other problems for the populace.

In the case of Africa, the issue of sand mining is of serious concern. Given the huge demand for gravel and sand, Lawal (2011) analysed sand mining in Nigeria and underlined how the practice is turning into an ecological issue. Even when resources are employed to build sturdy structures that improve upon the socioeconomic conditions of the majority of Nigerians, these actions inevitably have a negative impact on the environment. A growing problem with important socio-political, economic, and environmental effects is sand extraction on a global scale. As a result, a robust global sand governance framework is required (Torres, et al. 2017a). After oil, sand is the

resource that is used worldwide the most. Only water consumes more than 50 billion tonnes of resources annually, outpacing fossil fuels (Beiser, 2018a; WWF, n.d).

Ghana has one of the best coastlines in relation to other West African coastal nations, her beautiful stretchy beaches has attracted tourists from different walks of life for so many years yet its prospects are dimmed under the nose of security services and Environmental Protection Agency (EPA) who do little or nothing about the volumes of sand that are collected from beaches mainly for construction, although it is considered illegal. According to the African eye report, 2021, investigations have identified that illegal sand mining is highly carried out in areas like kpoglo, Keta in the Volta Region. Ada, Prapram, Chorkor Gbegbeise, Faana and its environs in the Greater Accra Region and some places in theWestern and Central Regions of Ghana. The Central region is seen as a coastal tourist hub which undoubtedly serves as a major source of employment. Its coastline like others worldwide has been revealed to be showing the ebbing into land over the last few years (African Eye Report 2022)

Extracting sand from its natural form is known as sand mining. Sand is utilised in many different applications, such as stabilising coastlines, creating artificial islands, and reclaiming land. (Ashraf et al 2010). Ghanaian metropolitan regions, like the Wa Municipality, are home to sand mining operations that provide raw materials for the country's road and building sectors. Peprah (2013). Similarly, Armah (2011) conducted a study to investigate the factors that lead to erosion-induced shoreline changes and the rate of shoreline change in Accra, Ghana, and concluded that illegal sand

mining was included the major factors that contributed to the shoreline change aside the challenging natural factors.

The primary source of erosion along the shoreline of Cape Coast is sand mining, according to research on sand and stone sand mining in Ghana's Central Region. Jonah et al, (2015). Many Environmentalists have cautioned the rate of shoreline erosion in the Central region due to accelerated rate of sand mining on the beach. It is stated in their report that the region loses about four meters of its shoreline yearly, due to unregulated sand mining activities. Again, comparing satellite images from 2015 and photographic maps from 2005, researchers studied that 37% of the 550km long coastal land had been claimed by erosion and flooding between 2005 and 2017. Obvious beach erosion especially in Elmina, Cape Coast and other coastal communities is seen as a dent in the country's mission to safeguard beach resources. Beach erosion in these areas has also affected nesting sites and habitats of aquatic species, traditional fishermen have been deprived of their landing sites, not forgetting the breakdown of the once lucrative small coconut industry at the beachfronts. (Mongabay News, 2021).

In essence, it appears that, environmental intervention is required immediately as more consequences become apparent because the issues of sand mining have become an environmental issue worldwide of which Ghana is not an exception. With carefully controlled sand mining rules and laws, sustainable utilization of natural resources must be taken into account in all development endeavours. The activity is of great importance to environmental scientists as the adverse effects far outweigh the positive.

Statement of the Problem

Coastal retreat remains a challenge among others that face coastal communities today since about 70% of the sand beaches around the globe are found to be retreating (Bird 1985, Hanson and Lindh, 1993, Cai et al, 2009). This hurdle may be due to both natural and anthropogenic causes. Beaches seem to be caught in a 'coastal squeeze' between the effects of human made factors on the terrestrial side and the manifestation of climate change at sea (Schlacher & Thompson, 2007). Natural causes to retreat of the coastline include climate change-induced sea level rise and increased storminess, river watershed changes, the actions of waves, winds and tides, causing littoral drift of sediments while anthropogenic factors include urbanisation in active dune areas, shore armouring, sand mining and construction of jetties (Esteves at al., 2003). The activities of man have been identified as external factors affecting soil evolution and soil erosion (Montagne et al., 2008; Naik et al., 2011).

In addition, the absence of or poorly regulated governance framework for sand, makes sand mining a venture of ease due to little restrictions. This makes extraction a regular economic activity on countless occasions causing so many ecological and social shortfalls. For instance, a 'save our souls' campaign to protect coastal communities against illegal sand mining was organized by Moree Urban Council in May 2022 after about fifteen rooms are devoured by sea waves and several people displaced (Daily Graphic, May 20, 2023). In addition to forcing residents to escape their homes in search of safety, illegal sand mining accelerates erosion and alters ecosystems, which has an impact on fisheries and wildlife (Beiser, 2018b). Sand mining and

trading are highly common in developing nations, and poor governance of these industries also fosters corruption and violence within the industry.

Countless efforts have been made by institutions and NGOs to curb the problem of illegal sand mining. These include periodic unannounced patrols to apprehend culprits and sensitization programs that are organised by institutions such as NADMO, EPA, Minerals Commission, Municipal and Metropolitan Assemblies and NGOs to help curb the problem if not minimize it. For instance, NADMO in the Komenda-Edina-Aguafo-Abrem (KEEA) Municipality for instance in its efforts to combat illegal sand mining organises monitoring-for-arrest patrols twice every week, weekly educational campaign on the negative effects of illegal sand mining and occasional durbar in the various communities to sensitize the residents on the menace (NADMO coordinator, KEEA, 13-12-2022).

Nevertheless, a lot of energy has also been geared towards illegal sand mining by academia. Mark (2021) investigated the Governance of Global Sand mining, Madyise (2013) did A Case Study on The Environmental Impacts of Sand mining and Gravel Extraction for Urban Development in Gaborone, and Tendaye, at al (2019) studied the Regulatory and Policy Implications of Sand Mining Along the Shallow Waters of Njeleje River in South Africa. Jonah et al. (2015) Assessed Sand and Stone sand mining Along the Coastline of Cape Coast, Ghana

In spite of the aforementioned efforts made by academia and major stakeholders, the problem still persists in the face the affordable penalty of GHS 200 and bureaucratic procedure in the acquisition of license. Again, major studies conducted so far focused more on the effects while a few

enquiries have been conducted on the mitigation measures of illegal sand mining hence the need to probe more into the subject.

Research Questions

This study attempts to answer the following:

1. What are the causes of illegal sand mining along the Cape Coast-Komenda coastline, Ghana?
2. How do illegal sand mining activities affect the coastline along the Cape Coast-Komenda coastline, Ghana?
3. Are there constraints posed by illegal sand mining at the management and policy enforcement levels?

Research Objectives

The main objective of the study is to assess illegal sand mining along the coastline of the Central Region of Ghana.

The following are the specific objectives of the research:

1. Examine the causes of illegal sand mining along the coastline of the Central Region of Ghana.
2. Assess the effects of illegal sand mining along the coastline of the Central Region, Ghana.
3. Examine the challenges faced in the implementation of policies in place to address illegal sand mining along the coastline of the Central Region. Ghana.

Significance of the Study

There is the need for this research to be conducted on “the menace and mitigation measures of illegal sand mining in selected areas in the Central Region of Ghana”. The outcome of the research will provide the local

authorities as well as the central government the appropriate information to present some management and policy strengthening opportunities that will discourage sand mining in the selected areas and beyond.

The outcome of this enquiry will also help to educate the people about illegal sand mining and the devastating effects it comes with most especially in their lives and the physical environment which will go a long to curb the problem if not minimize it.

The study may also contribute to literature and knowledge on coastal or shoreline degradation in general and illegal sand mining in particular and add to the studies that have been done so far on illegal sand mining.

Scope or Delimitation of the Study

The study is limited to the coastal areas, specifically three selected communities in the Central region of Ghana. It also concentrated on beach along the Cape Coast-Komenda coastline of the Central Region of Ghana.

Contextually, the enquiry mainly looked at the mitigation measures of illegal sand mining along the Cape Coast-Komenda coastline of the Central Region of Ghana only, without taking into account other coastal communities along the coastline of Ghana. The study could have also investigated communities known for illegal sand mining in the middle-belt or northern part of the country.

The study was restricted only to the residents of the selected communities, both male and female who have witnessed illegal sand mining in their community. Again, only officials in NADMO, EPA, Minerals Commission, KEEA Municipal and CCMA will be interviewed.

Moreover, this investigation spans within a three-year period from January 2020 to 2022.

Limitations of the Study

The investigator faced some shortfalls in the course of the study which affected the consistency of the findings.

A few officials represented the regulatory bodies due to time and resource constraints. Seven interviewees were purposively selected but only five respondents participated in the interview, the other two participants were not willing to take part in the survey. In spite of that, the investigator ensured that the data from the few interviewees were meaningful and contributed immensely to the study.

Secondly, the researcher limited the analysis of the data to descriptive statistics when other methods such as inferential statistics or spatial analysis could have been used. The descriptive statistics still gave meaningful result to portray the state of illegal sand mining along the Cape Coast-Komenda coastline.

Again, data basically from residents could only be collected on Tuesdays and Saturdays as those were the days the most of them who were into fishing don't go to the shore. The researcher made good use of these days to collect data in order not to affect the study negatively.

Additionally, the number of visits to mining sites was limited, this is due to the fact that some miners were not receptive some armed themselves with sharp objects which was quite dangerous for the researcher, the few visits were done with the help of natives (who were sometimes busy with their activities) to convince the miners to partake in the survey. These visits were

prioritised by the researcher to obtain as much information as possible for the progress of the enquiry.

Field Challenges

This enquiry per every study, definitely came with some challenges or hurdles encountered on the field. However, the investigating team tried its best to overcome them. Firstly, the respondents were reluctant to provide information because they thought they may be prosecuted or sanctioned as a result. The researcher with the help of a native field assistant attempted to explain to the respondents on the significance of the study and how the outcome of the study will affect their lives.

Again, the target population also expected to be given some token before they give out information, this is because life is hard for them and time is money. Some even made it obvious that without money, they were not ready to relay any information. In order the make things easier, the researcher had to give a token of GHS 5 each to those who were willing and ready to partake in the study after the data was collected.

Next, the communities selected were fishing communities so reaching the residents any other day apart from Tuesdays and Saturdays was quite difficult. The researcher had to reschedule all activities and make arrangements for the said days for smooth data collection.

Moreso, but for the intervention of a field assistant who happened to be a native of Bantuma-Akyinim, the respondents would have initiated violence because they were quite sceptical about the study. This particularly happened in Bantuma-Akyinim where a similar event occurred and the maiden closed fishing season was implemented. A field assistant who happened to be a

native tried in his ways to inform the respondents that no harm was meant hence their safety was assured in the study

Organisation of the Study

First Chapter tackled the introduction which included the background to the study, the statement of the problem, the research questions, objectives, significance of the study, limitations of the study and scope or delimitations of the study.

Second Chapter dealt with the review of related literature which consisted the definition of sand, its uses sand mining and types of sand mining, illegal sand mining, causes of illegal sand mining, effects of illegal sand mining and the solutions to sand mining. Some empirical, theoretical and conceptual framework for the research were also be examined.

Third Chapter dealt with the author's methods with respect to the study. This dealt with details involved in the data collection process in order to obtain data. The main aim was to obtain a database on the causes, effects, constraints and opportunities for mitigation against illegal sand mining along the Cape Coast-Komenda coastline of the Central Region of Ghana. This was done by visiting sand mining sites and interviewing key informants. This chapter looked at the research design, instruments, sample technique and the sampling steps as well as the data collection procedure.

Fourth Chapter focused on the discussion of results and findings on the study on the mitigation measures against illegal sand mining along the Cape Coast-Komenda coastline of the Central Region of Ghana. Data was collected through individual interviews, focus group discussions, interview schedule survey and observation.

Fifth Chapter summarised, concluded and gave recommendations on illegal sand mining along the Cape Coast-Komenda coastline of the Central Region of Ghana.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Introduction

This section examines some literature relevant to this study starting from the definition of sand, its uses sand mining and types of sand mining, illegal sand mining, causes of illegal sand mining, effects of illegal sand mining and the solutions to sand mining. Some empirical and conceptual framework for the research will be examined.

Concepts of Sand Mining

Definition of Sand and Its Uses

Sand, an affordable and dense material formed from the erosion of rocks and minerals due to weathering, plays a significant role in various industries, especially construction (Goddard, 2007). It is primarily composed of quartz, typically silica, but its composition varies by place (Owen, 2017). Geologists characterize sand based on both its composition and grain size, which typically ranges from 0.625mm to 2mm (Owen, 2017).. Geomorphological processes like bioerosion and erosion from water, rocks, or mined contribute to sand formation (Chilamkurthy, 2016; Morgan, 2016).

Bioerosion, for instance, occurs when animals feed on corals, generating sediments. Parrotfish, for example, play a significant role in producing carbonate sediments within the seas (Morgan et al., 2016). River sand is created when water flows over rocks continuously, progressively dissolving them into sediments (NOAA, 2017). Desert sand, on the other hand, forms through similar processes as beach or river sand but undergoes

years of mined shaping and rounding of grains before an area becomes arid (Beiser, 2018a).

Sand plays a important role in enabling modern life, more often in the context of global infrastructure development, where concrete, which sand makes up a large portion, is widely utilised in the construction of structures and roads (Beiser, 2018a; Lampriere, 2017). Not only do adjacent communities benefit financially from sand mining and related businesses like building, in many cases in developing nations (Husrin et al., 2017; Mngeni, 2016), but are also driven by increasing demand due to human activities such as land reclamation, construction, and technological advancements. Certain countries, including Malaysia, Singapore, and Hong Kong, engage in land reclamation by depositing sand along their shores to expand their land mass (Subramanian, 2018). Sand has been more in demand since Singapore has used it to expand its land area by 22% over the last 50 years and has plans to do so in the future (Meynen, 2017).

As stated by Subramanian (2018) and referenced in Beiser 2018a, sand is an essential ingredient in several artefacts, such as computer chips, glass, soap, and concrete. The manufacturing of glass vials for vaccines relies on sand, particularly borosilicate glass, which contains silicon dioxide, a major constituent of sand (Hogue, 2020). The surge in demand for two-dose COVID-19 vaccinations has caused a shortage of vials, unforeseen demand on the availability of sand resources (Blais 2020; Baranuik, 2021). The global effort to protect the population against COVID-19 through vaccination and its variants, requiring 15 billion doses, presents not only a challenge in medicine but also an industrial problem (Blais, 2020). Prashant Yadav at Harvard

Medical School warns that if the organization and management of vaccine and vial production, as well as distribution, are inadequate, which may lead to a shortage of vials due to limited sand resources (Blais, 2020). Although the medical business is experiencing an increase in the use of sand, the construction industry, being the biggest consumer, is also not excluded from this trend (Tweedie, 2018; UNEP, 2019). The construction sector used 29.6 billion tonnes of sand in 2012, and this number has been increasing every year since then (UNEP, 2019). Annually, the global sand use is anticipated to range from 30 to 50 billion tonnes, with building, glass, and electronics being the primary sectors utilizing it (Bendixon et al, 2019). The pace of sand consumption is probably surpassing the rate at which sand is replenished (Chilamkurthy, 2016; Lamb et al., 2019, Peduzzi, 2014).

Despite the apparent abundance of sand, not all types are suitable for construction or manufacturing. Coastal, estuary, and riverine sands are in high demand for construction purposes, while desert sand, smoothed and rounded by years of erosion, is suitable for use in concrete (Beiser, 2018a; BNEF, 2020). Consequently, communities in coastal areas are most directly impacted by sand mining operations.

Methods of Sand Extraction

Sand mining, which involves the extraction of sand from its natural setting, serves a variety of purposes, including land reclamation, the construction of artificial islands, and shoreline stabilization (Pielou, 1966). Sand mining refers to the actual extraction of sand from their original locations (Langer, 2003).

Sand mining, the process of extracting sand resources, is the dominant global extraction activity, accounting for 85% of Earth's available resources (Hall, 2020). Sand is gathered from four primary sources: the seabed, coastal areas or beaches, rivers, and quarries. The extraction methods utilized differ based on the scale and location of the operation and include tactics such as dredging, mechanical approaches employing equipment like bulldozers and excavators, and manual extraction performed by hand.

Dredging is the primary technique used to extract sand of industrial quality (Beiser, 2018c). This procedure comprises the employment of a dredging vessel to suction sand from the seabed and later transport it onto a barge (Tweedie, 2018). After the barge is filled to its maximum capacity, the sand is unloaded into dump trucks to be transported to its assigned location (Tweedie, 2018). Other mechanical methods involve machinery such as bulldozers, scrapers, and loaders, appropriate for both wet removal (from beneath a water body) and dry removal from beaches and occasionally dry streambeds (Padmalal, 2014). However, these technologies are intrusive and have detrimental consequences on the environment and ecosystems.

Manual sand extraction is more common in situations where substantial machinery is either inaccessible or prohibitively costly, this includes small, unauthorized extraction activities (Hezekiah et al., 2020). In such an approach, individuals use tools like buckets, bags, or shovels to extract the sand, resulting in less environmental harm compared to instances where heavy machinery, which can disturb habitats, are lacking (Hezekiah et al., 2020; Padmalal, 2014). However, despite its lower ecological impact,

manual extraction is generally less efficient and is not the preferred choice when mechanical alternatives are accessible.

In the context of this literature, beach sand mining (or sand winning as they are used interchangeably) will be the focus where sand is extracted from old and new beaches, inland dunes and sand pits located inland about 20 meters or less from the shoreline or 20 meters seaward. This is mostly done using simple implements such as pick axe and shovels to collect the sand from the beaches and its environs. The sand collected can also be poured directly from the beaches or sand dunes into tipper trucks until they were full.

All methods of sand extraction have consequences for ecosystems and communities, as the demand for sand rises, the frequency and intensity of these impacts are on the rise. Various factors were driving sand extraction, demand, and trade, including the continuous growth of the global population, as more individuals migrate to urban areas Relative to prior years (Edwards, 2015), this population and economic increase are closely related to the need for sand resources (Gomby, 2017; Marschke, 2016, pp. 166). An illustration of this is seen in Hong Kong, where the growing population is being addressed through the creation of artificial islands via land reclamation—a project intended to mitigate the housing crisis but one that may pose environmental challenges due to the use of reclaimed land from the sea (Graham-Harrison, 2019). The land reclamation, together with subsequent infrastructure and housing development on these man-made islands, will greatly sour Hong Kong's requirement for sand.

Illegal Sand mining

Unlawful sand mining operations can be classified into two primary categories.: theft and corruption, often intertwined. Stealing sand involves extracting it from restricted areas, such as private land not owned by the miner or locations protected by policies like zones of maritime protection (Beiser, 2018a; Tweedie, 2018). Corruption, on the other hand, entails the involvement of a network of insiders, including miners, law enforcement, and government officials, facilitating the illegal sand trade through methods like falsifying documents to alter the quantity or extraction site, or proposing bribes to officials and other connected parties (Beiser, 2018; Mahadevan, 2019; Rege, 2016).

Beach theft or illegal sand mining per this study occurs where sand is mined from beaches and its surrounding without state permission, mineral right, mining licenses and mineral transportation permit. Section 9(1) of the Minerals and Mining Act, 2006 (Act 703) states that "a person shall not conduct activities on or over land in Ghana for the search, reconnaissance, prospecting, exploration, or mining for a mineral unless the person has been granted a mineral right, regardless of a right or title which a person may have to land in, upon or under which mineral were situated."

Section 10, further states that *"unless otherwise provided in this Act, a mineral right shall not be granted to a person unless the person is a body incorporated under the Companies Code 1963(Act 179), under incorporated private partnership act 1962(Act152) or under an enactment in force"*

The above in addition to Article 268 of the 1992 constitution of Ghana implies parliament must permit and confirm all transactions and undertaking

which involves the grant of a right for the exploitation of minerals in the country. In addition, sand is identified as industrial minerals under the above-mentioned Act and as such requires mineral right if not is considered “illegal”.

After establishing the definition of illegal sand mining, this research will proceed to examine the organization responsible for the most extensive network of unauthorized activities, known as the Sand Mafia.

Criminal organizations commonly referred to as "Sand Mafias" frequently orchestrate illegal sand mining, with a notable presence in developing nations (Salopek, 2019). A noteworthy instance is the Sand Mafia in India, an infamous and robust criminal organization engaging in the unauthorized mining of sand resources, resulting in severe social and environmental devastation (Beiser, 2018a; Mahadevan, 2019; Salopek, 2019). These Sand Mafias do not have a specific religious or Identification (Mahadevan, 2019), yet in India, the expression "Sand Mafia" is employed to designate organizations participating in unlawful sand mining, frequently resorting to violence or threats against those who resist their activities (Beiser, 2018a; Mahadevan, 2019). Any unlawful sand mining organization that resorts to threats is labelled a "Sand Mafia" (Mahadevan, 2019). Described as "sand piracy" at times, illegal sand mining is not just the domain of Sand Mafias (Beiser, 2018a).

Illegal sand mining operates opportunistically, with sand deposits exploited wherever they were located (Mahadevan, 2019). Due of the extensive and various locations of these deposits, enforcing restrictions and monitoring these activities have proven hard (Popesco, 2018). Both legal and illegal sand mines have been reported to extract from protected biodiversity

reserves and areas, causing harm to habitats and wildlife (Koehnken, 2018). For example, sand mines have been observed within national parks and internationally recognized wetlands, threatening rare animals (Pearce, 2019). Such areas were considered ecologically and culturally significant and should not host activities that harm their integrity (UNEP, 2019: pg 5).

Construction companies are regularly sold sand that has been collected illegally (Mahadevan, 2019; Salopek, 2019). In the tourism sector, sand unlawfully taken from one beach may be vendored to another for replenishment purposes. Incidents of entire beaches being pilfered cases have been reported, such as the one in Coral Spring, Jamaica, where some 500 truckloads of sand were illegally extracted for a proposed resort and allegedly sold to rival resorts (Carroll, 2008). Suspicions of corruption within local law enforcement were raised in such instances. Similar occurrences, as observed in Surfside, Florida, involved wealthier counties aiming to restore their beaches by extracting sand from less affluent counties.

The sand industry is tremendously lucrative, especially in India, predicted to become the third-largest building market. The clandestine Sand Mafia, responsible for around 17 million USD in monthly earnings, emphasizes the viability of this sector (Mahadevan, 2019; Rege, 2015). Despite the clear environmental degradation harming agriculture and fishing, sand mining remains a key source of employment. India's construction sector, primarily dependent on sand, generates work for around 51 million individuals (Prakasan, 2020). A lot fishermen and farmers who lose their sources of income owing to sand mining sometimes transfer to these very mines that displaced them, as the economic rewards can outweigh those of alternative

employment (Husrin et al., 2017). In India, working in a sand mine can provide quadruple the salary of a field laborer and may involve less physical strain, basedss on the exact function (Husrin et al., 2018; Salopek, 2019). These elements contribute to the allure of work in sand mining, ultimately compounding the situation.

Opposition to both legitimate and illicit sand mining is seen in certain impacted areas, seeking government support, often without success (Fritts, 2017). Some local communities in Kenya, leverage social media platforms to raise awareness of and express opposition to illicit sand mining activities, causing ecological damage to coral reefs, seagrasses, and shorelines (Obura, 2019). While illegal sand mining is a global issue, it is particularly visible in many developing countries where resources for monitoring and enforcing regulations were limited (Barwell, 2016; Besier, 2018a; Torres et al., 2017a).

As a result, authorities might be more receptive to overlooking the issue in return for a percentage of the monies they make (Beiser, 2018; Popescu, 2018; Mahadevan, 2020). Corruption and connections between illegal mining businesses and government personnel or agencies further complicate the challenge of managing illegal sand mining (Beiser, 2018; Peduzzi, 2018; Popescu, 2018). Consequently, illegal sand miners typically wield enormous authority, and protests can escalate into violence, resulting in injuries and even deaths, with protestors and journalists often subjected to beatings or worse (Beiser, 2018; Lamb et al., 2019; Meynen, 2017). In one scenario mentioned by Rege (2016), an officer who arrested three individuals for illegal mining was intercepted by thirty guys from the unlawful group on their way to the police station. They made threats to burn the cop on fire

unless he released the three men. The intimidation and corruption cultivated by Sand Mafias make research and regulation of the sand sector particularly tough. As a result, authorities might be more receptive to overlooking the issue in return for a percentage of the monies they make (Beiser, 2018; Popescu, 2018; Mahadevan, 2020). Corruption and connections between illegal mining businesses and government personnel or agencies further complicate the challenge of tackling illegalities of sand mining (Beiser, 2018; Peduzzi, 2018; Popescu, 2018). Consequently, illegal sand miners typically wield enormous authority, and protests can escalate into violence, resulting in injuries and even deaths, with protestors and journalists often subjected to beatings or worse (Beiser, 2018; Lamb et al., 2019; Meynen, 2017). In one scenario mentioned by Rege (2016), an officer who arrested three individuals for illegal mining was intercepted by thirty guys from the unlawful group on their way to the police station. They threatened to burn the cop on fire unless he released the three men.

Sand mining in West Africa

The global demand for sand is surging at a rate that natural processes cannot keep up with, resulting in increasing sand scarcity and higher prices for this commodity (Edwards, 2015; Goldberg, 2019). Sand mines, particularly those supplying the construction industry, often operate in developing nations where labor is inexpensive, and rules may not be adequately enforced (Roos and Van Der Warf, 2010; UNEP, 2019). As demand continues to grow at an unsustainable pace, existing sand mines are depleting rapidly. This situation is further exacerbated by the rising global population and its aspiration for an improved quality of life.

The over-excavation of sand for the construction industry, mostly in urban development in West Africa, has raised significant environmental concerns (Mwangi, 2008). Sand, historically used for constructing buildings, roads, and dams in West Africa due to their affordability and easy accessibility, are now in higher demand as the overall socio-economic conditions in West Africa have improved. Sand mining is prevalent in most Sub-Saharan African countries, occurring both legally and illegally.

A disturbing pattern is occurring in Cape Verde, a group of islands located 15km off the West African coast. Despite being regarded one of the safest areas globally, every third individual on these islands is unemployed. Stealing sand has become a quick way to get money. However, the effects of extensive sand mining are severe. Beaches that were formerly nesting places for tortoises are now degraded to dirt and stones. Without sand to function as a barrier, saltwater encroaches inland, harming crops, vegetation, and buildings.

Sea turtles on Cape Verde nest their eggs in the sand on the islands' beaches.

The Cape Verdean government implemented a ban on sand mining in the city of Pedra Badejo on the island of Santiago in 2002. The military is presently protecting the black sand there. In February 2017, the government took a decision to prohibit sand mining on all the islands. There were additional limitations placed on the utilization of machines for sand mining. Nevertheless, due to poverty, residents are compelled to venture deeper into the water in order to gather containers of sand from the ocean floor (DW.com, 15.02.2017).

Lawal (2011) did research on the commercial enterprise of sand mining in the Minna Emirate Council of Niger State, encompassing both land and river activities. The stakeholders engaged in these activities encompassed landowners of quarry sites who supplied sand to private and government contractors, in addition to local government authorities and the Niger State where the quarries are located. The actions also impacted farmers whose agricultural and grazing grounds were disturbed, wildlife communities whose habitats were influenced, aquatic community members, and the culprits themselves. Aromolaran (2012) conducted an investigation to evaluate the impacts of sand mining on rural inhabitants residing on agricultural land in Ogun State, Nigeria. Although the advantageous applications of sand were recognized by many, they emphasized that the detrimental effects on their property surpassed the advantages. Lawal (2011) underlined that sand mining is fast becoming a biological issue as its need develops in several states across Nigeria's industry and construction sectors, with both legal and illegal mining contributing to environmental deterioration.

Sand Mining in Ghana

Sand mining in Ghana has developed to the extent that it has disclosed the foundations of hillside buildings, compromising their stability. Although there is a great amount of unused desert sand on Earth, marine sand is crucial in construction material production because of its cohesiveness. Ghana possesses rich sand deposits and a motivated sand mining workforce, despite the practice generally being unlawful (Zietlow & Mulgund, 2021).

Miners in this profession sometimes turn aggressive when faced by authorities, given the enormous earnings involved. For instance, a sand contractor in Ghana could make a minimum of $55.47 per day in 1993, a huge contrast to the $1.22 minimum daily pay at the time (Zietlow & Mulgund, 2021).

The absence of appropriate work possibilities plays a big influence in the decision of Ghanaians to opt for sand mining. In one research, 19% of sand miners had no other occupation besides sand mining, while the remaining 81% coupled it with jobs in fishing, farming, or minor trading to boost their income. Unlike other vocations, sand mining is comparatively safe, as farming and fishing entail substantial starting expenses and dangers. The scarcity of electric power and clean water makes it tough to manage small businesses, but sand mining just requires basic instruments like pans and shovels (Zietlow & Mulgund, 2021).

Undoubtedly, sand mining is an integral aspect of the Ghanaian economy in specific locations. Rural communities, feeling that the government does not provide appropriate support, take matters into their own hands and utilize the proceeds from sand mining to fund community activities such

providing electricity, clean water, schools, and healthcare (Zietlow & Mulgund, 2021).

Arthur (2016) studied a damaged sand mining site in Golinga, Northern Ghana. Initially a rural town, Golinga developed into a sand mining location. The study attempted to determine the entire area left barren owing to mining, identify the motive for changes in land use, and examine the impact of deterioration on the living conditions of the common people, taking gender into consideration. The findings found that indigenous land systems in the area conflicted with environmental legislation and practices. There were no reclamation plans in place to aid in the replenishment of the impacted area.

Sumani (2019) evaluated the potential environmental and socio-economic implications of sand mining in Danko, Upper West Region of Ghana. The enquiry revealed that sand mining offered various reasons, including support for the construction of structures and roads, source of livelihood, and the production of dugouts for residential use. However, detrimental repercussions included land and environmental damage, the loss of farmlands, and the marginalization of women.

Peprah (2013) conducted a study on the viewpoints of indigenous sand miners in Wa, Ghana, regarding sand mining and land degradation. The statistics found that 56% of sand miners had been in the business for at least half a decade, 78% made 6-10 trips of sand and 70% made 6-10 excursions of gravel every day. Approximately 96% of sand miners used laborers from Wa, and 82% employed six laborers per day. A considerable number of the drivers (52%) disagreed with the premise that sand mining harmed the terrain. Furthermore, 70% believed that sand mining did not lead to unemployment

among farmers, and 74% disagreed that it caused food shortages. However, 76% disputed that sand mining enhanced the number of mosquitoes and malaria cases. The majority (84%) agreed that sand mining was a viable industry.

Sand Mining Along Ghanaian Coastline

Coastal features along the Ghanaian coast reflect both past and present processes that have been going through changes. These changes are influenced by a number of morphogenic factors such as geology and prevailing climatic conditions. These seasons have shaped the coastal geomorphic features through weathering processes that decay and disintegrate the coastal rock. Sea level rise due to climate change is expected to increase coastal erosion and thus result in rapid changes in shoreline positions (Appeaning Addo, 2010).

Mensah & Mattah (2023) investigated the issue of illegal sand extraction along the coastal areas of Ghana, exploring the drivers behind this practice and potential solutions. The study primarily relied on qualitative research methods. The research identified key drivers of illegal sand extraction, including insufficient coastal surveillance, corruption within the system, the allure of profit and livelihood support, the perceived abundance of sand as a resource, unemployment, and cultural misconceptions about sand being a superior construction material.

Another study by Jonah et al. (2015) assessed sand and stone extraction along the shoreline of the Central Region of Ghana. They deployed ArcGIS and the Digital Shoreline Analysis System (DSAS) technologies to investigate short-term (2005–2012) changes in the coastline using data from

2005 and 2012. The investigation found that sand mining was the primary source of erosion along the Cape Coast coastline.

Armah (2011) undertook a study to evaluate the mechanisms leading to erosion-induced shoreline changes and the velocity of shoreline change in Accra, Ghana. The study uses the Digital Shoreline Analysis System (DSAS) to estimate shoreline changes from 1990 to 2010 by evaluating aerial photos and Landsat satellite imagery inside a geographic information system (GIS) framework. The study found that unauthorized sand mining was a substantial contributor to coastal alterations, alongside natural causes.

Jonah et al. (2015) assessed the ecological impacts of beach sand extraction in Ghana using ghost crabs (Ocypode species) as biological indicators. Their studies demonstrated that beach sand extraction had detrimental implications on ghost crab populations.

Appeaning Addo (2010) conducted a study on Changing morphology of Ghana's Accra coast. The study used both primary and secondary methods of data collection. The investigation identified that human activities such as dam construction over the Densu River, engineering interventions to check the spread of erosion and sand mining has created sediment deficit which has worsened coastal erosion in Accra. Anthropogenic factors are estimated to account for 70-90% of coastal erosion issues in Accra.

Ecological Effects of Sand mining

Sand mining has extensive and significant ecological repercussions, impacting erosion and biodiversity (Lamb et al., 2019; Pearce, 2019). Initially, the practice results to heightened and faster erosion in diverse habitats, including banks of rivers, coastal coastlines, and farmlands (John, 2009; Lamb

et al., 2019; Masalu, 2002). The extraction of sand from the seabed supports the natural migration of sand from the beach towards the dredging trench, driven by gravity and currents, resulting to erosion and the extension of shorelines. Corals and seagrass perform a key role in aquatic ecosystems as natural barriers against erosion (Larson, 2018). Dredging activities pose a threat to, or perhaps complete destruction of, corals and seagrass, raising the vulnerability of these ecosystems to erosion (Pearce, 2019). In several instances, the depletion of sand dunes, operating as erosion buffers, has been entire due to mining, culminating in cliff collapses in coastal areas, as shown in the Azores islands (Borges et al., 2002). According to Borges et al. (2002), persistent sand mining from the 1960s to the 1980s damaged 950,000 m3 of beach sand, leading to irreversible erosion impacts reported until 2002 (the time of publishing). This situation demonstrates the requirement of recognizing the implications of sand mining to prevent ecosystems from exceeding their inherent resilience or reaching a state of maximum vulnerability is an issue addressed by Borges et al. (2002). Again, dredging activities in rivers impact the structural integrity of riverbanks and change the morpho-dynamic processes of the river channel (Erftemeijer et al., 2012; Meynen, 2017; Yuill et al., 2015). The mining of sand from riverbeds leads to basin deepening and broadening, contributing to the collapse of riverbanks and bridges (John, 2009; Meynen, 2017), thereby generating a hazardous environment for coastal communities (Torres et al., 2017b).

Another detrimental result of sand mining is on animals. When sand is removed from one place and redistributed elsewhere, such as in beach replenishment, wildlife and their nesting areas may be smothered (Larson,

2018; Sheldrake, 2013). The use of heavy implements in beach mining compresses and crushes the sand and soil below it, and the depositing of sand, as in beach replenishment, suffocates wildlife, disrupting habitats and nesting areas, with potential repercussions for local fisheries (refer to section 2.2.1 below) (Erftemeijer et al., 2012; Sheldrake, 2013). Moreover, the fall in water levels resulting from sand mining considerably harms aquatic vegetation that serves as a food source for migratory birds (Larson, 2018). Deprived of this source of food, the birds may lack enough energy to lay eggs or migrate (Larson, 2018).

The repercussions of sand transportation include the transfer of exotic species and predators from the mining site to the deposit location, along with carbon emissions from the vessels (Torres et al., 2017a). Although dredging is the prevailing method for sand extraction, it mostly leads to considerable environmental impacts (Pearce, 2019; Tweedie, 2018). Dredging results in the creation of sediment plumes that can remain suspended in the water and travel over enormous distances. These plumes have the power to smother aquatic organisms and hide sunshine, limiting photosynthesis and causing stress to corals and wildlife (Beiser, 2018; Erftemeijer et al., 2012; Obura, 2019; Pearce, 2019). Such stress breaks the food chain and, consequently, damages coastal sources of income that rely on fishing or farming. These events highlight the harmful biological implications of sand mining.

Socio-Economic implications of Sand mining

Sand mining gives birth to a broad range of social aspects and repercussions, involving challenges pertaining to erosion, health dangers, livelihood loss, and criminal activities (Hammond, 2019; Mahadevan, 2019;

UNEP, 2019). Primarily, coastal residents experience major challenges from the erosion created by mining, as their homes and sources of livelihood may disintegrate into the rivers where sand was mined (Beiser, 2018c; Hammond, 2019). The collapse of land owing to coastal retreat results in the demolition of homes, farms, shops, and sources of income (Beiser, 2018a; Torres et al., 2017b). The Mekong River presents as a dramatic example of a location coping with extensive sand mining, where erosion has caused an estimated 500,000 people in the Mekong Delta to relocate (Beiser, 2018b).

Secondly, sand mining can present health difficulties, such as the development of diseases like malaria or heightened pollution levels (Popescu, 2018). The stagnant pools of water left behind by mining produce breeding grounds for mosquitoes conveying malaria, potentially enhancing infection rates in the neighbouring people (Popescu, 2018). Moreover, the occupation of a miner could be perilous. According to Chandran (2019), a Thomson Reuters Foundation investigation in 2017 revealed incidents of miners in clandestine mines drowning in particular places of India. There are also instances of laborers in unlawful mining operations losing their lives when sand dunes collapse on them (PTI, 2019). Miners assume these risks since the salaries are generally higher compared to comparable skilled employment (Mahadevan, 2019).

Thirdly, these coastal communities generally depend on natural resources as sources of income, engaging in activities such as agriculture or fishing (Marschke et al., 2014). Erosion can result in seawater invading the land, posing a hazard not only to livelihoods but also to food security (Popescu, 2018). As initially indicated, sand mining leads to considerable

environmental impact, including erosion and loss of habitat (Pearce, 2019; Lamb et al., 2019). These consequences considerably affect fish available, resulting in many fisheries and aquaculture systems experiencing reduced productivity (Husrin et al., 2018; Marschke et al., 2014). Fish supply decline to a point where numerous fisheries are compelled to cease business, leading fishermen to fish more intensively and at greater distances, as observed in Cambodia, according to Marschke et al. (2014), or opt for sand mining, which is usually financially rewarding (Husrin et al., 2018; Rege, 2016). Frequently, illegal sand mining businesses breach existing restrictions, disrupt fisheries by mining, and later offer fishermen larger income than they used to earn. A similar circumstance occurred in Lontar Village, Indonesia, where multiple abandoned fisheries were transformed into sand mining quarries (Husrin et al., 2017). Sumaira Abdulali of the environmental advocacy group Awaaz Foundation, as cited in Chandran (2019), remarked, "Communities are losing their land and their homes because of sand mining, but they are divided on the issue because some peofple make a living from it, while others say it is ruining their lives."

Fourth, a fundamental difficulty in the sand sector, as well as its management, is the prevalence of illegal sand mining. Sand is generally viewed as a mostly available resource, and the increasing demand from the building industry has provided numerous chances for entrepreneurs in both the formal and informal sectors along the supply chain (Barwell, 2016). This growing need has turned sand into a priceless commodity, expanding into a multi-billion-dollar industry due to its ubiquitous availability, coupled with little laws, enforcement, and monitoring (Beiser, 2018a). This ever-growing

network and grooming tendency exacerbate linked social and environmental sustainability concerns, while concurrently hindering the adoption of solutions. Despite being the largest harvested solid mineral by weight and volume, sand is the least controlled resource globally (UNEP, 2019). The absence of laws and enforcement has allowed illegal sand mining activities to expand, even penetrating legal trade (Gavriletea, 2017; Torres et al., 2017a). According to Padmalal and Maya (2014), about one third of sand imported to Sri Lanka is from an unlawful source. A substantial management difficulty resides in the mingling of legal and illegal sources, making it impossible to track the movement of sand across borders. Again, a shortage of trustworthy information exists, as investigating the illlegal sand sector is risky due to threats from mining individuals and groups (Mahadevan, 2019; Rege, 2016).

Environmental Effects of Sand mining

To begin with, Pereira (2012) has pointed out that sand mining poses a substantial danger to water security by depleting groundwater storage and decreasing the alluvial water table. For instance, important rivers in India's Kerala province, such as Pampa and Manimala, have suffered a drop in water levels by four to six meters due to sand mining. If uncontrolled sand mining continues in India until 2050, it is anticipated that the water table will plunge by nearly 2537 square meters. The lowering of the water table as a consequence of sand mining leads to the drying up of drinking water wells, leaving people without access to clean water. Additionally, the emission of suspended particles from mining activities can significantly affect downstream water quality, resulting in increased water treatment expenditures. Saviour (2012) has also highlighted the worsening of water quality owing to the

presence of dissolved suspended pollutants and particles from mining activities. Water quality can further be affected by oil spills and leaks from excavation machinery and transportation trucks, potentially poisoning aquatic species (Stebbins, 2006).

Secondly, Schaetzl (1990) has dwelt upon some of the harmful environmental effects encountered in many American areas where sand mining is common. He highlighted that the deterioration of sand from streambeds and coastal communities leads to the deepening of rivers and estuaries, as well as the widening of river mouths and coastal inlets in locations like Michigan and California. Furthermore, excessive mining poses a threat to bridges, bridge piers, and subsurface pipelines. Goddard (2007) has revealed that gravel expoiltation and processing have considerable negative effects on picturesque landscapes. Excessive mining exacerbates coastal and exposed hillside erosion, resulting to the entry of seawater up rivers, rendering beaches more prone to adverse weather events. Pereira (2012) has noticed that while uncontrolled and unscientific sand mining persists, there is diminished protection from seawater, resulting in an increase in coastline erosion rates, especially during maritime catastrophes. Lawal (2011) has reinforced the notion of landscape disruption and topographical distortion as effects of excessive soil mining in Nigeria.

According to Bagchi (2010), the development of ponds due to sand mining leads to the contamination of sand aquifer water. Harvesters commonly dig in regions with thick sand beds, generating water ponds. These ponds collect water together with biodegradable elements from flora and fauna waste, leading to pollution. Moreover, still water in gravel mining ponds

provides a good habitat for mosquitoes bearing the malaria parasit. Lawal (2011) concurs with Bagchi regarding the formation of pools resulting from mining, which serve as breeding places for pests in Nigeria.

Furthermore, various detrimental repercussions have been identified on habitats. Stebbins (2006) has observed that important timber resources and wildlife habitats are destroyed since all species need certain circumstances for long-term existence. indigenous species in streams and rivers have developed to adapt to situations that existed before large-scale human modifications, favouring some species over others. This leads to a loss in fisheries productivity, biodiversity, and recreational potential. As deep pools are filled with gravel and silt, habitat complexity is reduced, and huge predatory fish are damaged. Channel widening leads in a shallower streambed, causing braided flow or subsurface inter-gravel flow in riffle places, restricting fish transit between pools (Stebbins, 2006). Mining operations entail tree cutting, habitat degradation, and biodiversity erosion (Saviour, 2012).

Moreover, Schaetzl (1990) has emphasized that sand and gravel mining generate additional heavy cars and traffic, which have significant environmental implications. Heavy cars harm access roads in riparian zones and compress the earth. Kuttipuran (2006) confirms Schaetzl (1990) regarding the building of access roads on riverbeds, since heavy machinery and tipper trucks proceed to collecting locations. Some tracks are also caused by pedestrians. This leads to a general disruption of highways and bridges, affecting adjacent people who encounter problems with livestock posts, agricultural land, boreholes, and wells.

Apart from compacting the terrain, large vehicles are a source of pollution for settlements surrounding mining areas. According to Lawal (2011), noise and air pollution occur as dust collects on gravel roads, which is a reality for communities near mining areas, resulting in a general degradation of the ecology in Nigeria. Air pollution induced by dust particles can pose health dangers, producing respiratory illnesses such as asthma and lung inflammation (Saviour, 2012). Additionally, sand is typically removed using rock blasting, which creates noise pollution. The ground vibrations created by blasting might lead to ground tremors. Pereira (2012) has reported that sand is unlawfully dug 24 hours a day, year-round, even during monsoons in India. This constant activity causes severe noise pollution, disturbing sleep quality and normal school hours. Vibration noise caused from over-extraction and transportation is particularly intense at night, becoming an irritation to individuals.

Stebbins (2006) has pointed out that as mining takes place, there is a loss of the protection afforded by the sand, as it sorts out contaminants. Gravel pits are at times utilized as dumping sites, with tipper trucks transferring rubbish to dump sites as they arrive to gather sand and gravel. Pollutants from the waste filter and make water unsafe for drinking, thereby putting people's health in danger in Maine State. Goddard (2007) has stated that mine and trash dumps are developed as a result of soil mining in Australia, harming the environment. Mwangi identified the same consequence of transforming gravel pits that are no longer in use into dumping sites as a severe effect of mismaneged gravel mining in Kenya. Wokorach (2002) has emphasized air and water pollution in Botswana as detrimental repercussions of mining on the

environment. Tailing and waste dumps from mining activities harm groundwater resources near mining locations and pollute soils.

Saviour (2012) has explored water pollution originating from several physio-chemical and biological characteristics that characterize the degradation of water quality. These factors include changes in pigmentation from brownish to reddish-orange, a drop in pH, and an increase in electrical conductivity. These changes are attributed to high concentrations of ions such as sulfate (SO), iron (Fe), and other heavy toxic metals like zinc, nickel, and copper, as well as low dissolved oxygen (DO). When mined materials, such as walls of open pits and waste rocks, are exposed to oxygen and water, acid can accumulate, resulting to acid mine drainage that washes off into streams and rivers (Saviour, 2012). Leaching of this acid into the ground causes water contamination. The pH of water climbs to 4, impacting fish, aquatic plants, and animals. Acid mine drainage can also dissolve hazardous metals like copper (Cu), aluminum (Al), and iron (Fe). Iron may coat the bottom of rivers, proving hazardous to both humans and wildlife (Saviour, 2012).

In Stebbins' 2006 study, the deleterious consequences of sand mining on soil structure and profiles in American states were highlighted. Uncontrolled sand mining operations led to the removal of vegetation, topsoil, and subsoil, resulting in a fall in faunal populations. Saviour's 2012 research emphasized the major impact of sand mining on existing vegetation and soil profiles in Indian locations, particularly harming flora and wildlife as sand mining activities continued. This influence was supported by Kuttipuran in 2006, who noticed the common loss of plants and ecosystems around Indian rivers, marring the natural beauty of the area. Pereira, in 2012, discovered the

degradation of mangrove forests in India owing to unlawful building for sand storage, transportation, and sand mining, which increased the rate at which of land are prone to floods in Mumbai.

Aromolaran, in 2012, found land degradation in rural communities, with the soil surface and structure being eroded, leading to a reduction in the nutrient condition of agricultural land. Lawal's 2011 research in Nigeria examined the environmental devaluation arising from operations like sand and gravel sand mining, leading to the loss of fertile land, timber, habitat modifications, and disruptions to ecosystems, hurting native species. The rise in turbidity also had a considerable influence on aquatic species, underlining the need for early assessments into the type of flora and potential effects before sand mining takes place.

Furthermore, Draggan's 2008 study in the United States discovered that gravel extraction and pit sand mining in open areas have left open pits near developing metropolitan areas. These open trenches caused risks, resulting to tragedies involving children and grazing animals, particularly in Nigeria as documented by Lawal in 2011. Water collection in these trenches during the rainy season led to the drowning of domestic animals. In India, sand barges harmed the livelihoods of fishermen, destroying their nets, and even resulting in loss of lives, hurting tourism, agriculture, and fishing potential. Accidents were also reported in Palakkad District, India, where youngsters perished in water-filled open pits filled with water while attempting to swim, resulting in a loss of recreational opportunities for the land.

Numerous construction activity generated pits and holes in farmland near Harare, as witnessed by Lupande in 2012. Miners in Botswana left behind unsafe open trenches that presented risks to animals and cattle. The disturbance of land surfaces rendered these open pits challenging to restore both physically and economically following sand mining activities.

Lastly, sand mining operations were found to involve deforestation and the degradation of biodiversity. Ekosse's 2004 research in Botswana focused on the environmental implications of sand mining, notably around the Kgwakgwe Manganese Mine. The investigation demonstrated demineralization and contamination of soils, leading to the establishment of dead zones, as well as reduced plant growth. Sand mining of sand near oceans resulted in salinization, allomineg entry of seawater, as documented by Pereira in 2012. The Mines and Minerals Act of 1999 in Botswana highlighted several environmental impacts of authorized and illegal sand mining and gravel extraction, including accidents caused by open, uncovered pits. Removing sand worked as a reservoir for charging groundwater wells, requiring deeper digging, which increased water expenses. In general, sand mining operations led to the loss of employment for farm workers and human rights violations against farmers as agricultural land was destroyed to make room for sand mining activities.

Management and Policy Constraints of Illegal Sand mining

To commence the process, Mark (2021) addressed numerous difficulties relating to the existing management of global sand resources in her study titled "Governance of Sand Extraction." Key findings encompassed: insufficient availability of trustworthy data and research on sand reserves,

supply chains, and existing regulatory structures; inadequate regulations along with ineffective enforcement and monitoring; the challenge of monitoring resource movements due to numerous dispersed extraction sites; illicit sand extraction and corrupt practices within government and authoritative roles; as well as a deficiency in communication both among governments and between governments and stakeholders.

Dung & Phuong, le (2015) did an analysis of river sand mining management in Cau river in Vietnam and unveiled evidence indicates that the illicit and uncontrolled extraction of sand from the Cau River has resulted in significant consequences, including severe riverbank erosion, deterioration of dykes, collapse of stone embankments, damage to irrigation works, and the introduction of noise pollution. Despite endeavors by local authorities to curb these illicit sand mining activities in the Cau River, such operations constantly prosper. The primary barriers to effectively tackling illegal sand mining are an insufficient regulatory framework, misunderstanding over obligations among parties, poor resources for management, and ineffective engagement with local authorities.

Mahadavan, (2019). Studied ‘sand mafias’ in India: unplanned crime in a rising economy, observed that trends show that law enforcement authorities are hampered by both capacity resources and lack of political backing (from a political class that is mainly corrupt) from going after culprits. As a result, the state apparatus is likely to do anything against the sand mafias for fear of being assaulted by them.

Rai et al (2019) in their work, Policy Brief, Built on Sand, identified shortfalls associated with the implementation of policies against illegal sand

mining which include capacity and resource constraints, incentives and institutional response from cartels and kickbacks, the manipulated implication of bans and the limited adoption of manufactured sand.

The West African Coastal Management Program (WACA) released an essay entitled, What Can Be Done About West Africa's Disappearing Sand? And emphasized that many governments have taken action against illegal sand mining in West Africa, yet in other locations it still takes place uninterrupted. The lack of restrictions and the insufficient enforcement of the few rules that are in existence have opened way for faster pace of illegal sand mining. If guiding legislation are not adequately managed and executed in coastal West Africa, the extraction of sand and its subsequent transportation can have significant implications not only on the environment, the population and also on the economy.

Opportunities for Mitigation Against Illegal Sand mining

The 2002 United Nations Conference on Environment and Development Report, known as Agenda 21, emphasizes the responsible exploitation of natural resources. Sustainability, in this context, refers to the capacity to keep and use these resources over a protracted period. In 2007, Goddard underlined the advantages of sand and gravel, which are cost-effective and simply available materials for development. Therefore, it is vital to protect and restore these resources to assure their availability for future generations. It is crucial for governments worldwide to foster ecologically sustainable development initiatives.

Kondolf (2007) underlined the need of having an environmental assessment management and monitoring program as part of the mining

licensing procedure in the United States. This program is crucial to prevent undesirable outcomes, as it offers approaches for mitigation and restoration. Regular monitoring is important to guarantee appropriate resource exploitation. Mitigation efforts involve minimizing the quantity of extraction, repairing and rehabilitating mining sites, and replacing depleted resources. There's also a need to repair and compensate for the biological balance of ecosystems, especially as most soil extraction activities have environmental implications, an issue India is aggressively addressing, as mentioned by Saviour (2012).

Miners are required to produce an Environmental Management Plan (EMP) to assess and integrate potential project effects into the initial stages of development planning. In India, this is now a legal prerequisite for permission issuance, demanding authorization from the Department of Environment (DOE) and the Ministry of Environment and Forests, as noted by Saviour (2012).

Kuttipuran (2006) advocated repairing watersheds by replacing riparian plants to replenish huge woody debris while conserving spawning gravel. This technique seeks to re-vitalize the ecological balance of habitats and ecosystems, ultimately boosting fish yield. Aromolaran (2012) encouraged afforestation and re-afforestation to revitalize degraded land and prevent erosion. Rural communities should be informed about alternate resources to sand, such as crushed stone, and encouraged to engage in less environmentally destructive activities for agriculture. Pereira (2012) also proposed utilizing broken stone as an option to conserve sand. Zimbabwe's Environmental Management Authority (EMA) requires plugging holes after extraction,

planting trees and grass to reduce erosion, and constantly monitoring tree growth to reclaim land, as stated by Lupande (2012).

Stebbins (2006) stressed the need of examining possibly dangerous sediment contaminants in or near streambeds before gravel extraction while monitoring turbidity levels. To prevent sediment and debris from seeping back into the water, rough elements should be removed from the streams and rivers and placed far from residential areas. Ekosse (2004) advised remediating contaminated soils surrounding extraction zones to make them viable for future productive utilization. Bagchi (2010) supported restricting sand and gravel extraction operations to prevent harm to streams, rivers, and riparian zones.

Kondolf (2007) observed the negative impact of gravel bar skimming on aquatic habitats, suggesting its limited employment under specified scenarios, such as during low flows with the establishment of buffer strips to moderate the flow. Hill and Kleynhans (1999) endorsed this view, underlining the need for close monitoring and pit refilling in the riparian zone when bar skimming is applied. They also recommended against this method in rivers or streams with a history of bar erosion. Kondolf (2007) further stressed the need of monitoring all measures to reduce downstream gravel loss. If a river has lately suffered fast bar erosion, bar skimming should be avoided. Strict controls on gravel removal quantities are crucial to promote proper recruitment and deposition rates, reducing long-term impacts on channel morphology and fish habitats.

Stebbins (2006) conducted investigation on the cohabitation of gravel sand mining and water supply wells and discovered that continuing resource

mining lowers groundwater quality. He advised that authorities examine changes in groundwater and design appropriate management measures for both resources. Hill and Kleynhans (1999) presented guidelines to decision-makers analysing sand and gravel mining activities to make intelligent decisions when giving permits. Lawal (2011) urged Nigerian officials to prohibit the indiscriminate digging of plots for sand and gravel exploitation. He advocated that the government to create regulations mandating miners to reinvest in and rehabilitate old, inactive mining sites to reduce landslides and earth tremors. Government price for sand and gravel should be commensurate with the economic value of the environment. Ekosse (2004) proposed remedial measures for the restoration of polluted sand for appropriate land use.

After analysing the National Marine Fisheries Service (NMFS), Kondolf (2007) advised the use of contemporary technologies and field sampling before extraction to collect baseline data and evaluate options for avoiding negative outcomes in the United States. This includes calculating sediment and hydraulic flow budgets and factoring future changes in water quality and channel morphology. It's vital to address cumulative impacts and propose mitigation and restoration measures. Monitoring approved activities and ensuring compliance with environmental safeguards through the control of extraction rates and amounts are also critical. Regular benchmarking and documentation of channel cross sections using aerial photographs should be done. The NMFS Policy entails giving permits with half a decade limits, subject to yearly reviews, and the revisiting of fishery management objectives to establish and implement a long-term monitoring and restoration program in American states.

In Kenya, Mwangi (2007) described the formation of the National Environmental Watchdog of Kenya, which delivers directions to sand miners and businessmen in the Eastern Province. Mitigation options for sand and gravel extraction include refilling and planting appropriate plants on damaged sites by approved miners. The Kenyan government introduced the National Environmental Management Authority (NEMA) to oversee all extraction operations, including sand. NEMA interacts with District Sand Harvesting Committees to guarantee sustainable extraction techniques.

Summary

Sand and gravel serve as vital natural resources for fuelling economic development. These materials can be recovered from numerous locations such as open spaces, beaches, inland dunes, as well as riverbanks and streams. While extraction, or "sand mining," is vital, the methods involved can have detrimental consequences on the natural environment.

As noted by Saviour (2012), the presence of weak government and widespread corruption might permit unlawful sand extraction, contributing to the depletion of natural resources. To maintain the economic and social benefits obtained from these resources during extraction activities, it is vital that governments exercise discretion when providing leases for riverbeds and open space. Clear delineation and the implementation of efficient monitoring procedures through adequate institutional mechanisms are crucial measures.

A comprehensive approach to solve these environmental concerns needs the implementation of laws and regulations consistently across all countries. This can be achieved through the establishment of a high-level

committee responsible with overseeing and guaranteeing compliance with environmental norms, as advocated by Saviour (2012).

Theoretical Perspective

The Common Pool Theory

The concept of the "Tragedy of the Commons" was initially articulated by William Forster Lloyd, a political economist at Oxford University in 1833. He propounded this theory while examining the repeated degradation of common, commonly held meadows in England. The reason was straightforward: Each herdsman, driven by their own self-interest, repeatedly adds to their herd to maximize personal advantages. They are perfectly aware that if everyone else follows the same technique, the common grazing land will be depleted. Despite this awareness, each herdsman continues to do so because the individual private gain balances their part of the community loss (Dharmadhikari, 2015).

In 1968, ecologist Garrett Hardin looked into this societal conundrum in his paper "The Tragedy of the Commons," published in the Science journal. This study later created a foundation for arguments on sustainability and provided a rationale for the Neo-Liberal movement for the privatization of public assets (Dharmadhikari, 2015).

The concept of common resources was initially described by the Romans in 535 A.D. as air, water, and fish. With more of nature becoming part of human economic operations, other resources including forests, wild animals, and, most crucially, land, came under consideration. Depending on their economic importance, these resources were either immediately appropriated by monarchs and their vassals or administered by the state on

behalf of the people, as was the case with forests and wild animals. The state was responsible for adopting laws and regulations to enable the orderly and equitable usage of natural resources in a sustainable way (Dharmadhikari, 2015).

In this context, sand is termed a common-pool resource, meaning it is free to all, and its accessibility can only be limited at a considerable cost. Due to the problems in regulating their consumption, common-pool resources are subject to tragedy of the commons, where individuals may greedily mine them without considering the long-term implications. This can potentially lead to overextraction or degradation. Even when sand mining is monitored, it typically encounters rampant unlawful extraction and trading. Consequently, sand scarcity is rising as a substantial issue with major socio-political, economic, and environmental ramifications (Torres et al, 2017).

The need for sand is predicted to significantly increase as metropolitan areas develop and sea levels rise. Although major international agreements, such as the 2030 Agenda for Sustainable Development and the Convention on Biological Diversity, ensure appropriate allocation of natural resources, there are no international conventions in place to monitor sand mining, use, and trade (Torres et al, 2017).

As long as national restrictions remain inadequately implemented, adverse effects from sand extraction will endure. There is a compelling need for the international organisations to develop a worldwide approach to sand management, including the formation of global and regional sand management strategies (Torres et al, 2017).

Empirical Review

Several studies have been conducted to investigate the issue of unauthorized sand extraction along the coastline of the Central Region of Ghana. These researches have yielded findings that pertain to the causes, consequences, and strategies for mitigating illegal sand extraction.

Causes of illegal sand mining

Firstly, Johnbull & Brown (2017) conducted research on the socioeconomic impacts of unauthorized sand extraction along the Victory River in Port Harcourt, Nigeria. They employed of both quantitative and qualitative research methods to collect data, with a study sample consisting of 123 participants. Data was gathered through structured interviews and key informant interviews. The study's findings indicated that continuous sand extraction from the river had altered its course, leading to increased width and depth of the Victory River. This, in turn, disrupted the livelihoods of the local population, resulting in reduced purchasing power, elevated poverty levels, and the emergence of various social issues. However, it should be noted that there were some benefits, including employment opportunities and revenue generation for the affected communities.

Similarly, Mensah & Mattah (2023) investigated the issue of illegal sand extraction along the coastal areas of Ghana, exploring the drivers behind this practice and potential solutions. The study primarily relied on qualitative research methods. The research identified key drivers of illegal sand extraction, including insufficient coastal surveillance, corruption within the system, the allure of profit and livelihood support, the perceived abundance of

sand as a resource, unemployment, and cultural misconceptions about sand being a superior construction material.

Furthermore, Peprah (2013) examined the relationship between sand extraction and land degradation from the perspective of indigenous sand miners in Wa, Ghana. The study employed qualitative methods in combination with descriptive statistics. The findings revealed that a significant portion of the respondents did not believe that sand extraction led to land degradation (52%). Moreover, a majority of respondents (70%) did not think that sand extraction resulted in farmers losing their jobs. Additionally, a large percentage (74%) disagreed with the idea that sand extraction caused food shortages. However, the majority (76%) disagreed that sand extraction increased the prevalence of mosquitoes and malaria cases. On the other hand, a significant majority (84%) agreed that sand extraction was a profitable business.

These studies, despite variations in their research methods and geographical locations, share a common finding that illegal sand extraction has perceived benefits or reasons that drive this activity, even though it is considered unlawful.

Effects of illegal sand mining

Firstly, Ashraf et al. (2010) undertook an analysis of the causes, effects, and concerns related with sand mining in a case study from Bestari Jaya, Selangor, Peninsula Malaysia. They employed hydraulic and sediment transport modelling methodologies to evaluate likely sand accumulation and its flow toward Selangor River. The study identified various serious environmental impacts coming from sand extraction. The primary

implications, as stated by the study, included increased turbidity in streams, habitat disruption due to dredging, destruction of flora and wildlife, and water quality deterioration.

Similarly, Johnbull & Brown (2017) undertook a study on the socio-economic ramifications of sand extraction along the Victory River in Port Harcourt, Nigeria. They used a combination of quantitative and qualitative research approaches, collecting data from 123 scheduled interview schedules and key informant interviews. The data suggested that continued river sand extraction had changed the course of the river, resulting in increased breadth and depth of the Victory River. This adjustment damaged the livelihoods of the local inhabitants, resulting to decreasing purchasing power, increasing poverty levels, and the emergence of diverse social difficulties. Nevertheless, it's vital to mention that there were benefits like as labor possibilities and cash producing for the afflicted communities.

Another study by Jonah et al. (2015) assessed sand and stone extraction along the shoreline of the Central Region of Ghana. They deployed ArcGIS and the Digital Shoreline Analysis System (DSAS) technologies to investigate short-term (2005–2012) changes in the coastline using data from 2005 and 2012. The investigation found that sand mining was the primary source of erosion along the Cape Coast coastline.

Armah (2011) undertook a study to evaluate the mechanisms leading to erosion-induced shoreline changes and the velocity of shoreline change in Accra, Ghana. The study uses the Digital Shoreline Analysis System (DSAS) to estimate shoreline changes from 1990 to 2010 by evaluating aerial photos and Landsat satellite imagery inside a geographic information system (GIS)

framework. The study found that unauthorized sand mining was a substantial contributor to coastal alterations, alongside natural causes.

Sadeghi & Harchegani (2012) evaluated the impact of sand extraction on the particle size distribution of suspended sediments in Kofour Forest River, Iran. They evaluated the settling rates of primary sediment particles based on Stokes' law and the modified pipette technique. The analysis indicated that sand extraction significantly affected the distribution of suspended sediment particle sizes and showed no significant difference between data collected before and during sand extraction, further emphasizing the consequential effects of sand extraction on particle size distribution.

Akankali et al. (2017) assessed the effect of sand extraction on the water quality of Okoro Nsit Stream in Akwa Ibom State, Nigeria. Data was analyzed utilizing physiochemical investigation and assessment of heavy metal content. The results revealed that the water from Okoro Nsit Stream was polluted as a result of sand extraction activities. Consequently, the stream's water quality was declared unfit for drinking and other human functions with potential health effects.

Mahadevan (2019) undertook an inquiry named "Sand Mafias in India: Disorganized Crime in a Growing Economy." The data sources for this research comprised media reports, expert interviews, and academic publications. The probe implicitly linked the deaths of Indian communities to sand extraction, underscoring the effects of escalating water shortages and flash floods.

Jonah et al. (2015) assessed the ecological impacts of beach sand extraction in Ghana using ghost crabs (Ocypode species) as biological

indicators. Their studies demonstrated that beach sand extraction had detrimental implications on ghost crab populations.

Arthur (2017) evaluated the damaged extraction site at Golinga in Northern Ghana. The study utilized both quantitative and qualitative approaches, including GPS coordinates of the site, interviews, and secondary data. The inquiry revealed that the environment of the sand and gravel mining site at Golinga had been damaged to an unrecognizable extent. The loss of fertile topsoil not only affected ecosystems but also had impacts on the livelihoods, health, and overall peace of the local population.

Collectively, these studies, despite their diverse research techniques, undoubtedly indicate the detrimental repercussions of unauthorized sand extraction in the respective study regions. Thus, this behavior should not be encouraged, as it disturbs several parts of life.

Opportunities for mitigation against illegal sand mining

Gondo, Mathada, and Amponsa-Dacosta (2018) conducted research on the regulatory and policy factors connected to sand extraction in the shallow waters of Njelele River in South Africa. The study included multiple approaches, including observations, household interviews, and a series of Participatory Rural Appraisal (PRA) events involving chosen community members and sand miners to obtain data. The inquiry ended in a discussion of numerous legal and policy aspects affecting sand mining, divided into three scales: strategic, institutional, and operational.

Conceptual Framework

From the principles and the theoretical position of sand mining, this study only finds it fitting to adopt the driver-pressure-state—impact-response

model. This model is a paradigm that aids to find as well as characterize processes and relationships in human–environmental systems. It aids the exploration of particular cause–effect relationships in past, contemporary, and future development.

It is used in explaining complex environmental issues. It breaks down complex systems interactions to one-to-one linkages which can be frustrating in more complicated scenarios. The components are explained below:

Drivers

Drivers (or driving factors) are several entities that generate alterations or lead the behaviour of a system. They can be natural or anthropogenic in nature.

Pressure

Pressure parameters represent the initial stage to convey the effects of diverse, mainly man-made acts which are repercussions of a group of driving forces. Hence, pressure parameters are often connected to exact reasons.

State

Consequently, due to the acts that were characterized as pressures, environmental situations are mostly altered e.g., eutrophication owing to intensive agriculture, air pollution induced by combustion of fossil fuels).

Impact

Alterations in the state of the environment will change conditions of human life. Essential social components as health and well-being but also economic conditions were intimately tied to an intact environment.

Response

The response component accounts for human behaviors made as a repercussion of specific situations. In an ideal process, the reactions should make an impact on the driver and the pressures and therefore, improve the environmental condition.

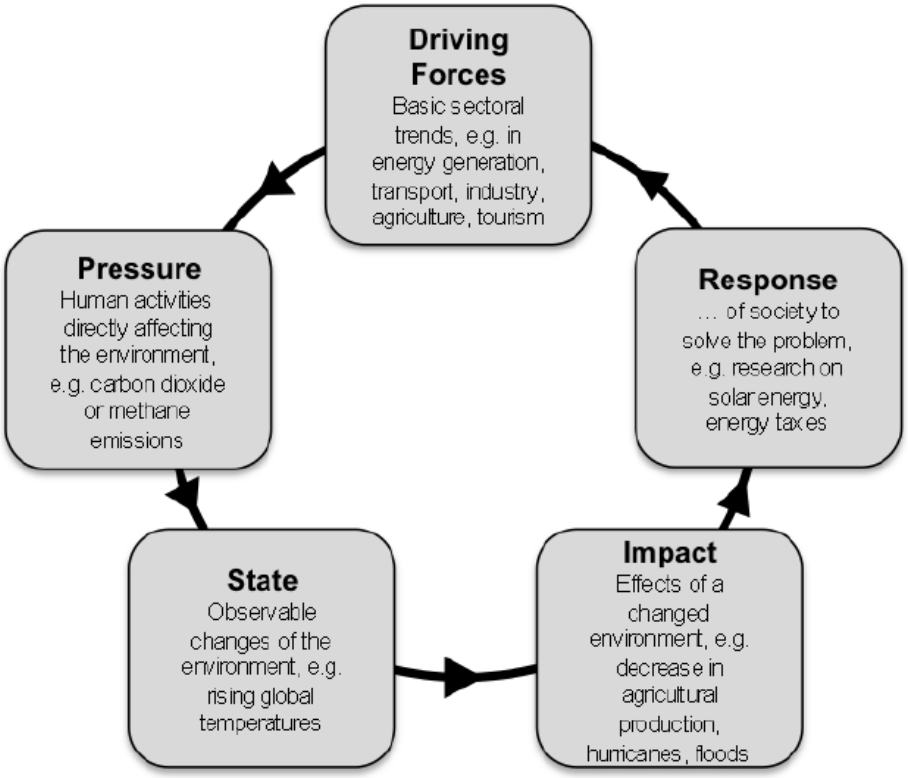
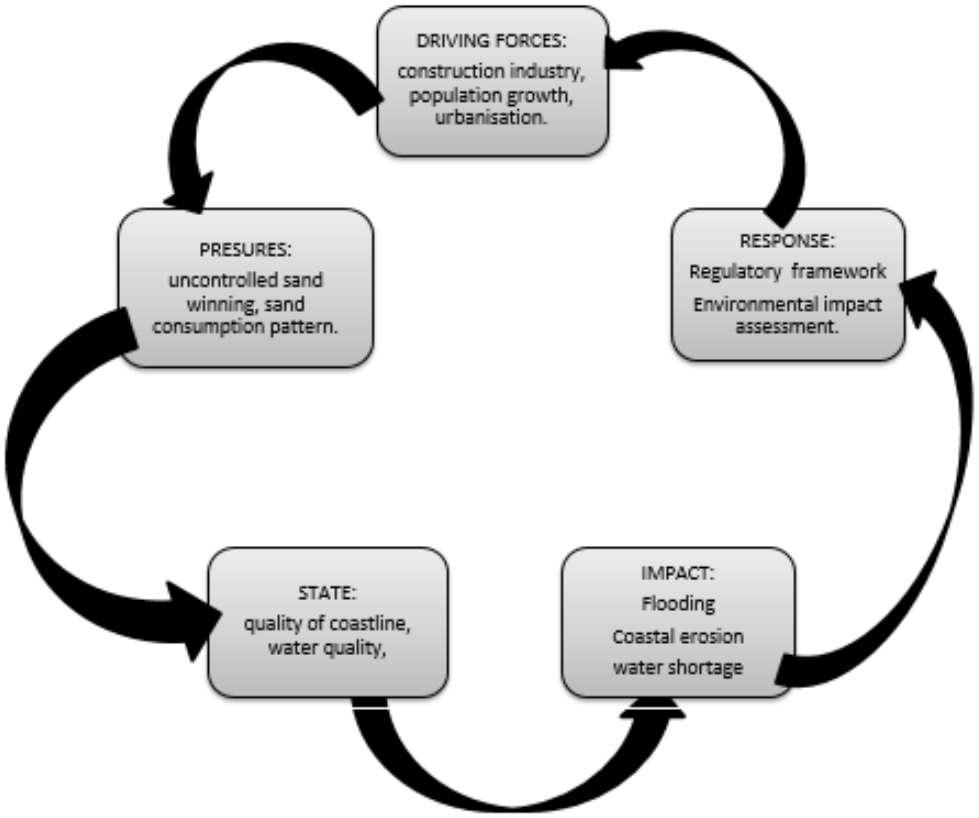


Figure 1: Conceptual Framework

Source: European Environment Agency (EEA, 1999).



Source: Adopted from European Environment Agency (EEA, 1999).

From the figure above, the DPSIR model was adopted to describe interaction of cause-effect relationship of sand mining and consumption along the coastline of the Central Region of Ghana.

Drivers

The driving forces were the processes and human activities that satisfy the basic necessities of man which results in the pressures on the environment. The origin of the drivers' starts from the global to the national and the local level. The drivers try to explain the socio-economic evolution in societies as a result of human activity. The factors of illegal sand mining such as population increase, urbanisation, infrastructural development, unemployment and many more function as drivers in this context.

Pressures

This basically looks at the alterations that occur in the environment driven by the activity of man or drivers. These activities create pressure on the environment as a result of production and consumption of sand. Pressure indicators per this study may include unregulated sand mining, sand consumption pattern, demand for sand, choice of housing and poor care for the environment.

State.

The pressure affects the state of the natural environment and ecosystems. The state is the mixture of the physical, biological and chemical events that affect distinct ecosystem constituents and can be assessed by their quality or quantity. The possible state of the environment as a result illicit sand mining are quality of the shoreline, water quality, quality and quantity of aquatic habitats.

Impact

The state of the environment and human wellbeing are altered owing to pressure. These changes take place in the biological, physical and chemical status of the environment, affecting ecosystem quality and human existence. Impact can be described as parameters in the change of status as in the case of beaches along the coastline of the Central Region of Ghana. Changes such as flooding, coastal erosion, exposure to malaria parasites and water deficit may arise due to pressures of illegal sand mining.

Response

Drivers and pressures will lead to primarily negative state changes unless the society decides to impact responses, which is a critical component

of DPSIR framework which applies particular action to the other components of the framework. Illegal sand mining no doubt causes a number of devastating impacts to the environment and human population hence the government and the local government can only put measures such as the provision of a regulatory framework, enforcement of laws, the introduction of environment impact assessment program as part of the licensing exercise and many more.

Linking the DPSIR framework with the common pool theory, it can be stated that the processes of human activities such as urbanization and population increase lead to pressures such as unregulated mining, consumption pattern and increase in the demand of the common pool resource which is the sand as it is consumed by man in order to maximize his income rather than the harm it causes to the environment. These pressures in turn lead to the change in the state of environment by affecting the quality and quantity of the ecosystem, in other words, diminishing returns begins to set on the common pool resource (sand). The pressures eventually affect the wellbeing and health of living things in ways such as flooding, coastal erosion and exposure to malaria parasites which will call for response from authorities to limit the consumption of the common pool resource in order to control its devastating effects.

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

This chapter explains the author's methods with respect to the study. This deals with details involved in the data collection process in order to obtain data. The central aim is to obtain a database on the causes, effects, constraints and opportunities for mitigation against illegal sand mining along the coastline of the Central Region of Ghana. This was done by visiting sand mining sites and interviewing key informants. This chapter will look at the research design, instruments, sample technique and the sampling procedure and the data collection procedure. The Statistical package for Social Scientist was used to analyze data obtained using both the qualitative and quantitative instruments.

Study Area

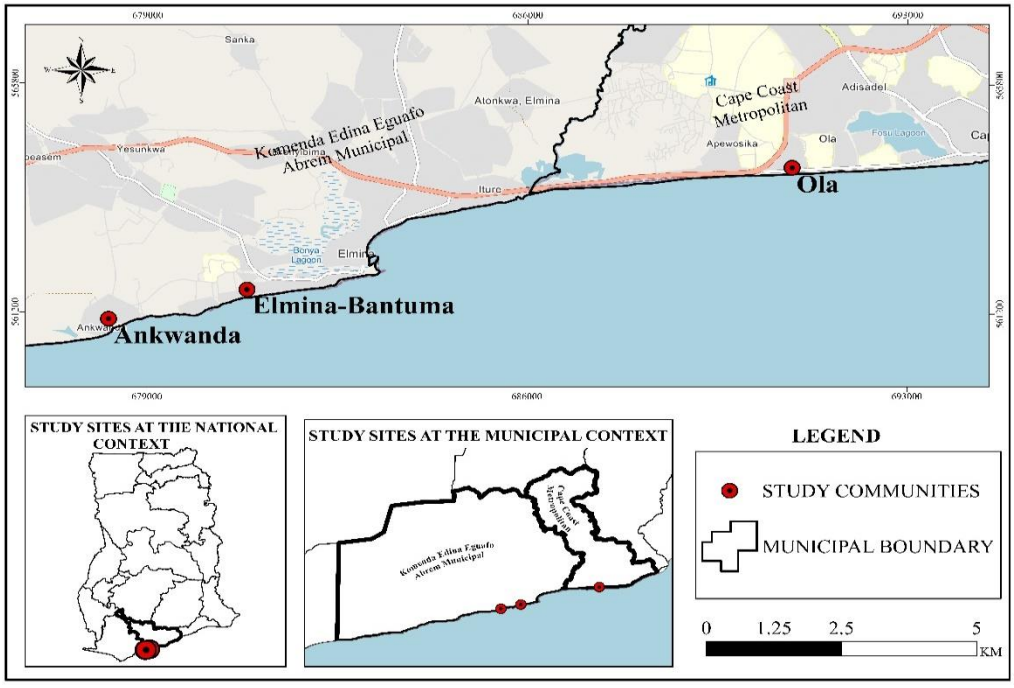


Figure 2: Map of the Study Area
Source: Department of Geography and regional planning. UCC

The study is based on three communities that were along the Cape Coast-Komenda coastline of the Central Region of Ghana. These communities include Ola, in the Cape Coast Metropolitan Assembly. Ankwanda and Bantuma Mbofra-Akyinim, both in the Komenda Edina Eguafo-Abrem Metropolitan Assembly. The communities were selected based on the following:

First, a study conducted by Jonah et al, (2015); the Assessment of sand and stone mining along the coastline of Cape Coast, Ghana, mentioned Ankwanda and Bantuma- Mbora Akyinim as sites where sand mining is very prominent. Again, Ola was also mentioned in a study conducted by Adotey et al, (2015) who investigated The Spatial and Temporal Analysis for Beach Elevation and Monitoring Coastal Erosion for Sustainable Development: A case study of Ola Beach in Cape Coast Ghana, as a beach prone to erosion due to clear sediment removal by human activities.

The three communities form part of Ghana's 600km long coastline, made up of sandy beaches, steep, partly cliffed with rocky hores interrupted by sandy bays. The stretch is covered by pre- Cambrian and Paleozoic rocks. The coastline of the Central Region of Ghana has an equatorial climate with double maxima rainfall regimes, these are: May-July and September-October temperatures range from 27° in January to 25° in July accompanied by an average rainfall of 1,402mm (Dei, L. 2010).

The coastline between Cape Coast and Komenda receives a south west wave that originates from the South Atlantic Ocean where it is produced by westerly gales. It breaks heavily on the coast, supported in the wet season by the tropical maritime airmass and slightly controlled from January to April

when it is opposed by the tropical continental air mass also known as harmattan (Dei, L. 2010).

Research Paradigm

A research's philosophy or paradigm is an essential component. The direction and broad notions of how a researcher views the world were underscored by the philosophical worldview that informs their research (Guba, 1990). This worldview informs a research's design and tactics for enquiring into the issue under investigation (Guba, 1990). The paradigm suggests a system of ideas that directs behaviour via examination of a recognized issue affecting people and their surroundings (Guba, 1990). Ontology and epistemology were two main approaches that are used to conduct philosophical analysis in research.

Any investigation aims to collect data subjectively from the world where human beings form their own interpretations of what they see in their surrounding from an epistemological point of view. The ontological perspective, on the other hand, views reality as what people interpret to take place in the world they inhabit as opposed to how they give meaning to their immediate surroundings. These two methodological pillars effectively convey the line of inquiry that a researcher chooses to take when looking into the world. There were many philosophical points of view, but this research focused on Creswell's (2009) line of pragmatics reasoning. As opposed to the antecedent conditions of positivism, pragmatism, according to Creswell (2009), arises out of the acts, situations, and consequences.

Pragmatism philosophy claims that ideology or preposition is true if it works satisfactorily, that the meaning of a preposition is to be found in the

practical consequence of accepting it and that unpractical ideas were to be rejected. The research employed both quantitative methods and the qualitative method of interviewing key informants. The approach was used to make decisions based on 'what will work best' in finding responses for questions under study

Research Design

The mixed-methods concurrent triangulation design was used for this study. It is the most used and popular approach of mixed method (Creswell et al. 2003). The main aim for this design is to collect diverse and comprehensive data on the same topic to best understand the problem. The design is utilised when an investigator intends to directly differentiate quantitative (numeric) data from qualitative data or expand quantitative data with qualitative results. This design is a one-phase design where the researcher executes the quantitative and qualitative methods in the same time frame with the same wight. The one-phase nature of the design is the reason for which it was called "concurrent triangulation design" (Creswell et al, 2003).

The two methods work in concert to gather comprehensive field data for this research. This is due to the fact that some data may be gathered through interview schedules but not through interviews or focus groups, and vice versa. Therefore, using a mixed method approach in this study will aid in obtaining some data that could have been overlooked if only a quantitative or qualitative approach had been taken. According to Teye (2012), the qualitative approach focuses on the experiences, perceptions, feelings, attitudes, and behaviours of respondents, whereas the quantitative approach emphasizes the utilization of data for analytical purposes for generalization and foresight.

Data and Sources

Data were gathered for the study mainly from primary sources. The primary data included information obtained through in-depth interviews, digital photos, observations, interview schedule and information from qualitative and quantitative sources. These methods were used to obtain data on the causes, effects, policy and management constraints and the mitigation measures of illegal sand mining along the coastline between Cape Coast and Komenda in the Central Region of Ghana. The secondary sources of information included reports, books, articles, and other publications.

Quantitative Data

Use of semi-structured interview schedules allows for the collection of quantitative data from the field. There were both open-ended and closed-ended questions in the questions. Five make up the format of the interview schedules, which match to the study's six objectives. In order to organize comments to subjects for the analysis, this was done. Demographic information on the respondents, such as their age, sex, and level of education, was acquired in the first part. The second segment was on causes of illegal sand mining in the selected localities. The third component gathered data on the effects of unlawful sand mining in the three communities. This was done to collect information on the general repercussions of sand mining including the socio- economic and environmental effects of illicit sand mining. The fourth portion discussed the constraints faced in the management of measures against illegal sand mining in these areas. The fifth segment looked at the opportunities that were available for mitigation.

Qualitative Data

Key informants were interviewed to get qualitative data. Semi-structured interview guides were used during the interviews. An interview is a type of conversation in which an individual limits himself to the interrogation of one or more participants or interviewees who limit themselves to answering these questions about ideas, behaviours, experiences, and attitudes in relation to social phenomena (Boejie, 2010 pg. 61). Officials in the regional and municipal assemblies, the Environmental Protection Agency, National Disaster Management Organization and the Minerals Commission were the major people who served as key informants for the study. Along with collecting data, digital photos were captured. These assisted in providing a visual representation of the places and circumstances that were seen in the field in order to clearly explain the issue being studied.

Target Population

The study population included local residents of the selected communities including males and females and the inclusion criteria is that the participants would have stayed in the community for more than five years and are aware or have witnessed illegal sand mining along the Cape Coast-Komenda coastline, Ghana , this means that a respondent that does not satisfy these criteria is excluded. Key informant including one (1) official each from the municipal assemblies, the Environmental Protection Agency, the Minerals Commission, National Disaster Management Organization were also interviewed.

Sampling Procedure and Size

The multi-stage sampling technique was used to identify three coastal communities involved in illegal sand mining along the coastline between Cape Coast and Komenda in the Central Region of Ghana.

The multi-stage sampling technique is explained as a sampling method that groups the population into clusters for conducting research. It is a complicated form of cluster sampling, alternatively known as multi-stage cluster sampling. When conducting this method, many clusters of selected people are divided into sub-groups at each stage in order to simplify primary data collection. (Adi Bhart, 2022)

This sampling technique was used because of the numerous communities that are found along the coastline between Cape Coast and Komenda in the Central Region of Ghana, thus, help select the community undergoing intense illegal sand mining activities. This multistage sampling technique in this study was involved in two stages:

First stage: selection of district

The first stage of the multistage sampling technique involved cluster sampling; this technique was used to draw the primary sampling units. This method was used because of the great number of communities found along the Central coastline. The population is the MMDAs found along the coastline between Cape Coast and Komenda in the Central Region of Ghana.

The clusters therefore are the KEEA Municipality and the CCMA. These selected clusters are made up of coastal communities.

Second stage: selection of communities

Purposive sampling was used to choose three communities. Thus, Ankwanda, and Bantuma-Mbofra Akyinim in the KEEA municipality and Ola in in CCMA were selected for the study.

The selection of the three communities was further affirmed based on the study conducted by Jonah et al, (2015); the Assessment of sand and stone mining along the coastline of Cape Coast, Ghana, where Ankwanda and Bantuma- Mbora Akyinim were stated as sites where sand mining is very prominent. Ola was also mentioned in a study conducted by Adotey et al, (2015) who investigated The Spatial and Temporal Analysis for Beach Elevation and Monitoring Coastal Erosion for Sustainable Development: A case study of Ola Beach in Cape Coast Ghana, as a beach prone to erosion due to clear sediment removal by human activities.

Convenience sampling was used in the study to select tipper truck drivers, sand loaders, sand sellers at the sand mining sites and the local residents of the selected communities including males and females who have witnessed sand mining in their locality and were willing to cooperate, this technique was used because only respondents who were willing to participate were involved. Officials from the KEEA and CCMA, the Environmental Protection Agency, National Disaster Management Organization and the Minerals Commission who were knowledgeable about the topic were purposively selected to take part as the key informants in the study, purposive sampling and for that matter expert purposive sampling was used because a selected few of the respondents had specific knowledge on illegal sand mining along the coastline between Cape Coast and Komenda in the Central Region

of Ghana. The inclusion criterion was that a staff should have good knowledge of the operations pertaining illegal sand mining along the coastline between Cape Coast and Komenda in the Central Region of Ghana. This implies that any official without this knowledge was excluded from the study.

From the calculation below, 388 interview schedules were administered. Large sample sizes were required for quantitative investigations in order to quantify the results and ensure that the sample is representative of the population (Beazley, 2004 as cited in Teye, 2012). In order to allow for a more thorough analysis and interpretations, it was important to ensure that the population was adequately represented in the study (Teye, 2012). Since both sexes were impacted by the illicit sand mining in the area, both sexes were taken into account when conducting the interview schedules. The population of Bantuma–Mbofra akyinim-4,200, Ola-7,375 and Ankwnada- 1,237 were acquired from the Ghana statistical service. A simplified formula by Taro Yamane (1967) was used. This formula is used to calculate sample sizes. The Yamane sample size calculator 666

Target population (the total population for the selected 3 communities) = (4,200+ 7,375+1,237) =12,812

Sample Size (Yamane, 1967) ; $n=N/(1+Ne^2)$

$n=12812/ (1+12812(0.05^2)$

n=12812/ (1+12812(0.0025)

n=12812/ (1+32.03)

n=12812/33.03

n=387.8898

n=388

Bantuma Mbofra Akyinim

4200/12812*100

0.3278*100

32.78%

Therefore 32.78% of 388=127

Ankwanda

1237/12812*100

0.0966*100

9.66%

Therefore 9.66% of 388 =37.48 =37.5=38

Ola

7375/12812*100

0.5756*100

57.56%

Therefore 57.56% of 388= 223.33=223

This implies that a total number of 127 interview schedules were distributed in Bantuma Mbofra Akyinim, 37 in Ankwanda and 223 in Ola.

Sample Size for Qualitative Data

Key informants who were purposively selected included one official each from the Cape Coast Metropolitan Assembly, Komenda-Edina-Eguafo-Abrem Municipal Assembly, the Environmental Protection Agency, National Disaster Management Organization (KEEA) and the Minerals Commission, in all, five participants were interviewed. Teye (2012) argues that interviews lack the need for huge sample sizes because the focus is on the meaning and the

interviewing process. This did not include tabulating opinions, but rather taking into account feelings, convictions, and cultural context.

Focus group discussions were organised for eight males and eight females in each community.

The sample sizes from the interviews (5) and the focus group discussion (48) gives a total qualitative sample size of fifty-three (53).

Data Collection Instruments

To gather the data, both quantitative and qualitative methods were used. The strategy was utilized to compile data in its entirety. The two methods work in concert to gather comprehensive field data for this research. This is so that some data may be collected through an interview but not by an interview schedule, and vice versa. Thus, using a combined strategy enabled the collection of information that a quantitative or qualitative approach alone could have overlooked. The key instruments that were used in the study were described below:

Focus Group Discussion (FGD) Guide

A focus group guide was designed to assist the moderator for the FGDs. This guide was designed to solicit opinions of participants on all the research questions. The guide will be flexible enough to allow the moderator to probe more information on the subject under discussion. The focus group discussion was used to obtain qualitative data from eight males and eight females from each community. This was to ensure effective participation and the collection of varied opinions from respondents from diverse backgrounds in order to enrich the outcome of the study. The guide entailed five sections based on the objectives of the study. The first section dealt with the

demographic information of participants and the communities in question. The second section looked at questions on the views and causes of illegal sand mining along the coastline of the Central Region of Ghana. The third section also handled the effects of illegal sand mining along the coastline of the Central Region of Ghana. The fourth section addressed the constraints faced at the management level in their fight against illegal sand mining along the coastline between Cape Coast and Komenda in the Central Region of Ghana. The last part dealt with the opportunities for mitigation against illegal sand mining along the coastline between Cape Coast and Komenda in the Central Region of Ghana.

Interviews guide

An interview guide was designed to generate data at the institutional level in the three selected communities. The purpose of the interview guide was to obtain data from the various institutions and organizations operating in CCMA and KEEA such as National Disaster Management Organisation, the Environmental Protection Agency, the Municipal Assemblies and the Minerals Commission. The guide entailed five sections based on the objectives of the study. The first section dealt with the demographic information of the official interviewed. The second section looked at questions on the views and causes of illegal sand mining along the coastline of the Central Region of Ghana. The third section looked at the effects of illegal sand mining along the coastline of the Central Region of Ghana. The fourth section also addressed the constraints faced at the management level in their fight against illegal sand mining along the coastline of the Central Region of Ghana. The last part dealt with the

opportunities for mitigation against illegal sand mining along the coastline of the Central Region of Ghana.

Interview schedule

The interview schedule was designed to help obtain quantitative data for the study. The questions were made up of both open and close-ended questions. Five sections made up the format of the interview schedules, which correspond to the study's objectives. In order to organize replies to topics for the analysis, this was done. Demographic information about the respondents, such as their age, sex, and level of education, will be gathered in the first section. The second section was on causes of illegal sand mining in the selected communities. The third section gathered data on the effects of illegal sand mining in the three communities. This was done to obtain data on the general effects of sand mining including the socio-economic and environmental effects of illegal sand mining. The fourth sections tackled the constraints faced in the enforcement of policies against illegal sand mining in these communities. The fifth part looked at the opportunities that were available for mitigation.

Observation guide

Cohen and Crabtree (2006) described observation as a methodical technique to data collecting in which observers utilize all of their senses to examine individuals in naturally occurring settings or situations. To some extent, researchers will welcome their observations as a way to cross-check phenomena found in the field and consequently, incorporate them into the research's final analysis. As a result, the investigation spotted odd characteristics on the ground. The activities that occur at the sand mining sites

and their impacts on the surrounding were keenly observed as well as other relevant ideas. To guarantee clarity, photographs were taken of any unusual traits that were noticed.

Data Collection Procedure

Data were collected chiefly by fieldwork. Hence quantitative and qualitative approaches were used, qualitative approach used included key informants' interview and Focus Group Discussions.

The FGDs was held in each of the three communities: one for females and another for males, each lasting for forty minutes, two days were spent on each community for FDGs giving a total of six days. This was to allow more comprehensive data on the issue under study. This was to also provide a comprehensive data for the subject matter under investigation.

Officials of some governmental institutions were engaged in in-depth interview to provide more data on the various institutional arrangements within the two municipalities. This is to last for duration of one month (July).

Quantitative data included interview schedule surveys prepared using the kobo toolbox. The link was shared with the field assistants to facilitate quick entry of responses. A total of about 388 interview schedules were filled within all three communities under study, a duration of twenty minutes was to be spent on each respondent. A proposed number of one week was spent on each community for interview schedule administration. Totalling a number of 21 days for the entire quantitative stage of data collection. This was done between May and August, 2022.

Data Management Plan

Due diligence was paid by the data collection team to avoid unnecessary errors and the data collected were well scrutinized for errors as well. The data were compiled in the data base of the kobo toolbox until the proposed number of participants was obtained after which the data was imported into Excel for storage. The data gathered was stored in one folder on several platforms such as iCloud, OneDrive, google drive and Microsoft excel before it was entered into SPSS. The data was kept for a week for further scrutiny prior to analysis. Data was kept by student and supervisor for a period of two years for the event of a possible publication of the study or part of it in a journal.

Data Processing and Analysis

The results of the analysis of the information gathered through quantitative and qualitative approaches were merged to complement one another. Both qualitative and quantitative data from surveys were analyzed in order to identify the types of differences in each dataset and respondents' responses while also giving this data meaning. A Software called Statistical Package for Social Sciences (SPSS) was used to analyze the quantitative data. Next, using descriptive statistical techniques, the data was used to produce and compute for a variety of statistical analyses. Microsoft Excel was used to create pie charts, bar graphs, plates, and tables to illustrate the causes, effects, policy and management constraints and mitigation measures of illegal; sand mining along the coastline of the Central Region of Ghana. This is to improve visual presentation of results obtained.

Concurrently, the qualitative data was manually analyzed into themes based on pertinent topics or patterns discovered throughout numerous interviews and focus group discussions.

Ethical Issues

Every research design should take into account ethics of respondents and bear the sensitivity of the issue in mind. Gwimbi and Dirwai (2003) defined ethics as the acceptable moral principles propounded by persons or groups which serves as a code of conduct for research with regard to selected subjects, participants and all stakeholders of the study procedure. In the course of the research, the investigator is obligated to protect the respondents from harm and offer them the necessary details on the vitality of the study and grant them the opportunity to withdraw when necessary.

The researcher applied for ethical clearance from the University of Cape Coast Institutional Review Board (UCC IRB) and the green light was given for the study to be carried on. Again, permission was sought before entry into the various communities. Entry was made into Ankwanda and Ola through the assembly members while that of Bantuma-Akyinim was done through the chief of the locality. Information on the nature, purpose and study procedure was provided to the would-be respondents and the confidentiality of data and information provided were made to them before starting the study. Respondents who were reluctant to partake in the study were excused. Interviewees were given the chance to provide their answers when they were less busy, as such the researcher met the at their times of convenience.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter focuses on the presentation of results and discussion of the findings from the study on the mitigation measures against illegal sand mining along the coastline between Cape Coast and Komenda in the Central Region of Ghana. This chapter is segmented into two sections, the first section will talk about the demographic characteristics of the respondents. The second section will discuss the various outcomes of the study, based on the causes, the effects, policy and management constraints and mitigation measures against illegal sand along the coastline between Cape Coast and Komenda the Central Region of Ghana. The quantitative data was analysed using SPSS and represented in the form of tables and graphs while thematic analysis was used to analyse the qualitative data.

The study considered three selected communities along the coastline between Cape Coast and Komenda in the Central Region of Ghana where enquiries were made on how the challenge illegal sand mining posed can be tackled. Three hundred and eighty-eight (388) respondents were sampled to take part in the interview schedule survey. One hundred and twenty-seven respondents (127) were from Bantuma Mbofra Akyinim, two hundred and twenty-three (223) from Ola and thirty-eight (38) were from Ankwanda. One Focus group discussion was conducted for each for males and females in the communities. Interviews were conducted for one official each in the various agencies that enforce laws against illegal sand mining. The results were represented using tables, charts and pictures.

Demographic information of the respondents

This section is vital to the study because its components were related to other aspects of the study. The components contained in this section include sex, age, level of education, religious affiliation, marital status, occupation of the respondents.

Distribution of respondents by Sex

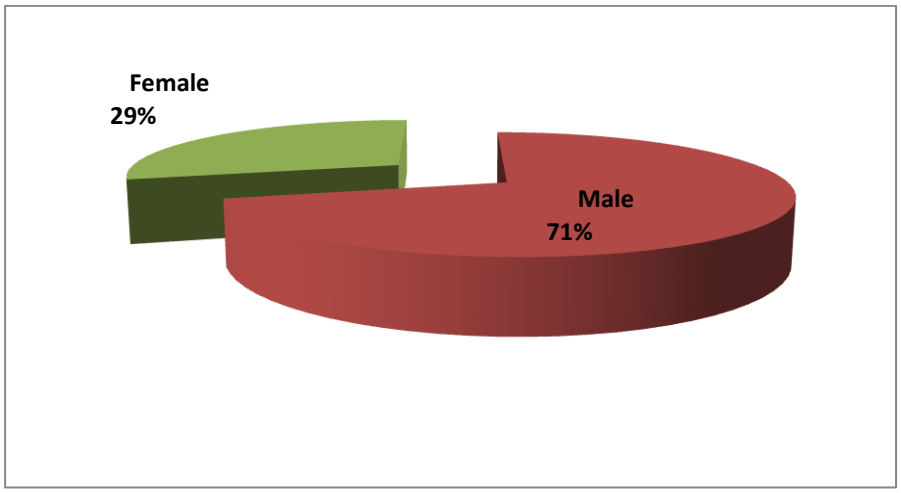


Figure 3: Sex of respondents

Source: Field data 2022

This refers to the two main groups (male and female) into which humans and most other living things were divided into based on their reproductive functions. This study considers the sex of the respondents because it plays a role in determining the outcome of the study. Both males and females were sampled for the study. The inclusion criteria on the survey were any male or female who is aware or has witnessed illegal sand mining ongoing in the community. This implies that minors who have also witnessed the activity can also be included.

From figure 3, out of the 388 respondents, 70.9% representing 275 were males and 29.1% representing 113were females. The data obtained from Ghana's 2010 PHC report revealed that the residents of CCMA where Ola was found has about 48.7% being males and 51.3% females and that of KEEA Municipality where Bantuma-Akyinim and Ankwanda were found also has 48.1% males and 51.9% females. Both reports contradict the percentages obtained for the study. This is due to the fact that males were willing and ready to partake in the survey because sand mining activities were mostly dominated by males rather than females. Females rarely involve themselves in sand mining activities hence the low turnout. Also, (Madyise, 2013 & Sumani, 2019) agreed with the above finding that more males than females were involved in illegal sand mining.

Distribution by Age

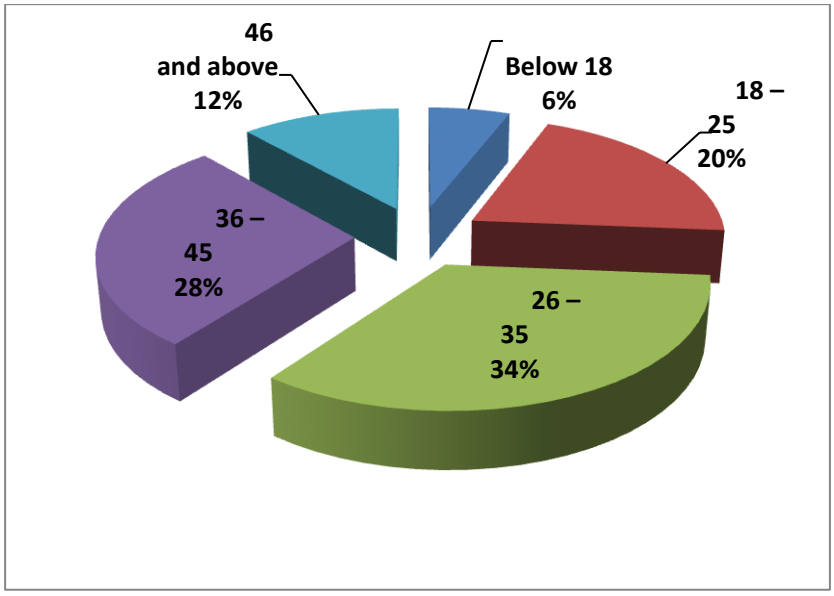


Figure 4: Ages of respondents

Source: Field data 2022

Age refers to the distinct period for which a person has lived his or her life. The age of the respondents is of great importance to the study because it is related to various aspects of the study and as such will affect the outcome of the study. From the above data provided, Majority (34%) that is 133 respondents falls between the ages of 26-35 years, due to the fact that this age group represents the youthful and more energetic labour force that were mostly present at the sand mining sites and were willing to avail themselves for the study, 20% representing 79 respondents were between 18-25, this age group included the youngsters who could read and write and understood environmental issues. while minority (5.9%) that is 23 respondents were below 18 years, this group constitute the minority because a few of them were conscious of issues concerning illegal sand mining. The above information contradicts that of the 2010 PHC report where majority of the age groups for CCMA and Ola for that matter, falls between 20-24 years, likely that this because this age group consists of youth who were in the tertiary institutions and may not be available in their number for the survey. Moreso, that of KEEA also differs from that of the study, in that the age group below 18 yeas specifically, 0-4 years formed the majority. Studies conducted by (Madyise, 2013 & Peprah, 2013) on the contrary also found out that the age group 21-25 and 30-39 years were of the highest frequency respectively.

Level of Education

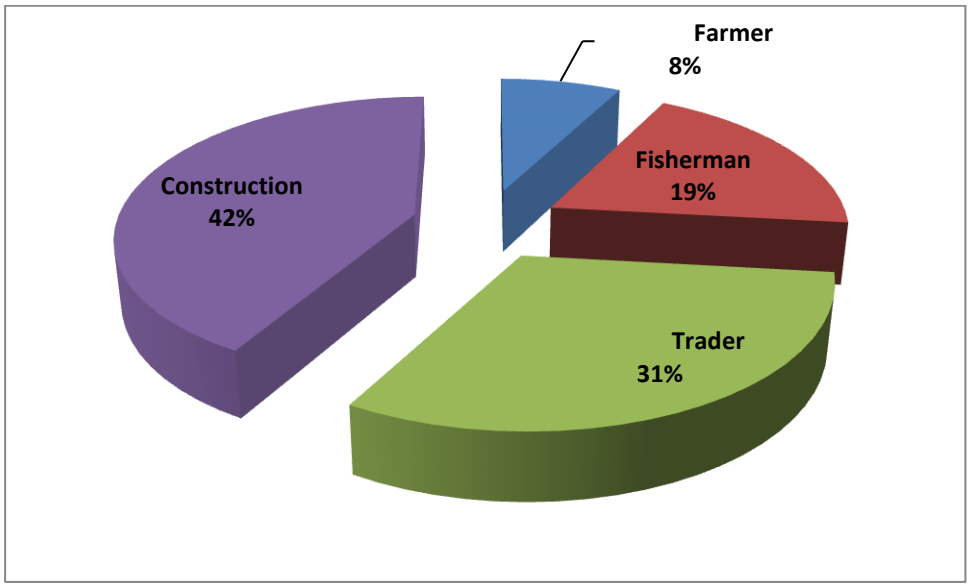


Figure 5: Level of education

Source: Field data 2022

The level of education according to the framework of International Standard Classification of Education (ISCED), levels of education were an ordered set of categories with the intention of grouping educational programs according to the gradations of learning experiences and the knowledge, skills and competencies which each program is designed to impact. The ISCED 2011 classification of education entails levels of education. This includes early childhood education, primary education, lower secondary education, upper secondary education, post-secondary non tertiary education, short-cycle tertiary education, bachelor's level, master's level and doctor level (UIS 2012). For the object of this study, the levels considered were the primary, the lower and upper secondary or the Junior and senior high schools and the tertiary or the bachelor's, masters and doctor levels.

From the data obtained, 38.9% that is 150 respondents were educated to the JHS/Middle school and this is no news as illegal sand mining activities

do not require any form of special skill or literacy. JHS/Middle school recording the highest percentage implies that Middle school education formed the majority of people among the educated portion of the participants. 38.4% representing 149 respondents went to the Senior High School, 16.2% representing 63 people were educated to the tertiary level and 6.4% that is 25 people had no formal education. This information goes in contrast with the 2010 PHS report where majority of the occupants of CCMA were in the tertiary, 27% in the primary while a total of 24.5% were in the JHS/SHS category. Meanwhile the report provided by KEEA tallies with the findings where majority (30.6%) has attended JHS/Middle School, followed by the basic level (21.9%). Again, (Sumani, 2019) agrees with the finding that respondents with basic school education (19%) forms the majority while (Peprah, 2013) on the other hand had respondents with no formal education being the majority (44%).

Occupation

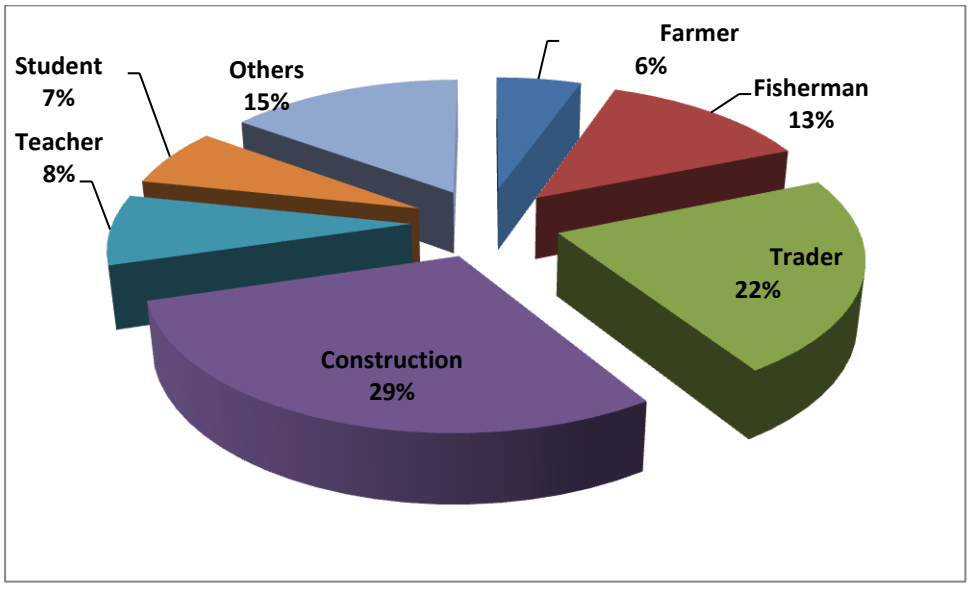


Figure 6: Occupation of respondents

Source: Field data 2022

Occupation implies the means of earning, work or vocation of an individual. The occupation of the respondents is important to the study since it is going provide a fair idea of the activities they were involved in a within their various communities. 29.4% of the respondents (113) were in the construction industry, they included masons, sand loaders, block makers, tipper truck drivers and tricycle drivers that were found at the sand mining sites or at their residents and who were willing to avail themselves for the survey. 22.2% (86 respondents) were traders that included fishmongers who sold fish at the shore, food sellers who hawked around the sand mining sites, the communities and the sea shores, entrepreneurs or business owners that were not hesitant to partake in the investigation. 58 respondents (14.9%) were involved in other occupations such as hairdressing, tailoring, security personnel and administration work. 52 respondents (13.4%) were fishermen who were present in their homes and made themselves available for the study. 31 teachers (8%) who teach at Edinaman Senior High School, a few teachers who live in Ankwanda and Ola also fully participated in the study with the knowledge that they can make suggestions to the local and central government on illegal sand mining. 26 respondents (6.7%) were students who resided in the various communities and have witnessed illegal sand mining activities and 21 respondents (5.4%) were farmers who were resting in their homes and availed themselves for the study.

The 2010 PHC report disagrees with the above data, it was rather revealed that the highest number of the population of CCMA were service and sales workers, likewise, that of the KEEA Municipality also had most (42.2%) of its population as Skilled agricultural, forestry and fishing workers, followed

by service and sales workers (20.6%), then crafts and technicians (18%) which forms 8% of employed persons altogether. (Madyise, 2013) also found out that majority (22.2%) of the respondents were livestock herders.

Awareness and causes of illegal sand mining in selected communities along the coastline between Cape Coast and Komenda of the Central Region of Ghana

Respondents who were aware of the emergence of sand mining activities in their community

Figure 7 indicates the number of respondents who have witnessed sand mining activities in the selected communities. The figure indicates that 75.8% of the respondents have witnessed illegal sand mining in their communities, while 24.2 % have not witnessed sand mining on-going in their communities.

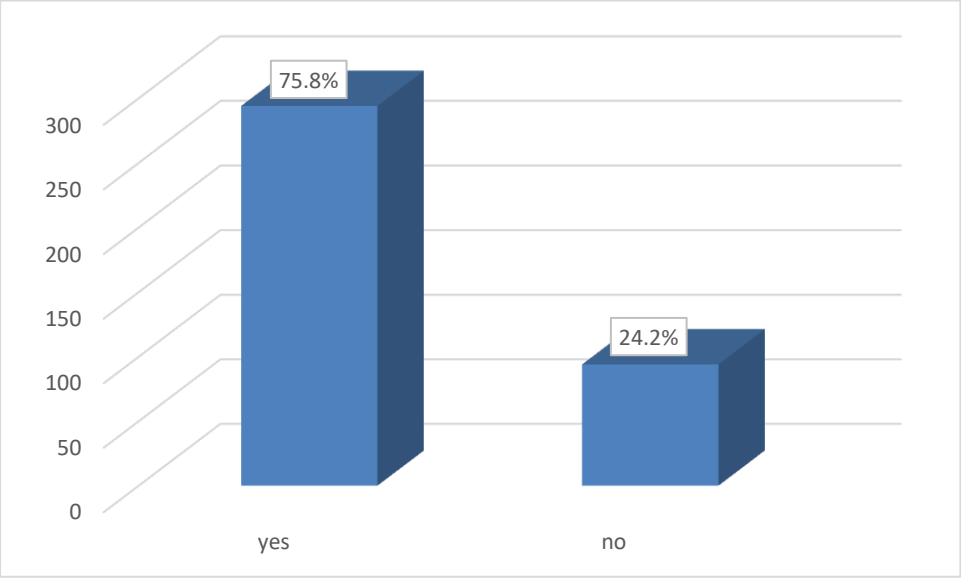


Figure 7: Respondents who have witnessed sand mining activities in their community.

Source: field data, 2022.

Many of the respondents have witnessed sand mining because they have stayed in their communities for more than five years. From the survey, FGDs and interviews, these illegalities were witnessed mostly at night between 9pm to 11pm in Bantuma Mbofra-Akyinim while that of Ankwanda is witnessed during the day due to little or no restrictions from Ankwanda traditional authorities. In the case of Ola, sand mining activities were witnessed mostly early in the morning (4-5 am) and the won sand were molded into brick immediately on the won site, this is done to avoid being detected by authorities.

Respondents' awareness of sand mining activities in their communities

Figure 8 depicts the knowledge of respondents on the emergence of sand mining in their communities. The figure denotes that 80.6% of the respondents were aware of the prevalence of sand mining activities in their communities but have not witnessed it while about 19.4 % were not aware of the incidence of sand mining in their communities.

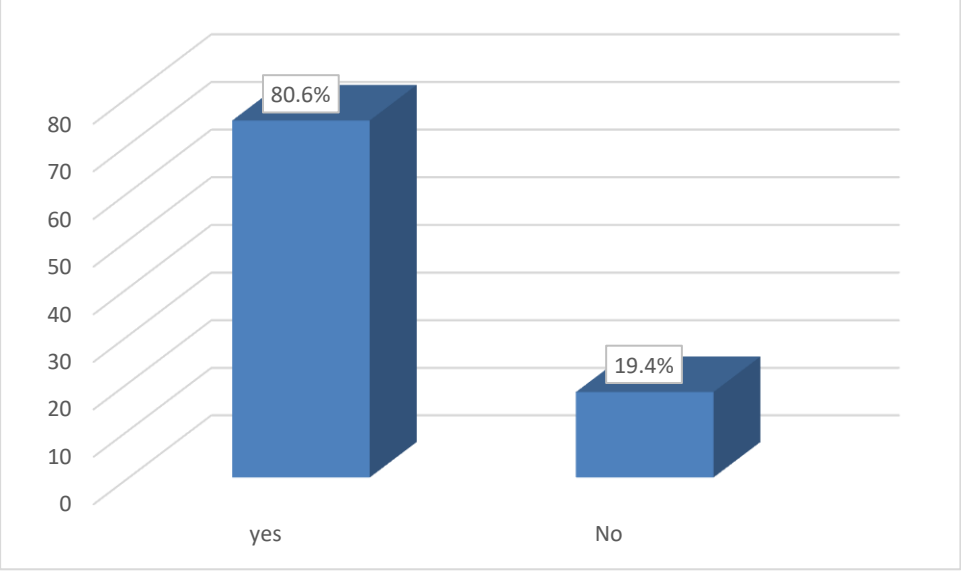


Figure 8: Respondents who were aware of the emergence of sand mining activities in their community.

Source: Field data, 2022

From the survey, FDGs and interviews organized, most of the respondents attest to the incidence of sand mining where the youth (26-35) were actively involved. The few who were not aware of the incidence of sand mining activities were mostly females who were mostly occupied by household chores and as such were not aware of the emergence of sand mining activities.

Ways by which the respondents became aware of sand mining in their communities.

Figure 9 displays the various ways by which respondents who have not witnessed sand mining became aware of the illegalities of sand mining. About 56% of the respondents became aware of sand mining in their communities through announcements from the regulatory bodies, local announcements through the public address system by the traditional or local authorities (32%), from colleagues (6.7%) and television announcements (5.3%).

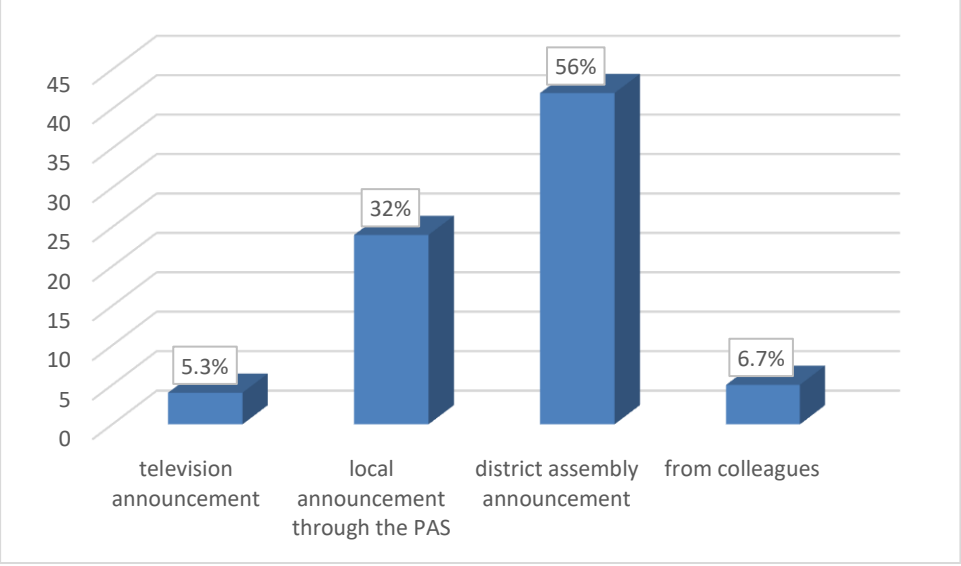


Figure 9: Ways by which the respondents became aware of sand mining in their communities

Source: Field data, 2022

From the data analysis, it was observed that majority of the respondents who have not witnessed sand mining activities became aware of the problem through announcement made by the Metropolitan, Municipal and District Assemblies. Periodically, the regulatory bodies such as the EPA, KEEA Municipal Assembly and CCMA make announcements on the fact that it is illegal to mine without following appropriate procedure and culprit found will be made to face the full force of the law. The announcements were sometime made through the local authorities as a result of a letter or communique issued to serve as a reminder to the and their local authorities. They were also made during sensitization programs organized by these government agencies. The issue is also made known to the populace through announcement made by the local authorities through the PAS. This is mostly done by the linguists of these communities when giving their usual announcements. Again, colleagues or friends also serve as a source of information to the respondents who have not witnessed illegalities of sand mining. Colleagues in terms of age mates, friends and neighbors who have witnessed the activity. Next, announcements from television stations also served as source of information to respondents who have not witnessed illegal sand mining. This is mostly in the form of educational campaigns and announcements from the Ministry of Information through the Ministry of lands and natural resources on the devastating effects of sand mining.

Knowledge of respondents on sand mining

The figure 10 demonstrates the knowledge of respondents on illegal sand mining. Out of the 388 respondents, majority, that is about 237 respondents (61.1%) perceive sand mining as the collection of sand illegally

from the shore, while 151 representing 38.9% see sand mining as just the collection of sand.

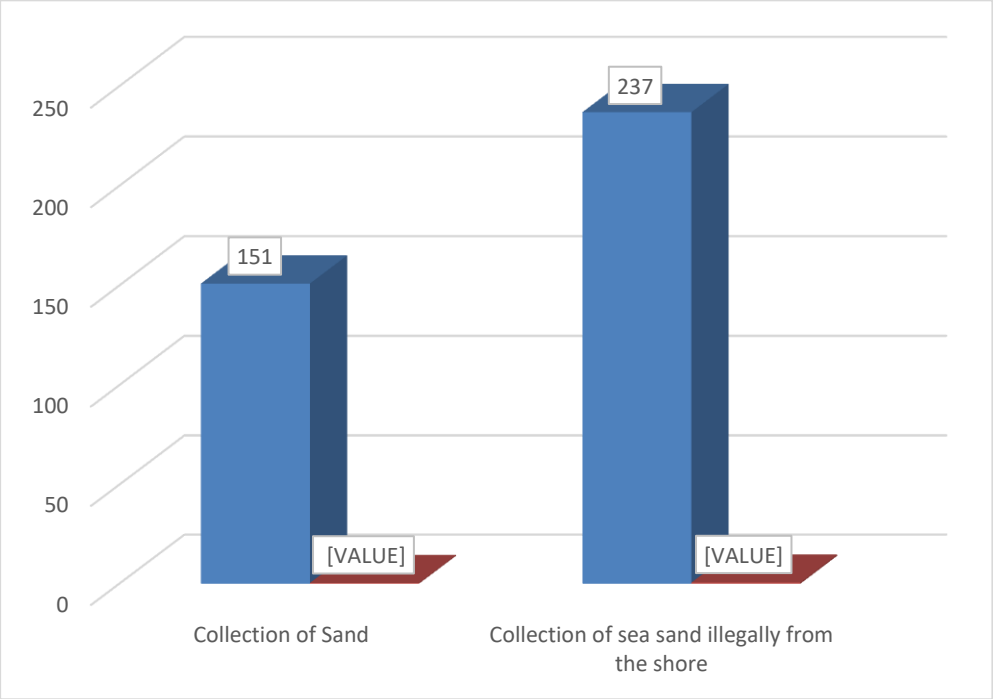


Figure 10: Knowledge of respondents on sand mining

Source: Field data, 2022

From the analysis, it was noted that there are a lot of the respondents perceived sand mining as the illegal collection of sand or collection of sand against the laws of the country. They knew that there were laws protecting the sand and needs to be adhered to and those found guilty will be penalized. A handful of the respondents see sand mining as the mere collection of sand and were not aware of any law covering these sands.

From the FGDs, many of the respondents believe sand mining to be illegal collection of sand since there were laws protecting the sands. Those who mine sand without permit were seen as culprits who can be dealt with by the law. Other respondents did not know about the existence of laws protecting the sands along the shores of the country.

Causes of illegal sand mining in selected communities along the Cape Coast-Komenda coastline in the Central Region of Ghana

The following figures show the causes of illegal sand mining in the selected communities along the Cape Coast-Komenda coastline, Ghana. Thus figure 11 shows the views of respondents on the causes of illegal sand mining in Ankwanda. About 87% of the respondents believe these operations are done to create jobs for the people, 53% says it's a free gift of nature, 55% mentioned urbanization, population increase (53%) and increased demand for housing were the other causes mentioned.

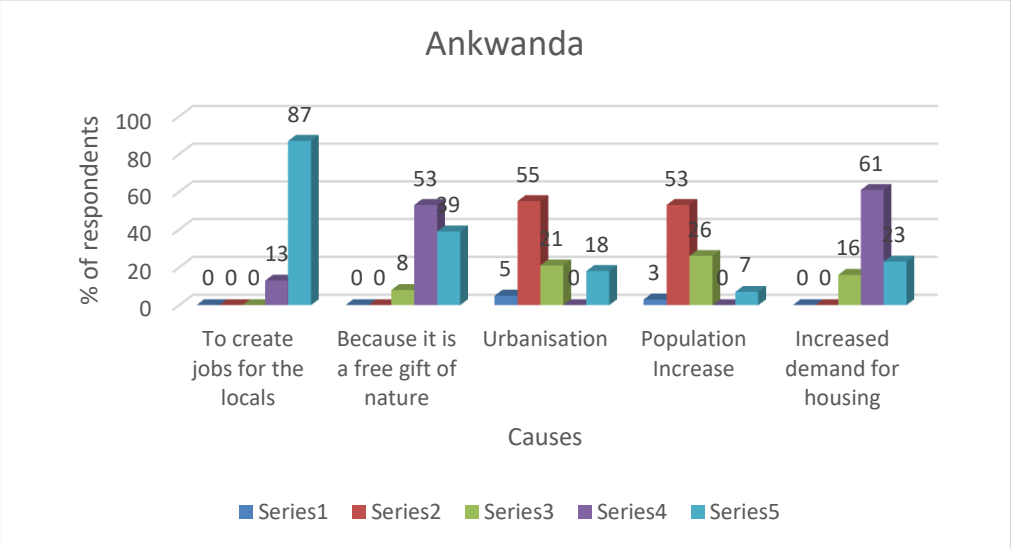


Figure 11: Causes of illegal sand mining in Ankwanda.

Source: Field data 2022.

Figure 12 depicts the causes of illegal sand mining in Bantuma Mbofra Akyinim. From the figure 51% believe illegal sand mining operations are done to create jobs for the local people, 50% see urbanization as a cause, followed by the increased demand for housing (37%) and population increase (14%).

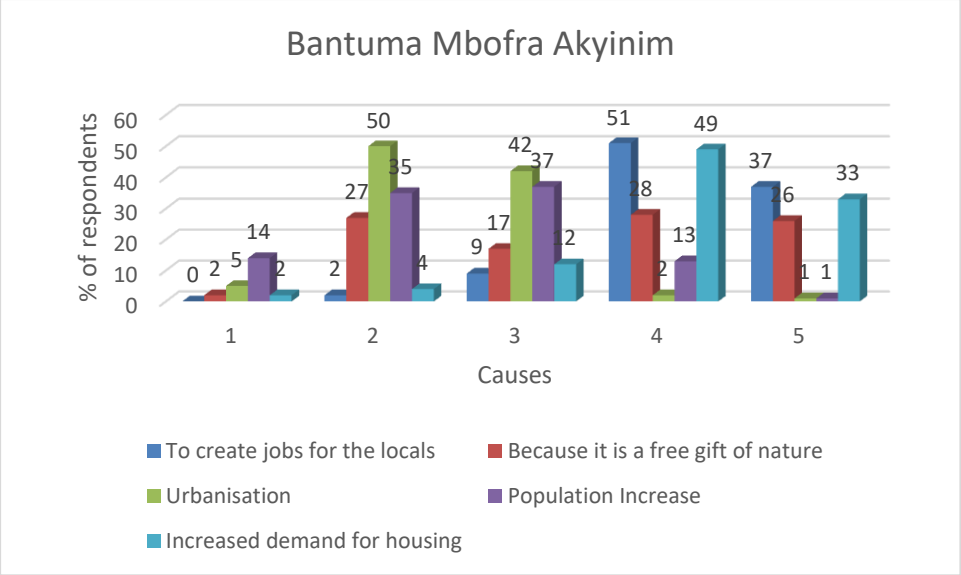


Figure 12. Causes of illegal sand mining in Bantuma Mbofra Akyinim.
Source: Field data, 2022.

Figure 13 represents illegal sand mining activities in Ola.

From the figure, the respondent opined that illegal sand mining activities are cause by the need for a job for the local people (79.4%), the increased demand for housing (75.8%), population increase (51.2%), urbanization (36.8%) and because it's the free gift of nature (32.7%).

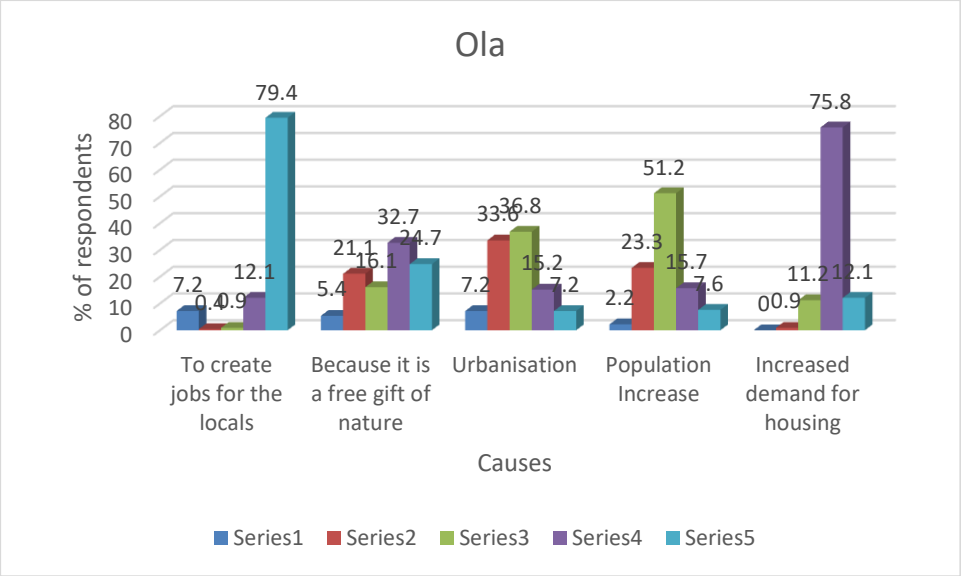


Figure 13: Causes of illegal sand mining in Ola.
Source: field data, 2022.

From the data analysis, it is clear that illegal sand mining activities serve as a source of income and employment for the people to fend for themselves and their families, since apart from the predominant occupation which is fishing, there were no other option except sand mining. This is affirmed by Johnbull & Brown (2017), Peprah (2013) and Mensah and Mattah (2023) all identified sand mining activities as providing employment opportunities for sand loaders, tipper truck drivers, tricycle drivers to food vendors and related services. These opportunities provide them with income so they can afford their needs. Illegal sand mining as indicated from the data obtained is seen as a free gift of nature The data collected from the interview schedule survey shows that both the residents and those related to illegal sand mining see sand as a free gift of nature, to them, sand is a resource provided by nature for man's use when needs such as housing and employment arise. The beach sand is also seen as a 'cheap' source of sand for construction companies and individuals as compared to sand acquired from agricultural fields. It is believed that bricks made from beach sand were stronger and make plastering easier as compared to those from other sources, hence it is preferred to sand from agricultural lands (Mensah & Mattah, 2023).

Additionally, the respondents particularly those in Bantuma and Ankwanda see sand as a resource that never finishes no matter how it is mined. Some even believe that if sand is not mined from time to time, it will become too much on the shore and make it difficult for recreational activities to take place and as such can be collected at any given time, sand is also collected due to increased demand for housing, expanding or increasing population and urbanization. In recent times, several individuals and families

are struggling to build houses of their own, thus the main reason for which a lot of farm lands are sold for construction purposes. This is also to support the growing population of these communities (karikari, 2013; Jonah et al., 2015).

In the same vein, focus group discussions organized for males and females for each of the three communities indicated that illegal sand mining activities come with benefits or the reasons for which people go into it. The reasons mentioned include: for building and construction purposes, to cover open pits, to generate income and to rid the shore of its burdens(sand) so more deposition can take place. A 62-year-old woman who happens to be a resident of Ankwanda said:

> *'I am becoming old and less energetic as I used to be, I only depend on my son who fetches sand on the shores for survival. He also has his family to cater for and so he has no option than to get money from the 'cheapest' source which is the sea sand. Nowadays, the price of fish is very expensive, not much is gained when sold. So, you see, we have no option but to go for the sand. It is better to do this than to stay home doing nothing.'* (10th May, 2022).

The quotation above denotes that there exist some benefits derived from illegal sand mining, though illegal as it is put. Prior studies confirm these findings. For instance, (Agyemang, 2010 and Peprah (2013) mentioned sand mining as a source of livelihood for tipper truck drivers, sand loaders, masons, brick makers and many more. From FGD, it was deduced that the respondents who work at the sand mining site especially the sand loaders in Bantuma-

Akyinim believe they were cheated by the chief of the community. This is vividly expressed below:

> *'The issue is we have no option; hence the chief tends to take advantage of us. The amount we charge as sand loaders includes the amount given to the chief, he says they will use it to equipment for communal labour yet we bring these implements from our houses when it's time for communal labour. My question is, where does the money go?* (10th May, 2022).

The statement above is a complaint from a sand loader who collects sand into basins for onward deposition into tricycles. According to him, they charge the tricycle riders an amount of GHS 40.00 where GHS 20.00 goes to the chief and the rest is kept by them. The chief says the money accrued was going to be used to purchase cutlasses, shovels and hoes so they can used during communal labour. But little or nothing of this nature is seen. Despite the bitterness, the youth still go to fetch the sand illegally just to make some income.

Again, interviews organized for key informants which include officials in the National Disaster Management Organization (NADMO), the Minerals Commission, the Environmental protection agency (EPA), the Cape Coast Metropolitan Assembly (CCMA) and the KEEA Municipal Assembly also indicated that illegal sand mining does not occur without their notice though it serves as an employment avenue, sources of revenue to some of the traditional authorities and source of income aside fishing. The key informant 'A' stated in his own words that:

> *'These coastal communities go in for the sand mining because, apart from the fishing, there were no jobs for them, the traditional authorities who were supposed to stop them also allow them to mine the sand because they have a stake in it. They claim, they use the revenue accrued to buy implements such as shovels and cutlasses for communal labour.' (15th May, 2022).*

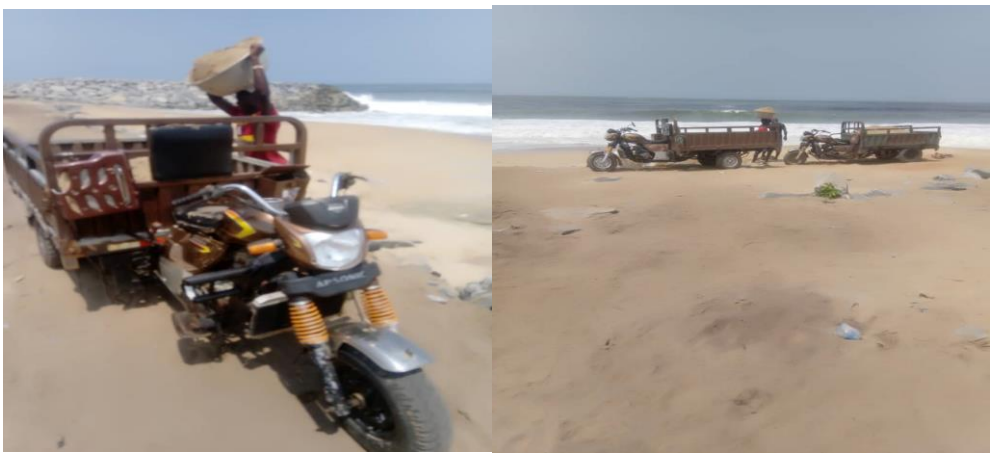
Key informant 'D' added:

> *'Some of them were really going through hard times, I recall in one of our patrols where I had an encounter with a boy who happened to be a then level 200 student of the University of Cape Coast, he was working in order to pay his fees. We were supposed to hand them over to the police but we could not bring ourselves to do that. That boy's education would have come to a standstill. In such instances, we have no option than to let him go.' (15th May, 2013).*

The above statements inform us that illegal the staff of these agencies were aware that illegal sand mining provides a lot of benefits to the community members and at the site. These include source of raw materials for the building and construction industry, employment, revenue to traditional authorities and alternative source of income. In light of these, it becomes difficult for the necessary sanctions to be meted on them.

In relation to the common pool theory, sand, as the common pool resource is exploited for the privatized gain of the individual in terms of income, increase in population and the demand for sand. Despite the strategies

put in place by the government to tackle the menace, individuals mine sand to satisfy their personal needs at the expense of the common loss.



Effects of illegal sand mining along the Cape Coast-Komenda coastline of the Central Region of Ghana

Figure 14 shows the effects of illegal sand mining in Ankwanda. The figure implies the respondents in view illegal sand mining can lead to retreat of the shoreline (74%), introduction to health hazards (61%), the destruction of valuable timber (47%) and pollution (45%).

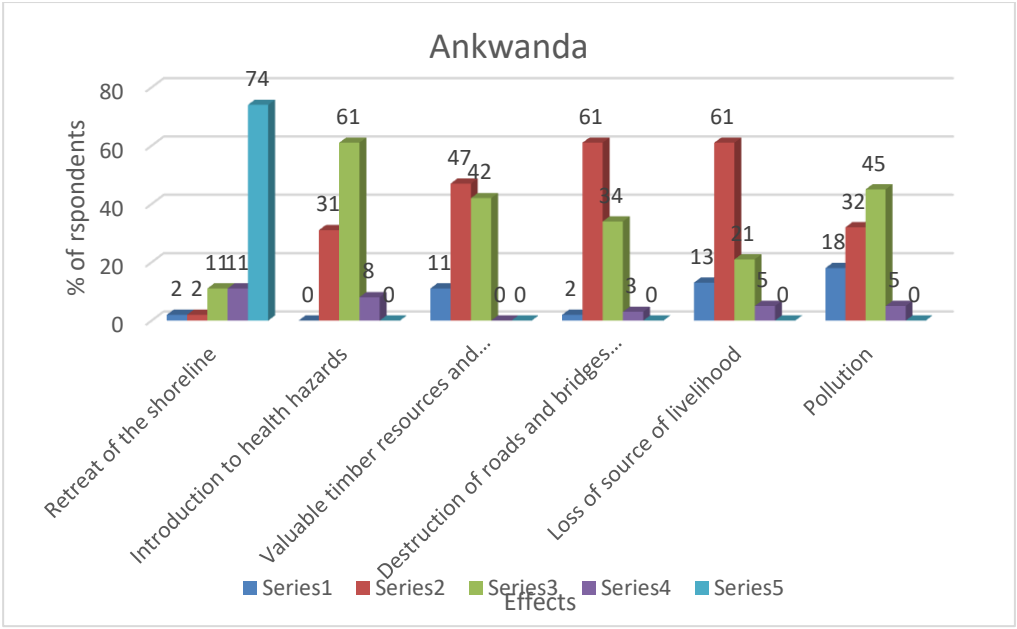


Figure 14: Effects of illegal sand mining in Ankwanda.

Source: Field data, 2022.

Figure 15 depicts the effects of illegal sand mining in Bantuma Mbrofra Akyinim. The figure communicates that illegal sand mining can lead to repercussions like destruction of roads and bridges by heavy duty vehicles (58%), loss of source of livelihood (47%), introduction to health hazards and pollution (40%).

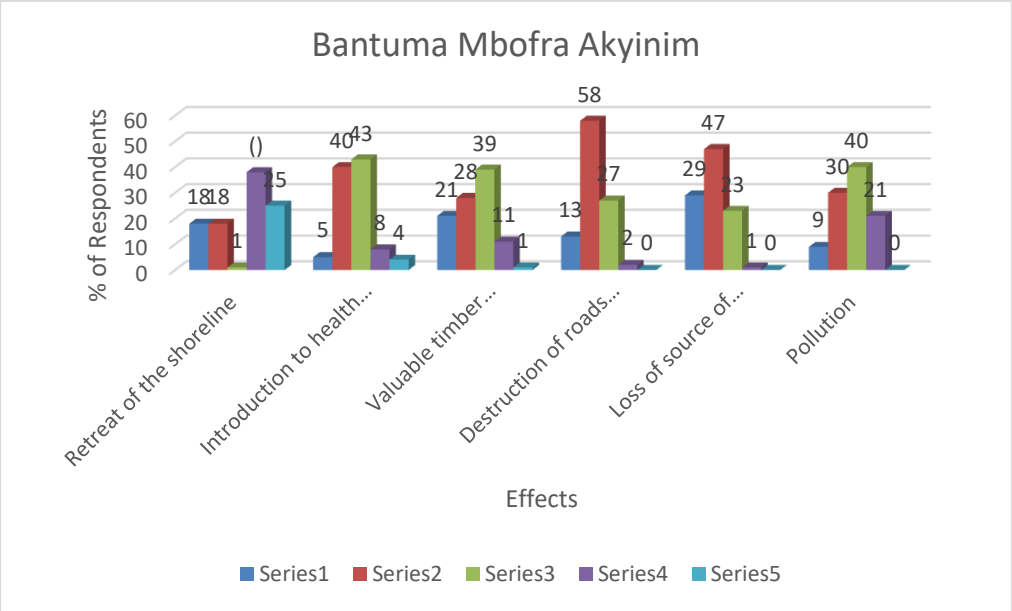


Figure 15: Effects of illegal sand mining in Bantuma Mbofra Akyinim.
Source: Field data, 2022.

Figure 16 represents the opinion of respondents on the adverse effects of illegal sand mining in Ola.

From the figure, the retreat of the shoreline (62.3%), destruction of roads and bridges by heavy duty vehicles (53.4%), introduction to health hazards (40.4%), loss of source of livelihood (39.9%) and pollution (33.6%) were the various effects of illegal sand mining indicated in Ola.

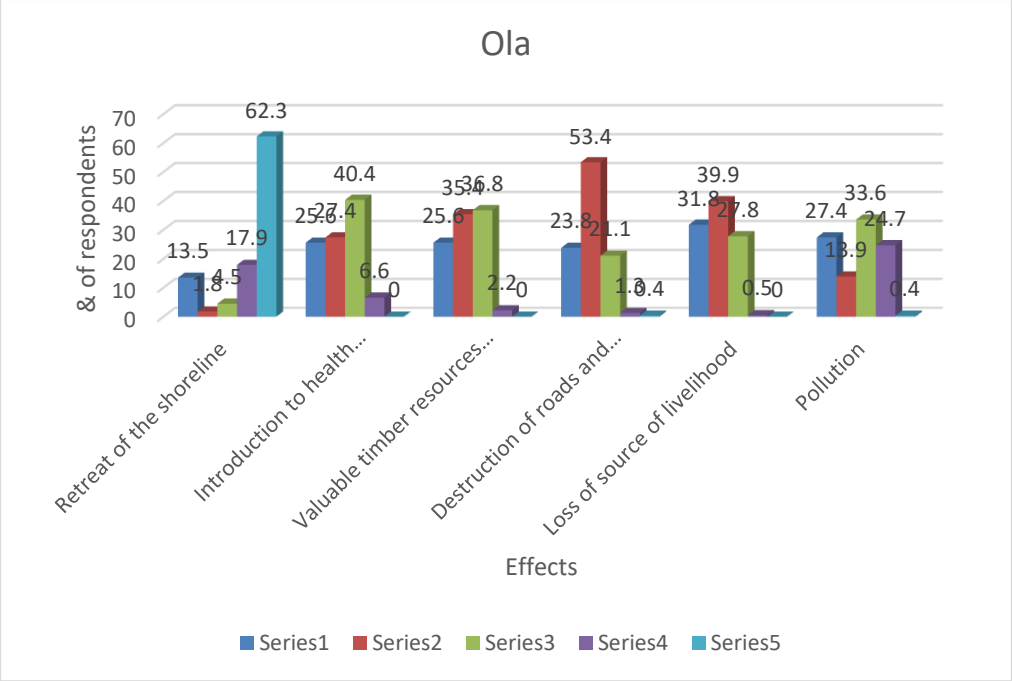


Figure 16: Effects of illegal sand mining in Ola.

Source: Field data, 2022.

From the data analysis, there is no doubt that illegal sand mining despite the benefits also has negative aspect. This implies the negative effects of these activities posed on the environment and the social lives of the people.

To start with, respondents saw retreat of the ocean as major effect of sand mining. This ranges from what they usually say as translated from the Fante and Ewe language that, ‘elders say that the sea is gradually coming into our homes’, to the incidents of coastal erosion they experience during the rainy season. Most of the respondents believe that their houses were likely to be flooded due to sand mining activities. This is further confirmed by studies that found out that coastal erosion is due to retreat of the coastline and the general deterioration of the quality of beaches which were attributed to illegal sand mining activities (Mensah, 1997; Armah, 2011; Jonah et al, 2015 and Mahadavan, 2019). Again, loss of livelihood is seen as an effect of illegal sand

mining, this is directly or indirectly due to coastal erosion. When the beach is eroded it devours homes, shops, farms and many sources of livelihoods that come along with it (Arthur, 2017; Johnbull, 2017; Beiser, 2018a and Torres et al., 2017b). The three communities of Bantuma- Akyinim, Ola and Ankwanda are made up of a lot of farms, beach resorts, fish processing buildings and shops that are found a few meters from the shore, therefore, when erosion takes place, most of these sources of livelihoods will be destroyed. This will affect the supply of food items, fish and other services that are rendered by these structures. There are relics of eroded structures that were found along the shores of these communities. Next, illegal sand mining pollutes the environment and air we breathe in. The miners litter around after eating and drinking, tipper trucks and tricycles also carry and transfer waste item such as diapers, polythene bags, bottles, cement bags and pits left after sand mining leaving these sites untidy and polluted. The carbon monoxide and the dust that are emitted by tipper trucks and other vehicles also pollute the air. These vehicles also disturb dwellings close to them due to the noise they make especially when they operate at night between 10pm and 5 am to avoid being detected by the authorities. (Lawal 2011; Madyise 2013 and Saviour 2012) agree that illegal sand mining causes air noise and land pollution which can disturb nearby houses and cause respiratory diseases such as the trigger for asthmatic conditions and irritation of lungs. Moreso, illegal sand mining is associated with health hazards. Illegal sand mining activities in Ankwanda and Bantuma Akyinim most especially have left remnants of their activities such as open pits filled with water which makes the nearby residents prone to Malaria. There were instances where open pits were dug a few meters from the

beach, these areas were mostly made up of purchased lands for residential and recreational purposes. Owners of the lands only visit their sites to find several pits around. This can cause accidents or unprecedented injuries on people who visit these areas. This result is in concordance with the investigations done by (Lawal, 2011; Arthur, 2017 and Popescu, 2018) who mentioned that the stagnant pools of water that were left behind by sand miners serve as a breeding ground for malaria causing parasite. Furthermore, illegal sand mining activities results in the destruction of aquatic species and nesting habitats. The sheer use of shovels to collects sand from these beaches destroys the habitats of species such as crabs and sea turtles who come to the shore to lay their eggs. To make matters worse, tipper trucks and tricycles pass over them to cause further destruction of aquatic habitats. This leads to loss of biodiversity, fish productivity and recreational potentials of these areas. (Ashraf et al, 2010; Arthur, 2017 and Jonah et al, 2015) all agree that illegal sand mining activities lead to loss of ecosystems and biodiversity.

Lastly, roads and bridges are destroyed as a result of illegalities of sand mining. Several tipper trucks move to and from the sand mining sites on several occasions, the movement of these trucks and that of tricycles destroy vegetation along their paths aside the compacting of ground, reducing the quality of roads and bridges. (schaezel 1990; Kuttipuran (2006) all agree that heavy duty vehicles and traffic affect the environment negatively.

Similarly, during the FGDs organized for males and females in each of the three communities, a lot of complaints were mentioned despite the numerous advantages.

Some of the effects mentioned from the FGDs were, coastline retreat, accumulation of pits which serve as a breeding ground for mosquitoes or accidents when filled with water.

A 34-year-old land owner in Bantuma- Akyinim, voiced his resentment as follows:

> *'It will be disastrous for one to obtain a land in this area, when you visit your site after a while, you will come back only to find several open pits on the land. Some were covered by the bush overtime so it may be a bit difficult to detect these pits. I nearly broke my leg the last time I went there when I mistakenly fell into one on my plot. This is very serious! Now, I have to fill all these pits before I can use the land productively'. (15th May, 2022).*

The above statement summarizes the plight of a land owner in Bantuma-Ayinim. This quotation is further endorsed by the study conducted by (Lawal, 2011) where open pits created by sand miners were seen to cause unprecedented accidents. The 62-year-old retired teacher who resides in Ola also expressed his worry below:

> *'I have lived in this community for over 30 years, when we were young, one could count about 20-25 coconut trees before one reaches the sea but nowadays, due to illegal sand mining activities, one can barely count up to 8 coconut trees before reaching the sea, this should inform you that the sea is gradually approaching our houses as the elders always say and it is very worrying'. (16th May, 2022).*

The above quotation depicts that the respondents believe that illegal sand mining activities were causing the coastline to retreat and this may cause them to lose their homes and sources of livelihood. This is further confirmed by investigations done by (Mensah, 1997 and Jonah et al, 2015) where illegal sand mining activities were attributed to coastal erosion as a result of shoreline retreat and beach deterioration.

Additionally, interviews conducted for key informants which include staff from the National Disaster Management Organization (NADMO), the Minerals Commission, the Environmental protection agency (EPA), the Cape Coast Metropolitan Assembly (CCMA) and the KEEA Municipal Assembly indicates that despite countless efforts taken to minimize the effects of illegal sand mining, the issue persists. Some of the effects reported from the interviews were exposure to coastal erosion and the displacement of aquatic species. The key informant 'B', mentioned that:

> *'As a result of these illegalities, aquatic animals are displaced. For instance, sea turtles and fishes lay eggs on the shore and go back into the sea after hatching. But due to activities like illegal sand mining, these aquatic species were displaced and this affects the quantity and quality of fish caught'. (16th May, 2022).*

The above statement is confirmed by the studies conducted by (Arthur, 2017 and Jonah et al, 2015) where it was concluded that sand mining activities can lead to loss of biodiversity, fish productivity and recreational potentials.

the key informant 'A' also expressed his sentiments as follows:

> *'It is a geographical phenomenon that heaps the sand and not man, as such the effect is long term not short term and that long term effect is the tidal waves. You notice that the number of coconut trees counted before one reaches the shoreline reduces due to tidal waves. It retards development done in these areas. When the sea begins to make its way into their homes, they begin to relocate to new areas along the coast.' (16th May, 2022).*

The above statement cements the issue of coastal erosion as a result of shoreline retreat as mentioned by majority of respondents. The above statement also goes in line with the studies conducted by (Mensah, 1997; Armah, 2011; Jonah et al, 2015 and Mahadavan, 2019) who attributed coastal erosion to sand mining activities.

According to the tenets of the common pool theory, the pursuit of the privatized gain by perpetrators of sand mining has eventually led to the devastating effects of these activities or the communized loss. This is due to the fact that sand miners only thought of their personal benefits they derive from sand mining which has eventually led to diminishing returns setting on sand.

Constraints faced in the fight against illegal sand mining along the Cape Coast-Komenda coastline in the Central Region of Ghana

Figure 17 illustrates the managements and policy constraints faced as a result of illegal sand mining along the coastline of the Central Region of Ghana. About 34% respondents were of the view that there were limited resources for management, followed by (21%) of respondents that think there

is an issue of unclear responsibilities among stakeholders, then weak coordination against local authorities (18%), inadequate legal framework (16%) and lack of support from government and other political parties (11%). The above findings were depicted in the figure below:

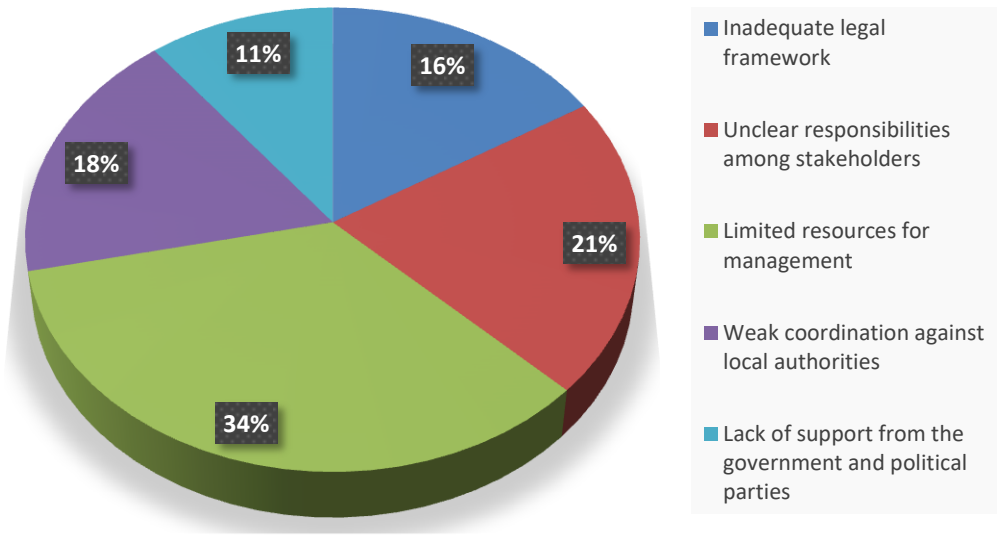


Figure 17: Constraints faced in the fight against illegal sand mining.

Source: Field data 2022.

From the data analysis, it is indisputable that there were so many challenges faced at the management level in their fight against illegal sand mining. Management in this context refers to NADMO, EPA, KEEA, CCMA and MC. Firstly, majority of respondents says there is a huge problem of limited resources for management. Resources such logistics in the form of cars, books for record keeping and human resources in the form of personnel. Most of agencies charged with the fight against illegal sand mining do not have cars to transport them to the sand mining site for monitoring, most especially when there is an impending monitoring for arrest. They end up

resorting to public transport which makes their work tedious. Again, the staff available were also not in good numbers as such it puts the burden on a few that were available. Most of the sand mining operations were held late at night, but the personnel available are not many and thus may be outnumbered by the miners. The 2017 report by the ad hoc committee of parliament to investigate the effects of illegal sand mining in the country also mentioned that most regulatory bodies were not able to perform their duties fully due to inadequate staff and logistics. (Dung & Phuong, le 2015 and Rai et al, 2019) further confirmed the above in their works, where they found out that one of shortfalls associated with the implementation of policies against illegal sand mining was capacity and resource constraints.

Secondly, the issue of unclear responsibilities among stakeholders. The stakeholders refer to the chiefs, municipal and metropolitan assemblies, and regulating bodies such as the EPA, NADMO, MC and NGOs. The above finding particularly applies to most, if not all of the regulating bodies. There is the problem of 'who is responsible for what?' as there were no laid down responsibilities for each staff, as a result, some officials easily shun some duties they deem undesirable. A study conducted by (Dung & Phuong, le, (2015) revealed that unclear responsibilities among stakeholders is one of the reasons for which illegal sand mining activities persist.

Furthermore, there's a weak coordination with local authority. This situation is very specific on the traditional authorities because per the 1992 constitution of Ghana, chiefs were seen as the custodians of the land hence, individuals perceive that they have to see them and pay a 'token' before sand is mined. The conflict lies in the statement in the same constitution that the

state owns the resources underneath, on and above the land and this has become a bone of contention between the state and customary institutions. Traditional authorities give the go ahead with the notion that they own the land. But government agencies come in to deem the activity illegal since no license has been obtained on the activity. Hence agencies bring letters to communities through their chiefs to put a halt to the illegal sand mining operations occurring but the same traditional authorities also give the go ahead for operations to resume after sometime, such is the case in Bantuma-Akyinim, but Ankwanda is a free zone for everybody to mine sand without repercussions. Studies conducted by (Dung & Phuong, le 2015 and Mark, 2021) identified weak coordination or lack of coordination between the government and customary institutions as one constraint that needs to be tackled in the fight against illegal sand mining.

Moreover, the legal framework on illegal sand mining is entirely inadequate as the mineral commission and the ministry for lands and natural resources do not go by the stipulated procedure for the exploitation of resources as per the Mineral and mining act, 2006 (Act 706) which suggests that the right for exploitation must be ratified by parliament. Also, a lot of individuals and companies are sand mining sand without any permit from EPA and no observable sanctions were taken on that, talk less of the bureaucratic procedure one has to follow before acquiring a license with a duration of 2-3years, hence impatient individuals will end up sand mining without any permit. This view is further affirmed by studies conducted by (Dung & Phuong, le 2015 and Mark, 2021) where inadequate legal framework is seen as a hurdle that needs to be tackled in the fight against illegal sand mining.

Another constraint faced by management in dealing with illegal sand mining is the lack of support from government and other political parties. Illegal sand mining activities that occur within these three communities were secretly fueled by individuals in top government positions. Some of these individuals own tipper trucks and tricycles that are used in their daily operations. As a result, these individuals have the backing of these politicians hence do not fear when they go about their activities. Culprits on several occasions have been arrested, only to be released immediately as a result of influences they have from individuals of high position. This has become a big headache to the regulatory bodies charged to fight against these illegalities. Studies conducted by (Mark 2021 and Mahadavan, (2019) identified corruption within government and authoritative positions as a major problem faced by regulatory bodies in tackling the illegalities in sand mining.

Additionally, the FGDs organized for males and females in the three communities enlisted some of the constraints that regulatory agencies meet in their work against illegal sand mining along the coastline of the Central Region of Ghana. most of the respondents mentioned corruption within top ranking officials and little or no knowledge of the legal framework on illegal sand mining. A 25-year-old student of the University of Cape Coast in Ankwanda expressed the above below:

> *'It is a bare fact that sand mining is illegal, but my worry is the officials who own the tipper trucks that are used in the operations, even the policemen who are supposed to stop these vehicles take monies at the check point at Ataabadze*

junction. Those who are supposed to fight the problem are the same ones fueling it' (16th May, 2022)

Another 46-year-old newspaper vendor in Ola said:

'There is no nothing to fight for here, because the officials who were supposed to solve the problem even ask town boys to mine the sand for them and mold bricks on the same spot to be used for their housing projects. I can boldly tell you that some staff at the assembly mine the sand and sell them to companies. If this is the case, my sister, whose quest is it to fight the sand mining issue?' (16th May,2022)

The above quotes denote the depth of corruption within government officials as mentioned by (Mark 2021 and Mahadavan, (2019) in their works.

Another 21-year-old lady in Bantuma -Akyinim also mentioned that:

'Madam, the issue is we were not even aware that there is the need for us to follow any procedure or acquire a license before we can collect sand. Most of our folks don't know about that. All we know is that it is against the laws of the land.' (16th May, 2022).

The above statement depicts that the community members were aware that sand mining is illegal, but less or little is known about the existing framework and its existence.

Again, most staff of the NADMO, EPA, KEEA, CCMA and MC were disgruntled by the shortfalls they have to deal with when it comes to illegal sand mining in Bantuma-Akyinim, Ola and Ankwanda so far as illegal sand mining activities were concerned. Some of constraints identified during the

interviews include inadequate personnel, fear for safety, inadequate logistics, enforcement challenges, no authority to arrest, misplacement of responsibilities, the vague nature of the law, disloyal officials, example the police, lack of corporation from traditional authorities and political interference. The key informant 'A' who was very perturbed about the who situation said in his own words:

> *'These activities are done in the night or weekend, when we get the tip that activities were ongoing, getting the personnel becomes an issue. Simply, no one is around, we are handicapped in personnel, getting them to even go and deal with the situation becomes a problem'* (16th May, 2022).

The above clearly denotes the inadequacy of personnel in these agencies as mentioned by (Mahadavan, 2019 and Rai et al (2019) in their studies that capacity and resource constraints is one of the major shortfalls faced in dealing with illegal sand mining.

Key informant 'B' expressed is sentiments in the quotes below:

> *'The laws were vague, it is not clearly stated that individuals should not mine sand, it is not categorically stated that sand mining is prohibited and punishment enumerated and the law does not mandate any official to mete any sanction(s) on the culprits, we only rely on the fact that, the coast is a holy land'*. (16th May, 2022)

Key informant 'C' also stated that:

> '*Many of the people don't know that sand is considered a mineral and certain procedures have to be followed before one*

> *can mine it. Those who know also find it frustrating concerning the procedure these miners have to follow before obtaining a license, some can take as long as three years, as a result of this, the miners rather go illegal'* (16th May, 2022)

The above quotes clearly denote the issue of how inadequate the legal framework concerning illegal sand mining is as stated by (Mark, 2021 and Dung & Phuong, le (2015) in their various enquiries the legal framework on the illegalities of sand mining is not adequately stipulated.

Again, the key informant 'A' expressed that:

> *'Most of the guys were hooligans, so going out there at night to deal with them, one has to think twice, because if you don't take care, your life is at stake'*. (16th May, 2022)

The above affirms the dangers involved as these regulatory agencies embark on their duties on illegal sand mining. This was stated in a report by an ad hoc committee of parliament in 2017 to investigate the effects of illegal sand mining. The governmental agencies explained to the committee that these illegalities take place at night and the miners were mostly armed with deadly weapons making it difficult to apprehend them.

The key informant 'A' again made a statement below:

> '*When we get hint of sand mining operations from whistleblowers, by the time you will contact the police, they were already gone. At times, you will arrest them and they will be calling 'people' for their rescue. Some even go to the extent of asking you whether you have the warrant to arrest them'* (16th May, 2022)

The above statement denotes the bitterness and the frustration these agencies go through in the hands of sand miners as a result of political backing mostly from high-ranking officials. This makes it very difficult for culprits for face the full rigors of the law. Studies conducted by (Mark, 2021 and Mahadavan, 2019) also identified that illegal sand miners have political support and becomes a big challenge for regulating agencies.

Opportunities for mitigation against illegal sand mining along the coastline between Cape Coast and Komenda in the Central Region of Ghana

The figure 18 illustrates the organizations involved in issues related to illegal sand mining along the coastline of the Central Region of Ghana. 45% representing about 174 respondents were aware that NADMO is a regulatory body that implements and enforces policies on illegal sand mining along the coastline of the Central Region of Ghana. Another 18% representing about 68 respondents knew that CCMA is a regulatory body that deals with issues concerning illegal sand mining. KEEA Municipal (17%) is also known to be related to issues concerning illegal sand mining in Ghana, the EPA (13%) and NGOs (8%) were also known agencies that handle illegal sand mining along the coastline of the Central Region of Ghana. The above findings were shown below:

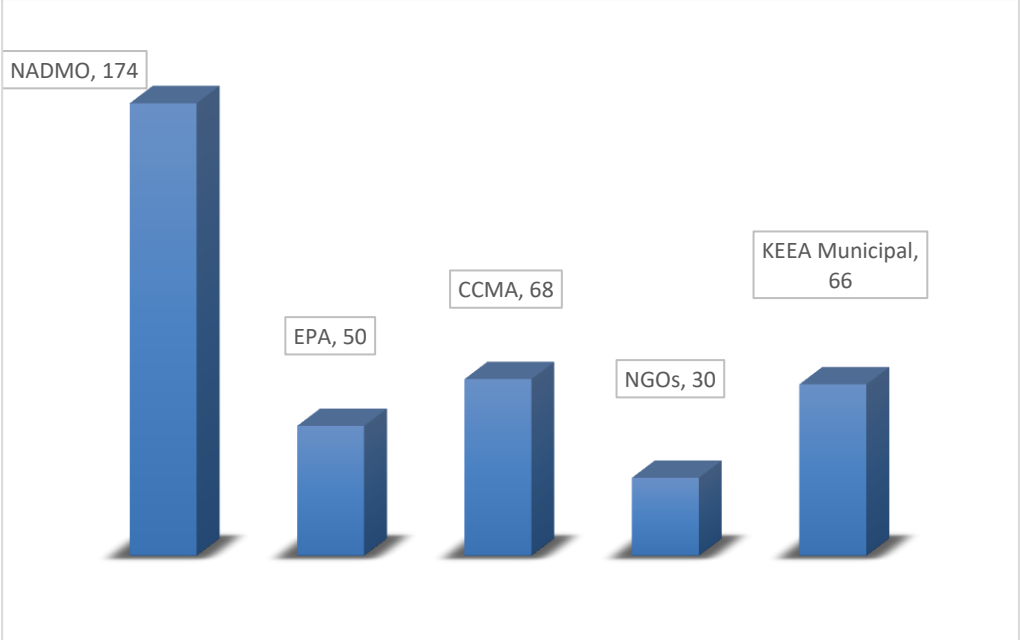


Figure 18: Organizations actively involved in dealing with issues related to illegal sand

Source: Field data 2022.

From the data analysis, respondents were of good knowledge that there exist regulatory agencies or bodies that tackle issues related to illegal sand mining along the coastline of the Central Region of Ghana. These include NADMO, KEEA Municipal, CCMA, EPA and NGOs. The aforementioned agencies were mentioned in the 2017 report of the ad hoc committee of parliament to investigate the effects of illegal sand mining in Ghana as regulatory bodies charged with the implementation and enforcement of policies associated with illegal sand mining in Ghana in general and the central coast of Ghana to be particular.

The figure 19 shows the opportunities for mitigation against illegal sand mining along the coastline of the Central Region of Ghana. 49% were of the view that laws on illegal sand mining should be enforced by high committee members. 20% suggests there an establishment of national

environmental watchdogs, indiscriminate opening up of plots for sand mining should be discouraged (19%), there should be a regulatory framework (9%) and the introduction of environmental assessment and monitoring program as part of extraction license (3%). The above information is illustrated below:

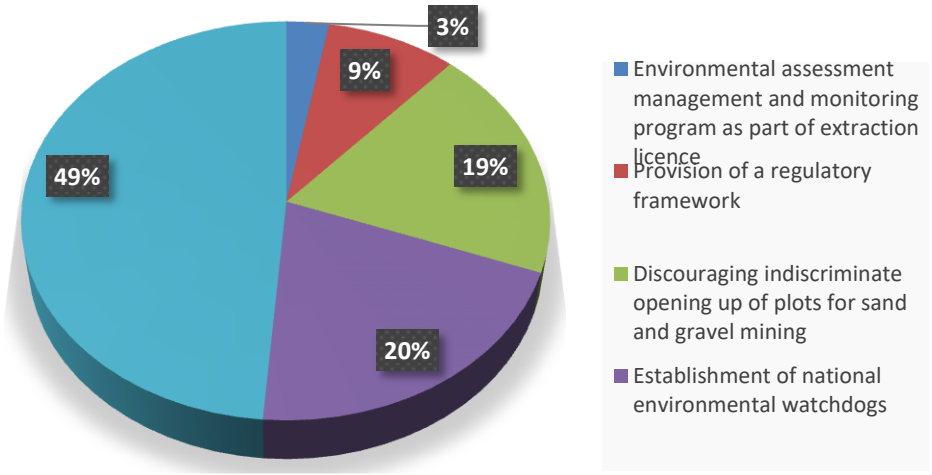


Figure 19: Opportunities for mitigation against illegal sand mining

Source: field data 2022.

From the data obtained, several initiatives were suggested as ways to deal with illegal sand mining operations along the coastline of the Central Region of Ghana. To begin with, the issue of illegalities of sand mining can be dealt with when laws were enforced by high committee members. The various staff of NADMO, KEEA Municipal, CCMA, EPA and NGOs have tried over the years to work hand in hand to deal with illegal sand mining operations. Although, challenges such as lack of corporation from other agencies, lack of authority to arrest and interference from people in higher positions makes the enforcement of laws against illegal sand mining in these three communities difficult. By implication, individuals or groups found culpable were to face the full rigors of the law. The 2017 parliamentary report on the effects of illegal sand mining suggested that the regulatory agencies such as NADMO, KEEA

Municipal, CCMA, EPA and other institutions should facilitate the prosecution of culprits found guilty of illegal sand mining devoid of external influences. Again, illegal sand mining can also be dealt with when there is an establishment of a national environmental watchdog of the country to deal with illegalities in the three communities in particular and Ghana as a whole. This implies an initiative where a group is established to observe, record damages made and take evidences of illegalities in sand mining both at the local and national level. This will go a long way to reduce, if not eradicate the illegalities of sand mining.

A study conducted by (Mwangi 2007) mentioned the institution of environment watchdogs of Kenya with a compiled guidelines to sand miners and traders in Eastern Province. The 2017 parliamentary report on the effects of illegal sand mining suggested the establishment of an adequately resourced taskforce made up of the Ghana Police Service, representatives from metropolitan, municipal and district assemblies, the EPA, NADMO and other agencies concerned to deal with issues concerning illegal sand mining. Next, the indiscriminate opening of plots should be discouraged. This can be done when the local authorities in conjunction with the Ghana Police Service, the EPA, NADMO, the Mineral Commission and where applicable can prosecute individuals or group guilty of opening plots to mine sand or made to pay exorbitant fine so as to serve as a deterrent to for impending culprits. Land owners can also report such cases to the authorities when necessary. (Lawal, 2011) encouraged Nigerians authorities to discourage individuals who arbitrarily open up plots to mine sand. Moreover, the provision of a regulatory framework or the introduction of legal strategies at both national and local

levels. The existing framework on illegal sand mining, that is the Mineral and sand mining Act 2006 (Act 703) is not very direct about how illegal sand mining is. Therefore, there is the need for the amendment or the provision of clewerer frameworks to serve as a guide for the regulatory bodies in their duel with sand miners. Also, the duration for the acquisition of license should be reduced to the bwerest minimum to encourage more potential miners to come for the license before sand mining sand and the penalty for illegal operations can also be increased to discourage such acts. The 2017 parliamentary report on the effects of illegal sand mining in Ghana suggested the amendment of Mineral and sand mining Act 2006 (Act 703) to provide a more decentralized system of acquisition of license on sand mining and the reduction of the procedures one has to follow before sand mining is done legally. Lastly, illegalities in sand mining can be dealt with when there is an environment assessment and monitoring program as part of the procedure in the acquisition of license, this should be done to minimize the adverse effects of sand mining. The environment should be assessed to identify the cost -benefit- effect of the impending sand mining operation so as to tell whether the license should be given or not, monitoring should also be done periodically to ensure sustainable sand mining. Studies conducted by Kondolf (2007) and Saviour (2012) suggested the initiation of environmental assessment and monitoring program and Environmental Management Plan for the U.S.A and India respectively as a statutory requirement for the acquisition of license to mine sand.

The FGDs organized for the three communities did not leave any suggestion behind on illegal sand mining. Possible solutions such as education, prosecution of culprits, the creation of pits on plots should be

discouraged, enforcement of laws, moderate collection of sand was suggested by some participants. A 22-year-old trader in Ola indicated:

> *'As for the collection of the sand, I know it is illegal but if you had not mentioned it, I would not have known that there were procedures one has to follow before we collect sand from the beach. At least the KEEA people should let us know.' (17 May, 2022).*

The above statement signifies that a few of the community members were awwere of the procedure for the acquisition of license, so far as they were concerned, one has to go to the beach to collect sand (although they know it is illegal). This implies the need for sensitization programs to be organized by the various regulatory bodies to create awwereness on the existing framework on illegal sand mining as mentioned in the 2017 parliamentary report on effects of illegal sand mining in the country.

Again, a 51-year-old man in Bantuma-Akyinim said:

> *'The collection of sand for sale or building has been there even before we were born, so we can't say they should stop it, but the digging of the pits becomes a headache for land owners, because they have to fill it otherwise, they might get hurt or can't use the land as they planned. That is my worry if only something can be done about it.' (17th May, 2022)*

The above quotation denotes the discouragement of the opening of pits by sand miners as mentioned by Lawal (2011) where Nigerian authorities were cautioned to discourage indiscriminate digging up of plots for sand and gravel sand mining.

The data collected from the interviews also entailed some mitigation measures that were suggested by the regulatory agencies concerning illegal sand mining, these agencies include but not limited to EPA, MC, NADMO KEEA, CCMA and KEEA Municipal Assembly. The suggested solutions included enforcement of the law devoid of all forms of interference, organization of skill acquisition training, review of the existing laws, clarity of responsibilities among the regulatory agencies, corporation from collaborating agencies, establishment of local taskforce, building of sea defense and education.

As said by the key informant 'A':

> *'The residents of these communities were mainly fishermen, so when the fishing does not go well for them, they resort to the sand mining, which is another easy way of getting money. So, I will suggest that the government introduces training models so that the youth especially can obtain some skill to augment the fishing, this will reduce the attention on illegal sand mining.' (16th May, 2022)*

The above sentiment denotes that there is the need for the government to organize training sessions for residents to provide more options for them apart from the fishing. They can be taught skills in tailoring, hair dressing, carpentry, masonry and many more to widen their options in the job market. This will divert their attention from illegal sand mining into their various wereas of training.

The key informant 'B' also mentioned that:

> '*The chiefs need to appreciate the effects of these illegal operations and stop allomineg them to collect the sand behind our backs, when they need anything, they can easily come to us for help, so there's no need to raise 'funds' through illegal sand mining'* (16th May, 2022).

The above view is calling for the need for local authorities to acknowledge the dangers posed by illegal sand mining so they can work together with the agencies to deal with the illegalities of sand mining.

He added that:

> '*The existing laws should be reviewed; it should be clearly stated that illegal sand mining is prohibited and penalties clearly stipulated.' (16th May, 2022)*

The above quotation denotes the amendment of the existing legal framework so that the various institutions can confidently implement and enforce the laws to reduce if not eradicate illegal sand mining along the coastline of the Central Region of Ghana and the entire Ghana. The 2017 parliamentary g on the effects of illegal sand mining proposed the amendment of the current legal framework to make legal sand mining more encouraging.

Summary

Sand mining activities were of significant importance to the development of the Ghanaian Nation. Despite the benefits it comes with, there were several adverse effects it has on the environment and the socio-economic lives of Ghanaians which were irreversible. Therefore, there is the need for mechanisms to be put in place so that the menace can be minimized if not entirely eradicated.

The illegal operations of sand mining call for response as stated in the DPSIR framework in order to minimize if not, eradicate the adverse effects of the canker.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Introduction

This chapter entails the summary, conclusion and recommendations on the causes, effects and management and policy constraints of illegal sand mining along the coastline between Cape Coast and Komenda of the Central Region of Ghana.

Key Findings

Summary

The main objective of the study is to assess sand mining along coastline of the Central Region of Ghana.

Specifically, the study seeks to:

1. Examine the causes of illegal sand mining along the coastline of the Central Region of Ghana.
2. Assess the effects of illegal sand mining along the coastline of the Central Region of Ghana
3. Evaluate the management and policy constraints concerning illegal sand mining along the coastline of the Central Region of Ghana.

According the first objective, it was observed that the respondents were defensive by giving reasons for which they engage in sand mining activities. The strongest reason given was that illegal sand mining served as a source of income, followed by free gift of nature, creation of jobs, urbanization and many more.

Based on the second objective, it was identified however that, the respondents also admitted to some extent that these activities come with some repercussions and they agreed strongly that illegal sand mining could cause retreat of the shoreline, loss of source of livelihood, pollution, introduction to health hazards and so on.

In accordance with the third objective, government agencies such as the NADMO, CCMA, KEEA Municipal, EPA and Minerals Commission in their attempts to regulate sand mining activities in the face of numerous setbacks most especially the limited resources for management, then the issue of unclear responsibilities among stakeholders, weak coordination against local authorities, inadequate legal framework and interference from high-ranking government officials.

Conclusion

Sand mining has been taking place in Bantuma-Mbofra Akyinim, Ola and Ankwanda since time immemorial, however, its incidence has escalated for the past few decades.

In addition, most of the sand mining operations were unregistered and mostly unregulated by state agencies who consider these operations as illegal. The study assessed illegal sand mining operations so as to have a detailed account of the activity. The investigator highlighted the views of the respondents through interview schedule survey, focus group discussions and interviews.

It can therefore be concluded based on the first objective that illegal sand mining comes with a number of reasons for which people undertake it which include creating jobs for the local people and a free gift of nature.

In addition, the objective two concludes that illegal sand mining has consequences it poses to the respondents, their environment and socio-economic lives. These effects include shoreline retreat and pollution.

The final objective also concludes that the enforcement of policies by regulatory bodies against illegal sand mining along the coastline between Cape Coast and Komenda of the Central Region of Ghana is accompanied by an array of challenges such as inadequate legal framework and weak coordination against local authorities.

This research concludes further that illegal sand mining in its present condition is unsustainable and the government agencies are losing their firm grip on the issue.

Recommendations

Based on the findings and conclusion and to also boost the benefits and decrease the adverse effects of sand mining operations, the study listed recommendations to the central government, regulatory bodies and the entire population in the selected communities and Ghana at large. Additional recommendations were also made for further research.

Based on objective one, the study recommends the following:

1. The regulatory bodies such as the CCMA, KEEA, EPA and Minerals Commission should come out with initiatives that provide alternative livelihood opportunities aside fishing in the selected communities, so they do not fall into illegal sand mining when the fishing does not go well. Modules such as Youth in Agriculture (YIA), Rearing for Food and Jobs (RFJs), Planting for Food and Jobs (PFJs) and many more

than can train and equip them to become tailors/seamstresses, carpenters, masons and so on.

2. There should be awareness creation and sensitization programs organized on topics affecting the environment where illegal sand mining is no exemption. This should be done by the regulatory bodies in collaboration with the Ministry of lands and natural resources.
3. The regulatory bodies should procure and position sign boards stating illegal sand mining as a prohibited endeavor must be increasingly placed at vantage points and sand mining sites and the punishment that accompanies it should be clearly stated.

Based on objective two, the study recommends the following:

1. There is the need for Environmental Assessment and Mentoring Program by the EPA to ensure proper measures were followed for a sustainable sand mining. The process should not end when sand miners obtain their licenses.
2. Measures should be put in place to reclaim abandoned pits created as a result of sand mining. This can be done by making contracted miners to post reclamation bond for future rehabilitation of dug pits after decommissioning. This can successfully be done under the supervision of KEEA Municipality, CCMA, NADMO, EPA, the Minerals Commission or where applicable.
3. Individuals and companies involved in sand mining must submit an Environmental Management Plan prior to operation to ensure that potential adverse effects of sand mining have been assessed and

included into the EMP. this will serve as a precondition to get a permit from the EPA.

4. Prospective and active miners must see to it that open pits are covered and refilled as reclamation in order to conserve the biotic nature of ecosystems. Afforestation can also be practiced in order to the control the rate of erosion on reclaimed land.

Based on objective three, the study recommends the following:

1. The existing legal framework on sand mining must be amended. This implies that the minister for lands and natural resources must submit a bill to parliament for the amendment of Minerals and Mining Act 2006 (Act 703). This can be done through a petition by the regulatory bodies for the delegation of some responsibilities of the ministry from the national level to the local level, such as the decentralization of the acquisition of license for sand mining. This will reduce the delays caused during the acquisition of license and encourage legal sand mining. again, the penalty for culprits should be increased from GHS 200 to GHS 1000 to serve as a deterrent to upcoming illegal miners.
2. Enforcement of existing laws, regulations and bye-laws associated with sand mining by the KEEA Municipality, CCMA, NADMO, EPA and the Minerals Commission. Bye-laws should be formulated in cases where there were not any.
3. An able task force that includes representatives from the KEEA Municipality, CCMA, NADMO, EPA and the Minerals Commission, should be deployed to be guard 24/7 to arrest illegal operators. Only licensed miners will be allowed in sand mining sites. Residents must

also serve as whistle blowers to aid in apprehending offenders instead of condoning such behaviors.

4. There should be opportunities given to EPA, NADMO and other regulatory agencies to recruit more staff in addition to the available staff to serve as a stronger front against illegal sand mining operators.

Recommendations for Further Research

The research conducted was inexhaustive and the investigator observed the need for further enquiry on the topic in the follomineg domains:

1. Other communities known for illegal sand mining can also be studied with more refined interview schedule survey.
2. A comparative study can be conducted during the rainy and the dry season to compwere and contrast the findings.
3. Further studies can be done on the alternatives for beach such as crushed stones from quarries or quarry dust.

REFERENCES

Adotey, J., Aheto, D. W., Asare, N., & Tenkorang, E. Y. (2015). Spatial and temporal analysis of beach elevations for monitoring coastal erosion for sustainable development: A case study of Ola Beach in Cape Coast. *Ghana Third Joint UCC-UNILORIN International Conference Proceedings.* University of Cape Coast, Ghana. (In press).

Agyemang, I. (2010). Population dynamics and health hazards of small-scale sand mining activity in the Bolgatanga and Talensi-Nabdam districts of the Upper East Region of Ghana. *Indian Journal of Science and Technology, 3*(10), 1113–1120.

Akankali, J. A., Idongesit, A. S., & Patrick, P. E. (2017). Effects of sand mining activities on water quality of Okoro Nsit stream, Nsit Atai local government area, Akwa Ibom State, Nigeria. *International Journal of Development and Sustainability*, *6*(7), 451-462.

Appeaning Addo, K. (2010). Changing morphology of Ghana's Accra Coast. *Journal of Coastal Conservation: Planning and Management.* https://doi.org/10.1007/s11852-010-0134-z

Armah, A. F. (2011). GIS-based assessment of shoreline changes in the coastal erosion-sensitive zone of Accra, Ghana. https://doi.org/10.3923/rjes 2011.643.654

Aromolaran, A. K. (2012). Effects of sand mining activities on land in agrarian communities of Ogun State. *Continental Journal of Agricultural Science, 6*(1).

Arthur, V. (2016). *The degraded sand mining site at Golinga, Northern Ghana.* United Nations University Land Restoration Training Programme. Retrieved from http://www.unulrt.is/static/fellows/docum ent/Arthur2016.pdf

Ashraf, A. M., Maah, J. M., Yussoff, I., Wajid, A., & Mahmood, K. (2010). Sand mining effects, causes and concerns: A case study from Bestari Jaya, Selangor, Peninsular Malaysia. *Scientific Research and Essays*, *6*(6), 1216-1231.

Bagchi, P. (2010). Unregulated sand mining threatens Indian rivers. *India Together*, *21*, 7-9.

Barwell, L. (2016). Coastal sand mining and its influence on coastline stability. *United Nations Environment Programme.* https://doi.org/10.18356/9ce803e8-en

Beazley, M. J., Martinez, R., Rajan, S., Powell, J., Piceno, Y., Tom, L., & Sobecky, P. (2012). Microbial community analysis of a coastal salt marsh affected by the Deepwater Horizon oil spill. *PLoS ONE*, *7*(7).

Beiser, V. (2018a). *The world in a grain: The story of sand and how it transformed civilization.* Riverhead Books.

Beiser, V. (2018b). Aboard the giant sand-sucking ships that China uses to reshape the world. *MIT Technology Review*. Retrieved January 16, 2019, from https://www.technolo gyreview.com/s/6215967/aboard-the-giant-sand-sucking-ships-that-china-used-to-reshape-the-world/

Beiser, V. (2018c). Dramatic photos show how sand mining threatens a way of life in Southeast Asia. *National Geographic News.* Retrieved March 15, 2018, from https://www.nationalgeographic.com/news/2018/03/ vietnam-mekong-illegal-sand-mining/

Bird, E. C. F. (1985). *Coastline changes: A global review*. John Wiley & Sons.

Blais, S. (2020). Le risque de pénurie de fioles à vaccin est réel, mais il existe des solutions. *L'actualité.* Retrieved December 13, 2020, from

https://lactualite.com/actualites/le-risque-depenurie-de-fioles-a-vaccin-est-reel-mais-il-existe-des-solutions/

BNEF. (2020). *Mafias, vanishing beaches, Bollywood chases: A sand story.* BNEF.

Boeije, H. (2010). *Analysis in qualitative research.* Sage Publications.

Borges, C. A., & Freitas, M. C. (2002). Dune, bluff and beach erosion due to exhaustive sand mining – The case of Santa Barbara Beach, São Miguel (Azores, Portugal). *Journal of Coastal Research, 36,* 89–95. https://doi.org/10.2112/1551-5036-36.sp1.89

Cai, F., Su, X., Lui, J., Li, B., & Lei, G. (2009). Coastal erosion in China under the condition of global climate change and measures for its prevention. *Progress in Natural Science, 19,* 415-426.

Carroll, R. (2008). Jamaican police left stranded after thieves steal a beach. *The Guardian.* Retrieved October 20, 2008, from http://www.theguardian.com/world/2008/oct /21/jamaica

Chandran, R. (2019). Sand mining 'mafias' destroying environment, livelihoods: U.N. *Reuters.* Retrieved May 7, 2019, from https://www.reuters.com/article/us-southeast-asia-mining-sand-idUSKCN1SD0K

Chilamkurthy, K., Marckson, A., Chopperla, K. S. T., & Santhanam, M. (2016). *A statistical overview of sand demand in Asia and Europe.*

Cohen, D., & Crabtree, B. (2006). *Qualitative research guidelines project.* Retrieved from http://www.qualres.org/HomeEval-3664.htm

Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed method approaches* (2nd ed.). Sage Publications.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Sage Publications.

Dharnadhikari, S. (2015). *Tragedy of the commons: Corrosive growth of the illegal sand mining mafia.* Retrieved January 26, 2025, from https://

www.thecitizen.in/index.php/en/NewsDetail/index/4/6137/ Tragedy-of-The-Commons:-Corrosive-Growth-of-the-Illegal-Sand-Mining-Mafia

Draggan, S. (2008). *Encyclopedia of Earth: Sand and gravel.*

DW.com. (2012). Sand mining decimates African beaches. Retrieved March 27, 2012, from https://www.dw.com/en/sand-mining-decimates-africa n-beaches/a-37546330

Edward, B. (2015). The insatiable demand for sand. *Finance & Development, December 2015.* Retrieved January 26, 2022, from https://www.imf. org/external/pubs/ft/fandd/ 2015/12/edwards.htm

Ekosse, G. (2004). *A handbook of environmental impacts of sand mining on soils around the abandoned Kgwakgwe Manganese Mine in Botswana.* Macmillan.

Erftemeijer, P. L. A., Riegl, B., Hoeksema, B. W., & Todd, P. A. (2012). Environmental impacts of dredging and other sediment disturbances on corals: A review. *Marine Pollution Bulletin, 64*(9), 1737–1765. https://doi.org/10.1016/j.marpolbul.2012.05.008

Esteves, L. S., Da Silva, A. R. P., Werejano, T. B., Pivel, M. A. G., & Vranjac, M. P. (2003). Coastal development and human impact along the Rio Grande Sul beaches, Brazil. *Journal of Coastal Research, 35*(Special Issue), 548–556.

European Environment Agency (EEA). (1999). *Environmental indicators: Typology and overview* (Technical Report No. 25/1999). https://doi .org/ISBN-1

Florida Department of Environmental Protection. (2020, September 18). *Why beach restoration | Florida Department of Environmental Protection.* https://floridadep.gov/rcp/beaches-funding-program/content/why-beach-restoration

Fritts, R. (2017). Sand mining ban lifted on beach in Suriname, causing public backlash.

Gavriletea, M. D. (2017). Environmental impacts of sand exploitation: Analysis of sand market. *Sustainability, 9*(7), 1118. https://doi.org/ 10.3390/su9071118

Ghana Statistical Service. (2014). *2010 population and housing census: District analytical report: Cape Coast Metropolis.* Ghana Statistical Service.

Ghana Statistical Service. (2014). *2010 population and housing census: District analytical report: Komenda-Edina-Eguafo-Abrem Municipal Assembly.* Ghana Statistical Service.

Goddard, J. (2007). *Land degradation and rehabilitation.* University of New South Wales Press

Goldberg, S. (2019). Demand for frac sand and concrete drives scarcity. *Investopedia.* Retrieved February 16, 2022, from https://www.investopedia.com/investing/demand-frac-sand-and-concrete-drives-scarcity/

Gomby, G. (2017). Sand in demand: Trapped behind dams. In J. Sills (Ed.), *Science, 358*(6360), 179. https://doi.org/10.1126/science.aap9525

Gondo, T., Mathada, H., & Amponsah-Dacosta, F. (2019). Regulatory and policy implications of sand mining along shallow waters of Njelele River in South Africa. *Jàmbá: Journal of Disaster Risk Studies, 11*(3), 12 pages. https://doi.org/10.4102/jamba.v11i3.727

Graham-Harrison, E. (2019, March 20). Hong Kong to build one of world's largest artificial island projects. *The Guardian.* https://www.theguardian.com/world/2019/mar/20/hon g-kong-to-build-one-of-worlds-largest-artificial-islands

Guba, E. C. (1990). *The alternative paradigm dialog.* Sage.

Gwimbi, P., & Dirwai, C. (2003). *Research methods in geography and environmental studies.* Zimbabwe Open University.

Hall, M. (2020). 6 things you need to know about sand mining. *Alchemer.* https://survey.alchemer.eu/s3/90255077/All-sites-Poll-2-Concern-on-COVID-19

Hammond, H. K., & Soe, C. (2019, March 10). 'Our land is collapsing around us': Ayeyarwady at risk from rampant sand mining. *Frontier Myanmar.* https://frontiermyanmar.net/en/our-land-is-collapsing-around-us-ayeyarwady-at-risk-from-rampant-sand-mining

Hanson, H., & Lindh, G. (1993). Coastal erosion: An escalating environmental threat. *Ambio, 22*, 188–195.

Hezekiah, O. A., Adeyemi, D. A. O., Akinyemi, O. O., Opafola, O. T., & Babalola, Y. A. (2020, July). Sand shoveling and related injuries among sand mine workers in Nigeria. *ScienceDirect.* https://www.sciencedirect.com/science/article/pii/S2468227 62030051X

Hill, L., & Kleynhans, C. J. (1999). Authorization and licensing of sand mining/gravel extraction in terms of impacts on in-stream and riparian habitats. *Journal of Mining Science, 15*, 17–19.

Hindustan Times. (2021, January 12). Sand price in Bihar shoots up by 30-40%, real estate sector hit. *Hindustan Times.* https://www.hindustan times.com/india-news/sand-price-in-bihar-shoots-up-by-30-40-real-estate-sector-hit-101610444159400.html

Hogue, C. (2020, September 22). Vials vital for COVID-19 vaccine. *Chemical & Engineering News.* https://cen.acs.org/materials/Vials-vital-COVID-19-vaccine/98/i37

Husrin, S., Prihantono, J., & Softyan, H. (2017). Impacts of marine sand mining activities to the community of Lontar Village, Serang-Banten. *Bulletin of the Marine Geology, 29*(2), 81–90.

John, E. (2009). The impacts of sand mining in Kallada River (Pathanapuram Taluk), Kerala.

Johnbull, W. S., & Brown, B. (2017). Socio-economic consequences of sand mining along the Victory River in Port Harcourt, Nigeria. *Asian Journal of Environment & Ecology*. https://doi.org/10.9734/AJEE/ 2017/34087

Jonah, F. E., Agbo, N. W., Agbeti, W., Adjei-Boateng, D., & Shimba, M. J. (2015). The ecological effects of beach sand mining using the ghost crab as biological indicators. *Environmental Science & Policy, 112*, 18–24. https://doi.org/10.1016/2015.05.001

Karikari, L. (2013). *The impacts of sand mining: A case study of Afigya-Kwabre District* (Unpublished BSc thesis). Kwame Nkrumah University of Science and Technology, Kumasi.

Koehnken, L., & Rintoul, M. (2018). *Impacts of sand mining on ecosystem structure, process and biodiversity in rivers*. WWF.

Kondolf, M. G. (2007). Geomorphic and environmental effects of instream gravel sand mining. *Landscape and Urban Planning, 28*(2–3).

Koranteng, A. K. (2021). The effects of sand mining on Ghana's economy. *African Eye Report.* Retrieved July 23, 2021, from https://africaneye report.com/the-effects-of-sand-mining-on-ghanas-economy/amp

Kuttipuran, M. (2006). *Rivers: Physical modifications*. Singapore: Donnelley.

Lamb, V., Marschke, M., & Rigg, J. (2019). Trading sand, undermining lives: Omitted livelihoods in the global trade in sand. *Annals of the American Association of Geographers, 109*(5), 1511–1528. https://doi.org/10.1080/24694452.2018.1541401

Langer, W. H. (2003). A general overview of the technology of instream sand mining of sand and gravel resources, associated potential environmental impacts, and methods to control potential impacts. *USGS Open-File Report OF-02-153*.

Larson, C. (2018). Asia's hunger for sand takes a toll on endangered species. *Science | AAAS*. Retrieved February 28, 2018, from https://www.sciencemag.org/news/2018/03/asiashunger-sand-takes-toll-endangered-species

Lawal, P. O. (2011). Effects of sand and gravel mining in Minna Emirate Area of Nigeria on stakeholders. *Journal of Sustainable Development, 4*, 193–199.

Lempriere, M. (2017). Can sand mining ever be green? *Mining Technology*. Retrieved June 19, 2017, from https://www.mining-technology.com/ features/featurecan-sand-mining-ever-be-green-5842185

Lupande, F. (2012). Zimbabwe: The high cost of sand. *The Herald, 34*(8).

Madyise, T. (2013). *Case studies of environmental impacts of sand mining and gravel extraction for urban development in Gaborone* (Master's thesis, University of South Africa).

Mahadevan, P. (2019). *Sand mafias in India—Disorganised crime in a growing economy*. Global Initiative Against Transnational Organized Crime.

Mark, M. (2021). *The governance of global sand mining* (Master's thesis, University of Waterloo, Canada).

Marschke, M. (2016). Chapter six: Fisheries transitions in Southeast Asia. In M. Caballero-Anthony & R. Barichello (Eds.), *Natural resource management for sustainable growth* (p. 166). Singapore: S. Rajaratnam School of International Studies (RSIS), Nanyang Technological University.

Marschke, M., Rousseau, J.-F., Schoenberger, L., & Hoffmann, M. (2020). Roving bandits and looted coastlines: How the global appetite for sand is fuelling a crisis. *The Conversation*. Retrieved May 4, 2020, from http://theconversation.com/roving-bandits-and-132412

Masalu, D. C. P. (2002). Coastal erosion and its social and environmental aspects in Tanzania: A case study in illegal sand mining. *Coastal Management, 30*, 347–359.

Mensah, J. (1997). Causes and effects of coastal sand mining in Ghana. *Singapore Journal of Tropical Geography, 18*(1), 69–88. https://doi .org/10.1111/1467-9493.00005

Mensah, J., & Mattah, A. D. P. (2023). Illegal sand mining in coastal Ghana: The drivers and the way forward. *The Extractive Industries and Society, 13*. https://doi.org/10.101 6/j.exis.2023.101224

Meynen, N. (2017). Concrete or beaches? World's sand running out as global construction booms. *The Ecologist*. Retrieved October 22, 2019, from https://theecologist.org/2017/may/09/concrete-or-beaches-worlds-sand-running-out-globalconstruction-boom

Mngeni, A., Musampa, C., & Nakin, M. (2016). The effects of sand mining on rural communities. *Sustainable Development and Planning, 443–453*. https://doi.org/10. 2495/SDP160371

Mongabay Environmental News. (2021, March 27). *Sand mining ban lifted on beach in Suriname, causing public backlash*. Retrieved from https:// news.mongabay.com/2021/03/sandmining-ban-lifted-on-beach-in-suriname-causing-public-backlash

Montagne, D., Cornu, S., Forestier, L. L., Hardy, M., Josière, O., Caner, L., & Cousin, I. (2008). Impact of drainage on soil-forming mechanisms in a French Albeluvisol: Input of mineralogical data in mass-balance modeling. *Geoderma, 145*, 425–438.

Morgan, K. M., & Kench, P. S. (2016). Parrotfish erosion underpins reef growth, sand talus development, and island building in the Maldives. *Sedimentary Geology, 341*, 50–57. https://doi.org/10.1016/j.sedgeo. 2016.05.011

Muangi, S. (2007). *Management of river systems in East Africa*. Nairobi: Macmillan.

Naik, P. K., & Jay, D. A. (2011). Distinguishing human and climate influences on the Columbia River: Changes in mean flow and sediment transport. *Journal of Hydrology, 404*(3–4), 259–277.

NOAA. (2017). *National Centers for Environmental Information, Monthly Global Climate Report for Annual 2017*. Retrieved January 17, 2025, from https://www.ncei.noaa.gov/access/monitoring/monthly-report/ global/201713

NOAA. (2020). How does sand form? *National Ocean Service Website*. Retrieved from https://oceanservice.noaa.gov/facts/sand.html

Obura, D. (n.d.). Why Kenya must take control of sand harvesting off its coast. *The Conversation*. Retrieved March 1, 2022, from http://theconversation.com/why-kenya-must-take-control-of-sand-harvesting-off-its-coast-113952

Owen, D. (2017). The world is running out of sand. *The New Yorker*. Retrieved March 16, 2022, from https://www.newyorker.com/magazine/2017/05/29/the-world-is-running-out-of-sand

Padmalal, D., & Maya, K. (2014). River sand mining and sand mining methods. In D. Padmalal & K. Maya (Eds.), *Sand mining: Environmental impacts and selected case studies* (pp. 23–30). Springer Netherlands. https://doi.org/10.1007/978-94-017-9144-1_3

Parliament of the Fourth Republic of Ghana. (2017). *Effects of illegal sand mining in the country: Ad hoc committee report*.

Pearce. (2019). The hidden environmental toll of sand mining. *Yale E360*. Retrieved from https://e360.yale.edu/features/the-hidden-environmen tal-toll-of-mining-the-worlds-sand

Peduzzi, P. (2014). Sand, rarer than one thinks. *UNEP Sioux Falls.* Retrieved November 16, 2020, from https://na.unep.net/geas/getUNEPPageWithArticleIDScript.php? articleid=110

Peprah, K. (2013). Sand mining and land degradation: Perspective of indigenous sand miners of Wa, Ghana. *Journal of Environment and Earth Science, 3*(14).

Pereira, K. (2012). Illegal sand mining: The unexamined threat to water security in India. Retrieved from http://www.ismenvis.nic.in

Pielou, E. C. (1966). Species diversity and pattern diversity in the study of ecological succession. *Journal of Theoretical Biology, 10*(3), 370-383.

Popescu, A. (2018). Inside the ecologically damaging practice of illegal sand mining. *Pacific Standard.* Retrieved from https://psmag.com/environ ment/people-were-stealing-sand

Prakasan. (2020). Here's why the Indian construction industry needs more skills in this fast-paced era. *India Today*. Retrieved February 2, 2022, from https://www.indiatoday.in/ education-today/jobsand-careers/story/ here-s-why-indian-construction-industry-needs-more-skills-in-this-fast-paced-era-1645985-2020-02-1

PTI. (2019). Four labourers killed during illegal sand mining operations in Bundi. *The New Indian Express.* Retrieved from http://www.newindian express.com/nation/2019/mar/27/four-labourers-killed-during-illegal-sand-mining

Rege, A. (2016). Not biting the dust: Using a tripartite model of organized crime to examine India's sand mafia. *International Journal of Comparative and Applied Criminal Justice, 40*(2), 101–121. https://doi.org/10.1080/01924036.2015.1082486

Roos, P., & Van der Werf, J. (n.d.). Mega-scale sand extraction from the North Sea. Retrieved January 12, 2022, from https://hydro-international.com/ content/article/mega-scale-sand-extraction-from-the-north-sea

Salopek, P. (2019). Inside the deadly world of India's sand mining mafia. *National Geographic.* Retrieved from https://www.nationalgeographic. com/environment/2019/06/inside-india-sand-mining-mafia/

Saviour, N. M. (2012). Environmental impacts of soil and sand mining: A review. *International Journal of Science, Environment and Technology, 1*(3), 125-134.

Schaetzl, R. (1990). Sand and gravel mining for aggregate. Retrieved from https://www.msu. edu/-soils

Sheldrake, S. (2013). Diving into the sandstorm. Retrieved October 15, 2021, from http://ocean.si.edu/conservation/habitat-destruction/diving-sand storm

Stebbins, M. (2006). Can gravel mining and water supply wells coexist? *University of Maine.*

Subramanian, S. (2017, April 20). How Singapore is creating more land for itself. *The New York Times.* Retrieved from https://www.nytimes.com /2017/04/20/magazine/how-singapore-is-creating-more-land-for-itself.html

Sumani, B. B. J. (2019). Possible environmental and socio-economic ramifications of sand and gravel mining in Danko, Upper West Region of Ghana. *Ghana Journal of Geography, 11*(2), 27-51.

Teye, J. K. (2012). Benefits, challenges, and dynamism of positionalities associated with mixed-method research in developing countries: Evidence from Ghana. *Journal of Mixed Methods Research, 6*(4), 379-391.

Torres, A., Liu, J. J., Brandt, J., & Lear, K. (2017). The world is facing a global sand crisis. *The Conversation.* Retrieved from http://theconver sation.com/the-world-is-facing-a-global-sand-crisis-83557

Tweedie, N. (2018, July 1). Is the world running out of sand? The truth behind stolen beaches and dredged islands. *The Observer*. Retrieved from https://www.theguardian. com/global/2018/jul/01/riddle-of-the-sands-the-truth-behind-stolen-beaches-and-dredged-islands

UNESCO Institute for Statistics. (2011). *International Standard Classification of Education (ISCED).* https://uis.unesco.org/sites/default/files/ documents/international-standard-classification-of-education-isced-2011-en.pdf

United Nations Conference on Environment and Development. (2002). Retrieved from http://www.johannesburgsummit.org

United Nations Environment Programme. (2014). Global governance and global rules for development in the post-2015 era: Policy note. *Committee for*

Development Policy, Economic and Social Affairs. Retrieved from https://www.un.org/development/desa/dpad/publi cation/cdp-policy-note-2014/

United Nations Environment Programme. (2019). Sand and sustainability: Finding new solutions for environmental governance of global sand resources. *GRID-Geneva, United Nations Environment Programme, Geneva, Switzerland.*

Wokorach, J. B. (2002). *Human and economic geography for BGCSE*. Mochudi: Salama Publishers.

World Wildlife Fund. (2018). Uncovering sand mining's impacts on the world's rivers. *WWF*. Retrieved from https://wwf.panda.org/our work/water/?333451/Uncovering-sand-minings-impacts-on-the-worlds-rivers

Yamane, T. (1967). *Statistics: An introductory analysis* (2nd ed.). New York: Harper and Row.

Yuill, B. T., Gaweesh, A., Allison, M. A., & Meselhe, E. A. (2016). Morphodynamic evolution of a lower Mississippi River channel bar after sand mining. *Earth Surface Processes and Landforms, 41*(4), 526–542. https://doi.org/10.1002/esp.3846

Zietlow, K., & Mulgund, A. (2019). Sand mining—Ghana's unspoken environmental catastrophe. Retrieved March 27, 2022, from https://studentsxstudents.com/coastal-erosion-due-to-sand-mining-in-ghana-4f9d11200b9b

APPENDIX A

INTERVIEW SCHEDULE FOR RESIDENTS AND THOSE AFFECTED BY ILLEGAL SAND MINING

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

UNIVERSITY OF CAPE COAST

RESEARCH TOPIC: *Illegal Sand mining: A Study of the Cape Coast-Komenda Coastline.*

I am an M-PHIL student of the University of Cape Coast, conducting a study on the aforementioned topic. I would be very grateful if you could support this study by completing this questionnaire and your candid response would be very much appreciated. The answers that will be given to these questions were purely for academic purpose and as a result, any form of information provided will be treated with utmost confidentiality and objectivity.

Instructions: kindly tick where appropriate and write your response where applicable or circle your answer as appropriate.

Thank you.

SECTION A: demographic information of the respondent.

1. Sex: A. Male B. Female
2. Age: A. below 18 B. 18-25 C. 26-35 d. 36-45 e. 46 and Above
3. Level of education.
   A. No formal education. B. Basic (primary/JHS) c. Senior high school/ TVET/ 'O' level education D. Tertiary education
4. Marital Status. A. Single B. Married C. Divorced D. Widowed
5. Religious affiliation. A. Christian B. Muslim. C. Traditional D. Other
6. Were you born here? A. Yes B. No
7. How long have you lived in this community? ……
   a. 1-9 b. 10-20 c. 21-30 d. 31-40 d. above 41
8. Occupation.
   a. Farmer
   b. Fisherman
   c. Trader
   d. Construction (Mason, Sand Loader, Block Maker)
   e. Teacher
   f Student
   g Others

Section B: Awareness and Causes of Sand Mining in the Central Region of Ghana.

9. Have you ever found sand mining activities in the community?
   a) Yes
   b) No

10. If No to Question 9 Were You Aware of the emergence of sand mining in your community along the seashore?
   a) Yes
   b) No

11. If Yes to Question 10, how did you become aware of the current problem?
   a) television announcement
   b) local announcement through the PAS
   c) district assembly announcement
   d) from colleagues

12. Which of the following best explains sand mining.
   a) Collection of Sand
   b) Collection of sea sand illegally from the shore.

13. What were the causes of illegal sand mining in central region of Ghana?
   a) Source of income
   b) Free gift of nature
   c) Urbanisation
   d) Increase demand for housing
   e) Increase in population
   f) Creates jobs for the locals

Section C: Effects of Illegal Sand Mining (environmental and social issues)

14. What were the effect of illegal sand mining in your community?
   a) Retreat of the shoreline
   b) Introduction to health hazards.
   c) Aquatic species and nesting habitats were destroyed
   d) Destruction of roads and bridges by heavy-duty vehicles.
   e) Loss of source of livelihood
   f) Pollution.

Section D: Constraints faced in the fight against illegal sand mining.

15. What were some of the challenges faced in the fight against illegal sand mining in your area?
   a) Inadequate legal framework
   b) Unclear responsibilities among stakeholders
   c) Limited resources for management
   d) Weak coordination against local authorities
   e) Lack of support from the government and political parties.

16. Which of these organisations actively involved in dealing with issues related to illegal sand
   a) NADMO

b) EPA
c) CCMA
d) NGOs
e) KEEA Municipal

17. The local initiatives against illegal sand mining in my area were:
    a) Chiefs and local people
    b) Chiefs and individuals
    c) Chief and elders
    d) Elders

Section E: Opportunities for mitigation against illegal sand mining.

18. The possible measures against illegal sand mining
    a) Environmental assessment management and monitoring program as part of extraction licence
    b) Provision of a regulatory framework
    c) Discouraging indiscriminate opening up of plots for sand and gravel mining
    d) Establishment of national environmental watchdogs
    e) The enforcement of laws by high committee members.

Recommendation

19. What can you recommend as the way to deal with illegal sand mining?
    A. Government should create more job
    B. Leave us to enjoy God's gift
    C. Prosecution
    D. There should be a penalty for perpetrators
    E. enforcement of laws
    F. education
    G. building of sea defence
    H. legislation

APPENDIX B

FOCUS GROUP DISCUSSION FOR MEN AND WOMEN

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING
UNIVERSITY OF CAPE COAST

RESEARCH TOPIC: *Illegal Sand mining: A Study of the Cape Coast-Komenda Coastline.*

Instruction: introduce yourself and explain reason for discussion.

Community Name:

Target Audience:

Total Participants:

Section A: Views on and Causes of Illegal Sand mining.

1. Have you ever found sand mining activities in the community?
   Yes [ ] No [ ]
2. what do you think is sand mining?
   Yes [ ] No [ ]
3. Do you think sand is a free gift of nature and as such any quantity can be extracted?
   Yes [ ] No [ ]
4. Why do think people mine sand?

Section B: Effects of Illegal Sand mining.

5. Do you think illegal sand mining affects the environment?
   Why (if yes or no)?
6. Do think illegal sand mining affects the socio-economic lives of people along the coast?

Why (if yes or no)?

Section C: Constraints in management and policy against illegal sand mining.

7. Has any good group taken initiative against illegal sand manning in the community?
8. Do you know that the government has prohibited the arbitrary extraction of sand?
   Yes [ ] No [ ]
9. If yes, to what extent do you think it has been effective?
10. What were some of the challenges faced in the management of policies against illegal sand mining?
11. In your opinion, were the measures taken by the government against illegal sand mining effective?
    Yes[ ] No [ ]

Section D: Opportunities for Mitigation against Illegal Sand mining.

12. What steps do you think should be taken by the government to minimize the occurrence of illegal sand mining?

APPENDIX C

INTERVIEW GUIDE FOR KEY INFORMANTS

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

UNIVERSITY OF CAPE COAST

RESEARCH TOPIC: *Illegal Sand mining: A Study of the Cape Coast-Komenda Coastline.*

Instruction: introduce yourself and explain reasons for the interview.

Section A: Personal Information of Participant(s).

1. Position and rank of participant……
2. Number of years served in current office……
3. Sex of participant……
4. Qualification……

Section B: Causes of Illegal Sand mining.

5. what do you think is sand mining?
6. Do you think sand is a free gift of nature and as such any quantity can be extracted?
7. Why do think people mine sand?

Section C: Effects of Illegal Sand mining.

8. What were the effects of illegal sand mining to the environment? .....
   .....
9. How does illegal sand mining affect the socio-economic lives of the people?.....

Section D: Constraints in management and policy against illegal sand mining.

10. What were some of the constraints faced in the management of policies against illegal sand mining?
11. In your opinion, were the measures taken by the government against illegal sand mining effective?
12. What role has your organization played in curbing illegal sand mining?.....
    .....

Section E: Opportunities for Mitigation against Illegal Sand mining.

13. What steps should be taken by the government to minimize the occurrence of illegal sand mining?
    .....
    .....