SAND AND GRAVEL EXTRACTION IN MELAMCHI MUNICIPALITY OF SINDHUPALCHOWK DISTRICT

A Thesis Submitted to the

APF Command and Staff College

Faculty of Humanities and Social Sciences, Tribhuvan University

In Partial Fulfillment of Master Degree in

Security, Development and Peace Studies

Submitted by

Radheshyam Dhimal

Sixth Batch (2077-2079)

Roll No. 4008

TU Registration No.: 7-1-25-0389-96

APF Command and Staff College

Sanogaucharan, Kathmandu, Nepal

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DECLARATION

I hereby declare that this thesis entitled **"Sand and Gravel Extraction in Melamchi Municipality of Sindhupalchowk District"** submitted to the APF Command and Staff College is entirely my original work prepared under the guidance and supervision of Dr Naresh Rimal. I have made due acknowledgement to all ideas and information borrowed from different sources in course of preparing this research paper. The result of this research paper has not been presented or submitted anywhere else for the award of any degree or any other purpose. I assure that no part of the content of this research paper has been published in any form before. I shall be solely responsible if any evidence is found against my research paper.

Radheshyam Dhimal

September 2022

LETTER OF RECOMMENDATION

This thesis titled **"Sand and Gravel Extraction in Melamchi Municipality of Sindhupalchowk District"** has been prepared by Mr Radheshyam Dhimal under my supervision and guidance. He has fulfilled the criteria prescribed by the Department of Humanities and Social Science, Tribhuvan University. Therefore, I recommend this thesis to the evaluation committee for its final approval.

…….

Dr. Naresh Rimal

(Supervisor)

Date: September 5, 2022

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LETTER OF APPROVAL

The evaluation committee has approved this thesis entitled **"Sand and Gravel Extraction in Melamchi Municipality of Sindhupalchowk District"** submitted by Mr. Radheshyam Dhimal in partial fulfilment of the requirements for the degree of Master in Security, Development and Peace Studies

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ACKNOWLEDGEMENTS

First of all, I express my profound gratitude to the Commandant and directing staffs of Armed Police Force Command and Staff College for their constructive and valuable guidance and kind support. I would like to express my sincere gratitude to my able supervisor Dr. Naresh Rimal for his unreserved guidance and mentorship throughout this journey. His sagacious advice, constructive criticism, patience, encouragement and being available have helped me greatly while undertaking this study. I would also like to extend my sincere gratitude to Prof. Dr. Ramesh Raj Kunwar for his valuable guidance and suggestion during the preparation of this paper. It's my pleasure too to register appreciation to my friends and peers who supported me in one way or another in this journey. I wish to thank the Melamchi municipality, residents and Sand Mining industry fraternity for providing the data I needed to accomplish this study. In the same vein, I appreciate all the anonymous respondents who took part in providing information reported in this work.

ABSTRACT

Contemporarily, riverbed material extraction is one of the serious environmental problems globally. The use of such river materials from the Indrawati River in Melamchi Municipality is also the key component supporting the urban infrastructure development supporting rapid urbanization in nearby Kathmandu Metropolitan City (KMC) and other areas. The indirect challenges to the socio-economy and impact on the air, water and biodiversity are key concerns in the area. The qualitative study helped understand the perception of sand mining in the study area leading to a broader need for attention to the governance and coordination between the stakeholders and government agencies for enhanced social and environmental management. Reclamation of abandoned sand pits; tree planting and agro-forestry practices to speed up the slow rate of natural succession by reduction of negative activities such as perennial bushfires, over-cultivation of lands, and over-grazing to reduce the nutrient depletion rate. Sand, gravel and boulder extraction activities reduce land socio-economic value by causing land degradation, loss of agricultural lands, low availability of water and low quality and loss of biodiversity as well as increased poverty among people in the area. Finally, compliance with statutory laws to regulate the conduct of sand mining on a sustainable basis for the sake of reducing its negative effects on the environment, economy and society is a critical aspect of the sand, gravel and boulder extraction in the municipality.

Keywords: *Sand, Gravel, Socio, Economy, Impact*

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ACRONYMS

CBS	Central Bureau of Statistics
DCCO	District Coordination Committee Office
DDMC	District Disaster Management Committee
DG	Deputy General
DHS	Department of Hydrology Station
DOTM	Department Of Transport Management
EEA	European Environmental Agency
EIA	Environment Impact Assessment
EPA	Environmental protection agency
FGD	Focus Group Discussion
GVW	Gross Vehicle Weight
MPITD	Ministry of Physical Infrastructure and Transport development
IBM	International Business Machines
IEE	Initial Environmental Examination
MFAGA	Ministry of Federal Affairs and General Administration
MMO	Melamchi Municipality Office
NEMA	National Environment Management Authority
SBD	Soil Bulk Density
SGESMS	Sand and Gravel Extraction Sales and Management Standard
SPSS	Statistical Package for Social Sciences
UNEP	United Nations Environment Programme
USD	United States Dollar

CHAPTER I

INTRODUCTION

1.1 Background of the Study

Soil is a cheap natural resource made up of gravel, sand, clay, and loam which constitute different types. Pit sand, river sand and gravel are components of soil which take years to be formed but are extracted in a matter of days. Rivers all around the world are under massive pressure because of diverse types of anthropocentric activities, among them indiscriminate extraction of sand and gravel which is disastrous as the activity threatens the river ecosystem (Mathias Kondolf, 1994). Rivers are equally essential in making economic, social, religious and cultural history in the region via which they flow. Rapid industrialization, urbanization and associated improvement have led to the exploitation of the river bed substances like sand and gravel. Sand and gravel are underground geological resources formed from eroding mountain rocks carried by streams and rivers. Soil has many uses and it is needed for agriculture, as a habitat and in construction but the genesis of the cash economy brought profits-driven companies to be involved in its mining both legally and illegally with some having no regard for the environment (Mwangi, 2007).

Sand and gravel and boulders extraction is an activity referring to the process of harvesting sand from an open pit or areas where they can be found in larger quantities such as rivers, streams and lakes. Sand mining also removes sand from its natural configuration (Ashraf et al., 2011). Sand mining refers to the actual process of removal of sand from a place of occurrence (Langer, 2003). Global extraction is an emerging issue with major socio-political, economic, and environmental implications. As such, an effective global sand governance system is a pressing need (Torres et al., 2017). The demand for sand is growing around the world, particularly in developing countries such as Nepal, India, China, and Kenya where the rapid economic development causes strong growth in the construction industry. The global sand harvesting concerns about environmental impacts are increasing, with reports from other countries for example China (Xu et al., 2021), Ghana (Mensah, 1997) and India (Padmalal & Maya, 2014). China plays a significant role in the sand industry as both a consumer and a producer, consuming more sand for construction purposes between 2011 and 2013 than the

United States did throughout the entire 20th century (Beiser, 2019). In 2017, China was importing one billion tons of sand annually, five times its annual coal imports (Meynen, 2017).

1.1.1 Sand and Gravel Extraction and Its Impact

Consequently, it has been argued that because of this globalizing extent and the magnitude of its impacts sand harvesting should be considered an aspect of global environmental change (Mingist & Gebremedhin, 2016). Unscientific and haphazard sand harvesting, on many occasions, leads to severe environmental problems in river basin environments that need immediate attention and corrective measures. In Nepal sand and gravel extraction has also been reported along major river banks all over the country and therefore there is a need to establish the effects of sand mining on the socio-economic lives of the people who live in the Indrawati River of Sindupalchowk area where these activities are carried out. In the Indrawati River, sand and gravel extraction are causing environmental degradation thus affecting socio-economic development though many agree that it has led to job creation among the youth, and children living in the area. The unfavourable impacts of sand mining can be both physical impacts together with well-known alterations of soil morphology. It also can result in biological impacts together with lowering water great and ecological impacts inclusive of lack of habitats and species disturbance, the eruption of diseases amongst others are the outcomes of sand and gravel extraction.

Nevertheless, mining of sand and gravel frequently generates land use conflicts (social conflict) in populated regions because of its poor consequences such as lack of biodiversity, truck traffic congestions, destruction of soil physicochemical association and properties, pollution, destruction of the natural habitats, quickens the price of erosion, and visually unpleasant landscapes. It additionally represents a conflict with competing land makes use of for activities consisting of farming, particularly in the areas where high-cost farmlands are extraordinarily inadequate. However, with the rapidly increased population in recent years as stimulated by the high fertility rate among other factors, the process of mining activities ultimately results in increased farmland availability, which further reduces farm yield something appears to be a grave concern for today’s world and for the people near Indrawati river and the central-Nepal, Sindhupalchowk in particular where the activity is to a great extent carried out. Sand mining as a worldwide economic activity has both positive and

negative impacts on the environment. (Gondo et al., 2019) noted that in the United States of America, many states such as California and Michigan rely on the mining of sand for roads and the construction of many other infrastructures.

The same activity is carried out in developing countries taking the example of India where the abundant supply of sand is rapidly diminishing (Johnbull & Brown, 2017). Lawal (2011) examined sand mining in Nigeria and highlighted that the activity is rapidly becoming an ecological problem as the demand for sand expands every day. Sand resources are used in the construction of strong structures which improve the socio-economic lives of most Nigerians however with notable negative environmental effects. (Mwangi, 2007) demonstrated the rate of sand mining in Kenya which is disturbing to the point that the government had to draft the National Environment Management Authority (NEMA), with a policy to apply to control all mining activities in the country. As more impacts are felt, there is a need for immediate environmental control and restoration. There is a need to consider the sustainable use of sand resources in project development with minimum environmental destruction for the benefit of not only the present but also the next generations (Johnbull & Brown, 2017).

Nepal, with the rapid population increase, has been experiencing many of the above-mentioned environmental resource challenges such as resource conflicts, resource overconsumption as well as environmental pollution-related problems. In recent years, Nepal is experiencing much sand mining occurring along riverbanks, while in Melamchi municipality, Sindupalchowk district occurs along Indrawati riverbanks, on the open farmlands. The increased human activities over the years have significantly contributed to the soil erosion issues evident throughout Sindupalchowk, Indrawati River. Sand and gravel extraction activities are widespread in Sindupalchowk district and to a large extent contribute to deforestation and land degradation among other notable environmental impacts. These practices often leave behind bare soils and large areas of gullies which usually collect water during rainy seasons while others are being permanently flooded. Water collected in these abandoned sand-mined pits results not only in health-related problems for neighbourhood communities but also causes several other negative impacts on biodiversity and ecosystems. Historically in Sindupalchowk District, the majority of farmers invested in acres of land for goat farming after 2018 to intensify the agricultural practices to produce both food and cash crops (Regmi, 2018). These farmers are small-scale farmers because they have smaller farmlands. This may be partly population pressure in some areas resulting in land

fragmentation as people expand areas for settlement and sand and gravel extraction. The process of expansion of human settlement in Kathmandu and nearby intensified sand mining activities taking agricultural lands become areas for mining. In addition to the steady increase in human population versus the high demand for economic development has led to increased environmental degradation like deforestation, water pollution, and excessive consumption of natural resources continue (Gupta et al., 2022).

1.1.2 Sand, Gravel and Boulders Extraction in Indrawati River

The economy of Nepal, until the mid of 2021, depended heavily on the exportation of cardamoms, wheat, vegetables and Soya bean oil (Prasain, 2022). However, as other countries of the world began producing the same crop more efficiently, the price for the Sindupalchowk district decreased and thus economy was weakened. This downturn caused Melamchi municipality to turn towards Sand gravel extraction as a quick replacement for wheat and vegetable production. The people near to Indrawati river economy are now primarily dependent on sand and gravel extraction, then manufacturing, fisheries, forestry, and wheat and vegetable harvesting. With these activities and the increase in population, therefore, there rises a large demand for construction materials such as sand and gravel in urban areas like Kathmandu. In Indrawati River; the control, maintenance, and management of non-renewable natural resources are under the Melamchi municipality, District Coordination Committee and District Disaster Management Centre. The principal aim of the Municipality and department's policy is to "protect, conserve, and develop natural resources for the social, economic and environmental benefit of present and future generations of the people of Sindupalchowk district". If adhered to, this stated aim and the policy would create an ideal environment for the conservation of the Indrawati River's both renewable and non-renewable resources. The nonrenewable resources in Indrawati River include sand, gravel, rocks, stones and soil but the exploitation of these resources is unsustainable and is resulting in less productive arable land as well as lowered biodiversity in certain areas.

The local and central government of Nepal, therefore, has agreed to attempt to minimize land degradation caused by overconsumption of sand and gravel non-renewable resources and to promote rehabilitation measures to the extraction sites through means such as replanting trees. Therefore, this study aimed to investigate the socio-economic impacts of sand and gravel activities in Indrawati River because of the additive and adverse impacts the process of

sand and gravel extraction can have on the river's soil erosion, local economies, community safety and the environment in general.

1.2 Problem Statement

Sand and gravel are the non-substitutable raw material in industrial construction worldwide which is used in everyday infrastructural development. It is typically produced by the mechanical and chemical breakdown of rocks. Sand once disaggregated from the source rock, is often eroded and transported by a natural agent like wind and water to their appropriate depositional environment (Jagodzi, 2010). Sindupalchowk district is being faced with environmental challenges, which in turn results in many serious crises and disasters such as landslides, risk of floods, drought, soil erosion, diminishing renewable natural resources, declining freshwater resources, poor waste management and increased pollution and the eruption of communicable diseases and food insecurity.

The CBS report shows that Kathmandu and other areas of Nepal have been witnessing the fastest growing rate of the human population (using increased fertility rate and immigration) in these recent years (CBS Nepal, 2021). Rapid population growth has led to an increase in demand for sand and gravel materials for housing and other infrastructural needs on the bank of the Indrawati River. Because of sand resource inadequacy, the communities usually once used all means to acquire land including agricultural reserve lands for sand and gravel extraction. In the Sindupalchowk District alone the farmers and residents constitute about more of the total population their number has been always increasing while the land resource near the Indrawati River is shrinking as much of these lands are devoted to extraction activities. These lands at once were mostly occupied by highly productive grown local food plants, and cash crops trees as well as medicine plants of high economic value and which serve as important means of livelihood for people. Most of these areas which were reserved for agriculture are now turned into unproductive land of sand and gravel mining abandoned pits. Unfortunately, private individuals and groups involved in the sand and gravel extraction activities engage in the destruction of the road and river bank which apart from denying farmers their productive land can also affect the natural balance of the environment.

Sand and gravel extraction in the Indrawati River has considerable effects on the water and air, loss of biodiversity, land degradation and soil pollution. It also results in a reduction of essential organic matter and the nutrients of the soil, reduces biological activities and

decreases the productivity of the soil. Though sand and gravel extractions have become an important economic and developmental activity in the Indrawaati River, their effects on the average household farmland, road and people's livelihoods cannot be estimated. Therefore, because of the scarce of study on the possible causal effect analysis on socioeconomic dynamism and the sand and gravel extraction activities in the Indrawati river of Melamchi municipality; this study, therefore, seeks to fill this gap by focusing on the social life of the people, their economic status and the general environmental consequences as a whole.

1.3 Research Questions

1.3.1 How sand and gravel extraction affect the environment and socio-economy of the community?

1.3.2 How legal provisions and standards govern/regulate sand and gravel excavation, sales and management?

1.4 Objectives of the Study

1.4.1 Examine the impacts of sand and gravel extraction and its challenges to communities.

1.4.2 Evaluate the legal provisions for sand and gravel extraction and management by the local government.

1.5 Significance of the Study

Sand and gravel extraction has a huge impact on people's livelihood, on land, air and water. Primarily, it reasons soil erosion, soil pollution, land fragmentation and degradation and a lack of biodiversity. As sand and gravel extraction activities were executed on suitable farmlands, the practice terrifies the health of the surroundings and the environmental stability in phrases of the natural food chain and food net amongst residing organisms. For although the activity has become an important economic activity in Indrawati River for most of the poor people, there is a little study that had been done about its possible impacts on the socio-economic status of the people in the current rapid rate of population growth. The outcome of this study will come up with useful and sustainable ways of practising sand and gravel

extraction such that people's lives and the environment will not be endangered to be utilized by both the existing the future generations to come.

This is to provide a source of data on the socio-economic impacts of sand and gravel extraction activities in the study area. Appropriate recommendations are also suggested for the reclamation of sand and gravel extraction pits based on the results obtained. This will not only ensure sustainable extraction of sand and gravel in the district but as well improve agriculture and reduce poverty among people living near to Indrawati river. Also, it, however, helped to improve environment protection agencies such as District Disaster Management Committee, District Co-ordination Committee and Melamchi municipality's database as well as assist in its awareness creation programs not only in the Sindupalchowk district where the activities are being carried out but, the country as a whole.

This study, therefore, is useful as can provide a framework and baseline point to the government to show how the communities and the ecosystems are being affected and come up with policy, rules and regulations recommendations to control excessive extraction of sand resources and mismanagement. Besides that, the study is important as it provides information about environmental changes in sand and gravel extraction activities. It also intended to provide awareness to society, especially local people, conservationist groups and many other stakeholders on the role of each citizen in the preserving and sustainable utilization of the sand and gravel resources for the benefit of today and future generations. Furthermore, the findings can be used as reference material for those who need to research the management of sand resources as well as to help Geographers in different fields of specialization.

1.6 Limitation of the Study

This study focused on examining the socio-economic impacts of sand and gravel extraction activities in Indrawati River, Melamchi Municipality. The interview administration was conducted during the harvesting season and this discouraged respondents' interest since they were too busy during the daytime. Therefore, this problem was solved by meeting the respondents for the face-to-face interviews in the evening and night time. The time was too limited for some respondents especially the government officials (at the Municipality's office, Entrepreneurs, and the Department of Nepal police) to meet and provide the required data to the researcher. Most of the time, the researcher communicated with them in the evening and morning. Some respondents were not open and confident to answer the questions, particularly

those questions touching illegal sand and gravel mining. This limitation was solved through assurance of their security and confidentiality.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter examines the literature relevant to the case study. It focuses on the general concept of the mining as an economic land use with particular reference to sand extraction activities, policy and regulations issues related to sand and gravel mining in Sindupalchowk, Melamchi municipality. It also focuses on the causes behind sand and gravel mining. The impacts of sand and gravel mining on the socio-economic status of the population, land use conflicts, agricultural development, biodiversity and biodiversity habitats loss, and finally it focuses on highlighting the potential for the sand and gravel extraction standard of government on the mine sited among other issues.

Many scholars have written about sand and gravel extraction and its socio-economic significance in Nepal and worldwide in general. Such scholars have examined the use and conservation of natural resources (sand) as well as how people perceived their use and sustainability. For instance, the poverty situation among the population is considered both a cause and impact of environmental degradation anywhere in the world, which also affects sand resources (Musah, 2009). Musah stated that the intensive use of sand resources causes a decline in agricultural production which in turn leads to a decline in the farmer's earnings. The scholar calls for better ways of sand exploitation to conserve the environment.

A study on assessment of the impacts of sand and gravel mining shows that the people near to Indrawati River at Melamchi Municipality constructed houses using traditional technologies and use local raw materials such as local trees, sand, lime and bamboo poles. It advocates that there is rapid population growth in Kathmandu and other urban areas which necessitated the urbanization processes to take place at a very fast rate. This resulted in the cutting down of many trees and clearing of forests for sand and gravel mining near rivers which are chiefly being used for construction purposes. Therefore, Sindupalchowk district is directly affected by sand and gravel mining activities as people meet the demands of another part of the country. Indrawati River contends that sands have been used over time as a source of construction work. It is always mentioned in Sindupalchowk district as one of the places that

are in danger of land environmental degradation in Nepal, stating that “it is currently suffering measurable degradation”. The concern about the increased pressure of commercial demand for sand and gravel, which if not checked, poses a threat to the future sustainability of the sand resources.

Sand and gravel as a resource are of great socio-economic value. It has several varied uses, among them, being used as a concrete constituent in the building and construction industry, as an abrasive (sandpaper and sandblast), as a source of silica for making sodium silicate, and used in foundries for moulding and parting. Thus, the importance of the resource cannot be overemphasized, and its uses are inevitable. River sand is one of the world’s most plentiful resources (20 % of the Earth's crust is sand) and can replenish itself. River sand is a natural resource that has utility and it can be extracted by humans to help them in earning a living. Natural resources are out there regardless, of whether or not human beings choose to use them to improve their lives. They are “neutral stuff” that make up the world, but they become resources when we find utility in them (Zimmermann & Hunker, 1964). Therefore, river sand is vital for human well-being and the sustenance of rivers. The human species is part of nature and should therefore participate effectively and gain from it. Its existence depends on its ability to draw sustenance from a finite natural world and its continuance depends on the ability to abstain from destroying the natural systems that regenerate the world. Economic activity must account for the environmental costs of production which includes labour. The maintenance of a livable global environment depends on the sustainable development of the entire human family through the use of natural resources in the improvement of living conditions (Brasso et al., 2012).

Natural resources are the basic building blocks in the production system, they are raw materials. Keller (1992) observed that little of their value is derived from human input such as labour; they generally have a lower value per unit than other commodities. In a few cases, natural resources have high value in the ground, but in this instance, it is the consumer that drives the price up if the demand is greater than the amount of resource available (Cutter, 2004). Therefore, natural resources like sand should be used properly to create jobs and improve people's lives. Resources when well used can improve the living conditions of the users. Economists view the resources that we extract from nature as a form of capital and just as traditional capitalist, systems seek to accumulate and re-invest monetary capital, ecological economist argue that natural capital should be regenerated rather than depleted (Hawken et

al., 2010). The environmental protection agency (EPA) calls for the development of a “sustainability consciousness toward a way of living that does not destroy the environment but keep it healthy for future use. Increased income for people is crucial for the sustainability of the family and the improvement of their living conditions.

Social scientists believe that real development lies in the economic empowerment of people and especially at the family level. It is believed that unemployment for people implies not only deterioration in their living standards but also an increase in their dependence on other people and loss of autonomy as well as security (Sen, 1989). Globally, sand and gravel are in great demand due to increased demand in the construction industry and should be of great economic benefit to the people who live in the area through accessing better education for their children. Globally, sand deposits are actively harvested on every continent except Antarctica (Brasso et al., 2012). In the United States, sand harvesting has been carried out in California, the Monterey Bay area, Georgia, Florida, Virginia and New Jersey.

In Australia, sand harvesting is carried out in the Kurnell peninsula where the harvesters use the money to invest in business activities and take their children to school while contributing to the construction of buildings. Though, as much as it has contributed to the improvement of people's lives, it has also led to the development of negative effects of sand including the permanent loss of sand in areas as well as habitat destruction (Brasso et al., 2012). A study by Borges (1992) in Acero archipelago Portugal found that sand harvesting impacted the social and economic growth of the archipelago in the 20th century, particularly in the last quarter of the century resulting in accelerated coastal development which included the construction of communication infrastructure and buildings all of which required a large volume of sand. Given the local geological constraints, natural and suitable aggregate in construction is a scarce natural resource. Construction, therefore, used beaches and dunes as principal aggregate sources, exploiting the weakness of legal constraints to these types of mining activity as well as the existence of proper coastal management plans. Sand and gravel extraction like any other economic activity can help the people in a given area in affording their basic needs given that it raises their purchasing power. A study by Deller and Schreiber (2012) on Franc Sand harvesting and Community Economic Development found that communities that are more heavily dependent on harvesting for employment tend to experience greater negative impacts after the mines close than positive impacts while the mines are in operation including the inability to afford basic health requirements. The study

also revealed that in many ways, sand harvesting can provide well-paying jobs leading to lower levels of poverty. But on the other hand, sand harvesting activity appears to be associated with poorer overall health levels within the community.

2.1.1 Supply of and Demand for Sand and Gravel

Potential mining sites are typically chosen based on the natural supply of any type of sand materials available, their quality, and land ownership. The demand for sand material relates to the increasing need for construction materials caused by abrupt demographic characteristic changes which approximately use 96% of the total amount of mined sand. Of the sand used in the construction, approximately 53% is used for residential and non-residential buildings. More than 60 to 70 tons of sand are needed to construct a single regular 6-room house, and approximately 30-40 trips per tripper per day of sand aggregate is needed to construct a social infrastructure such as a school or hospital. On top of that more than 10,000 tons of sand are being used to construct physical infrastructures such as roads and bridges. For although these values are rough approximations give some indication of the volume of materials used in daily building construction (Musah, 2009).

Currently, Sindupalchowk district is the sole supplier of sand and gravel in Kathmandu and other parts of the country due to the high demand for sand and gravel for housing construction; this in turn has resulted in the relevance of the theory of basic economic problem of ‘scarcity’ whereas the demands of natural good (human wants) far exceed its supply. There then, to maintain sustainability for sand resources, the decision was made in recent years leading to governmental interventions in sand resource management. With Nepal experiencing huge growth in real estate development which contributes to overall economic growth, effective policies are required to manage sand and gravel mining which is an important component in the construction process.

2.1.2 Sand and Gravel Mining

Sand and gravel mining is defined as the extraction of sand and gravel, mainly through open pits but sometimes mined from beaches and inland dunes or dredged from ocean and river beds for various uses, such as road construction material, housing material, filling materials and landscaping. Sand and gravel mining can be defined as activities associated with

extracting sand from the ground. Sand resources are obtained through mining extraction, and sand mining is the largest mining endeavour globally, accounting for 85% of material extracted from the earth (Pearce, 2019). The extraction phase of sand mining can take on several different forms depending on the size and location of the operation. The extraction methods include dredging, other mechanical methods such as bulldozers and excavators, and manually. The most common extraction method of industrial-grade sand is dredging (Beiser, 2019). This method uses a dredging boat in which sand is sucked up and pumped out from the sea or riverbed and onto a barge (Tweedie, 2018). Other mechanical methods use machines such as bulldozers, scrapers, and loaders, and can be used for the wet (extraction from below a body of water) or dry extraction of beach sand and dry intermittent stream beds (Padmalal, 2014).

Manual methods of sand extraction occur more frequently where large machinery is unavailable or unaffordable, including small, illegal mining operations (Hezekiah et al., 2020). This method consists of an individual extracting the sand using tools such as buckets, bags, or shovels; it is the least environmentally destructive compared to the previously mentioned mechanical methods. Although sand can be artificially manufactured by crushing coarser aggregates such as stone and gravel mined from a quarry, this analysis focuses on the mining of natural sand from the environment, particularly sand that is found along shallow waters of rivers. Sand and gravel extraction often occurs multiple times and at multiple sites from open land resulting in impacts that are likely to be both chronic and cumulative. When the rate of sand mining exceeds the rate of natural deposition over an extended period, numbers of remarkable problems occur due to the cumulative loss of sand (Ashraf, et al, 2010).

2.2 Impacts of Sand Mining

2.2.1 Ecological Dimensions and Impacts of Sand Mining

Sand is a natural resource that is overexploited by humans (Beiser, 2018; Mahadevan, 2019; Marschke et al., 2020). According to Weigand (1991), sand extraction activities negatively affect ecosystem balance. Some other adverse impacts of sand mining in the river or island may include loss of ability to hunt and gather, increased risk of flood and soil erosion, loss of soil fertility, loss of biodiversity, shortage of water resources, decreasing yields in

agricultural production, loss of freedom of movement of animals; plants and people, relocation of settlements, health hazards, and land use disputes between community members and mining groups, individuals and the government (Ashraf, et al., 2010).

Sand mining causes a wide range of ecological impacts including those related to erosion and wildlife (Lamb et al., 2019); Pearce, 2019). Sand mining has caused increased and accelerated erosion in areas such as riverbanks, coastal shores, and agricultural lands (John, 2009; Lamb et al., 2019; Masalu, 2002). Biomasses of both plants and trees can maintain or improve soil's physical properties and characteristics. Sand mining results in the clearing of vegetation cover; reduce essential nutrients; and organic matter of the soil, as well as biological activities, leading to adverse effects on the soil's physical property such as loss of biodiversity leading to land fragmentation and degradation (W. L. Daniels, Z. W. Orndorff, and P. D. Schroeder, 2003). All these therefore may cause low soil productivity in the areas affected by sand mining in Indrawati River, Melamchi municipality, and Sindupalchowk District. Soil Bulk Density (SBD) is defined as the mass per unit volume of dry soils (Ahmed, 2018). Sand mining decreases the soil bulk density of abandoned sites since it involves the removal of topsoil (soil organic matter) from the land. The soil bulk density is regarded as a key factor that is correlated with soil compaction and many chemical, physical and biological properties of soil (Ahmed Abed Gatea, 2018). Sand and gravel extraction has an impact on soil texture.

Soil texture is a composition of the size of soil particles that as sand, clay, clay and. Therefore, soil texture is defined as the particle size distribution of the fine earth fraction of less than 2mm. The texture of soil determines the nutrient supply ability of the soil as well as the ability of the soil to hold and conduct air necessary for plant growth. With the sand mining, the land lost its ability to support the growth of trees leading to the failure of agricultural activities and instead the abandoned sites turn into either temporary or permanent waterlogged grounds or depressions (R. B. Brown, 2004). Sand mining activities affect the soil's chemical properties which play very significant roles in the growth of trees. Sand mining activities deplete calcium minerals in the soil which may affect tree growth directly, simply by becoming deficient for growth. With the absence of tree cover in the mined areas as a significant factor for soil formation, the rate at which the soil naturally formed decreases respectively. Again, the destruction of soil pH balance leads to total deficiency in the soil and the productive capability of the soil. Land degradation is the changes that occur within the

land which negatively affect the structure or function of the land and thereby lower the capacity to supply its goods and services (FAO, 2001). Communities are especially impacted by erosion due to mining, as their livelihoods and homes can collapse into rivers that have been exploited for their sand (Beiser, 2018).

Among other factors sand mining activities worsen the burden of serious land fragmentation. Estimates indicate that about 50% of cropland surrounding Indrawati River will lose 2cm³ of soil every year as a result of soil degradation and erosion (Department of Forest and Soil Conservation Report, 2021). This results in a shortage of land and thereby escalating the problems of soil scarcity. Wildlife is also impacted by sand mining. When sand is extracted from a location and deposited elsewhere, wildlife and their nesting habitats can be suffocated or crushed (Larson, 2018; Sheldrake, 2013)**.** Sand mining on beaches or riverbanks compacts and crushes the sand and earth beneath it, while the depositing of sand (e.g., in beach replenishment) suffocates wildlife, and disrupts habitats and nesting areas which can have an impact on local fisheries (Erftemeijer et al., 2012; Sheldrake, 2013)

2.2.2 Social / Economic Dimensions and Impacts of Sand Mining

Sand mining also results in a wide range of social dimensions and impacts including those related to communities, conflict, health hazards, loss of livelihoods, and illegal mining (Hammond, 2019; Mahadevan, 2019: UNEP, 2019). Firstly, it is considered that conflicts resulting from natural resource exploitation anywhere in the developing countries are typically severe, resulting in violence, resource overexploitation and degradation, and if not addressed they can threaten the entire communities' life.

However, in the Sindupalchowk District, it is usually perceived that except for some of the village elders and a few district leaders, the majority of other communities. Members are usually not consulted in respect of the lands (usually farmlands) that are released for sand mining activities. Such perceptions have been over decades now having massive effects leading to social conflicts over land uses. The conflict between workers addressing equal amounts of wages and work division leads entire working area being affected. Sand mining activities generally have both negative and positive impacts on the local communities. Individual groups engaged in sand mining may contribute to the development of key socio-economic infrastructures and revenue collection; sand mining acts as a basic source of employment for local people, and triggers the establishment of a wide range of small

businesses such as catering and soft drink services. In Zambia for example, mining activities employ about 15% of the country's workforce (Popescu, 2018). Similarly, Nepal has got more employs than Zambia in sand and mining areas.

Sand mining can introduce health hazards such as malaria, or increased pollution (Popescu, 2018). The still pools of water left behind from mining provide a breeding ground for malaria-carrying mosquitoes, possibly exacerbating the rate of infection in the surrounding area (Popescu, 2018). The nonrenewable resources in Indrawati River include sand, gravel, rocks, stones and soil but the exploitation of these resources is unsustainable and is resulting in less productive arable land as well as lowered biodiversity in certain areas. Furthermore, apart from biodiversity loss, during the rainy seasons, the abandoned sand mining pits often fill with stagnant water, which provides an ideal breeding place for mosquitoes. This trend of increase in standing water could lead to elevated levels of different diseases diarrhoea, and malaria among people who depend on drinking water near Indrawati River if continued. Asia has significant sand harvesting, India, Karela, the activity is destroying the nature of the area, driving away tourists, business owners and residents and contributing to coastal erosion (Binoy, 2002).

A study has shown in river Periyar Karela India found that the annual demand for sand for construction purposes in Karela is estimated at more than 3 million tonnes. Collecting sand from rivers and its distribution has become an industry giving job opportunities to thousands. According to estimates, sand mining provides direct employment opportunities to over 60,000 registered laborers in the state. On average, each laborers earn several Rs. 150-200/- per day or even more from sand harvesting.60 % of the labors engaged in the activity and solely dependent on sand mining and are more than years. Similarly, a study on the socio-economic impact of sand and gravel mine surrounding Indrawati river in Sindupalchowk district, Nepal found out that the quarrying industry and associated other transport and related services industries have had an important role in the local economy of Melamchi municipality for many years (Annual report, 2021). On a national basis, quarrying has traditionally been probably second only to agriculture as a source of rural employment. The industry is one large employer that identified a lot of jobs associated with quarry ranging from manager labourers and truck drivers.

The mining of sand and gravel in Indrawati River, Melamchi Municipality, and Sindupalchowk district has created a job for youth. The revenue gained is used for the most

part to meet the basic needs of the family including food and to pay tuition for children. The laborers work in primitive conditions with the use of archaic tools (Shovel et al., n.d) and no guarantee of support in case of an accident. They earn an average of Rs 15000 – 25000 per month and the earnings are used to meet basic needs food, rent, medical care and children's schooling. Health diseases such as diarrhoea, stomach disorder, and hernias as well as sexual and physical weakness due to difficult working conditions were common without insurance. A study in Indrawati river sand and gravel extraction in Melamchi municipality, Sindupalchowk district found out that the process of sand and gravel harvesting had accelerated river environmental degradation at an alarming rate in many areas. The loss of land and destruction of property is due to soil erosion that leads to the loss of coastal land. While it is true that the sand users may be seen to be the main beneficiaries, there have been no studies that show that the process affects positively on the health and lives of the communities involved in the mining of sand and gravel in Sindupalchowk district and therefore need to look into strategies that the local authorities can ensure that the communities benefit from the activities. Sand and gravel harvesters are economically impoverished with some not able to afford medical services when they fall sick due to prolonged exposure to water-born diseases while contractors and transporters are getting richer.

Local police in Melamchi noted that sand and gravel mining in a rural area is causing the involvement chance of criminals and gangs to risk assisting their easy income in illegal sand and gravel mining. To some extent sand harvesting is increasing employment opportunities, it is also noted social and economic factors are the main reasons why people undertake sand and gravel mining. In the sand gravel mining area people are unemployed and underemployed which compels them to become sand carriers, sand loaders, and tally clerks to make ends meet. According to the department of transport Overloading of trucks is a common scene on the roads of Nepal. It is common to find trucks having as high as 18 to 20 tonnes against the legally permissible Gross Vehicle Weight (GVW) of 16.2 tons.

The truckers tend to overload assuming that carrying extra loads enhances their profits but at the expense of pavement damage and increased vehicle operating costs. Results of traffic volume and axle load surveys carried out by the DoTM in 2016 along the Prithwi Highway (at Naubishe/Dharke Dhading) is taken as the representative traffic volume and level of loadings on a typical road in Nepal. More than 20 crushing plants are engaged in extracting

stones from the Agra River along the Prithvi Highway in the district," according to Tufel Ahmed of the Revenue Department of the District Coordination Committee. Black stones from the river are shipped to crushing firms in Mahadevbesi, Eklephat, Satkilo, Naukilo, Thatre and Jungekhola. With 600-1,200 tractor-loads of stones being removed from the river daily, the water level has dropped by 3-5 metres. Similarly, it is happening in the Eastern part of Sindupalchowk district, Araniko Highway of Nepal from where sand and gravel loaded transported destructing highway daily move towards Kathmandu and another part of the country (Ministry of Physical Infrastructure and Transport, 2021). Sand and gravel mining can have a huge positive economic impact on the people involved in the business but fear that sand transporters are making a fortune in the Indrawati River while those scooping and loading it into Lorries are living in poverty with fears that sand scoopers are paid Rs.500 each for loading a lorry which fetches between Rs 20,000-30,000 in the city. While transporters continue to make huge amounts of profits, sand scoopers are not able to take their children to good schools. The local authority is planning to initiate the creation of industries to pack the sand which will then be sold in hardware stores like cement.

The carrying out a study on the effects of sand and gravel extraction on economic growth in Nepal with a case study of Sindupalchowk district established that in many areas along the river banks mining of sand and gravel on agricultural land is one of the alternative livelihood activities of the rural people and has now become a source of livelihood for many rural communities in Melamchi municipality, Sindupalchowk. All that needs to be done is to improve the activities so that they can be as beneficial to them as possible. A study on the impact of sand harvesting on the education of pupils in primary school in Sindupalchowk district found that sand and gravel mining negatively influence the education of pupils in terms of school attendance because most of them are involved in sand harvesting activities during school hours.

2.2.3 Sand and gravel mining governance

Sand is the least regulated resource globally, despite being the most extracted solid material by weight and volume (UNEP, 2019). Sand can often be seen as a freely available resource, and the demand from the construction industry has created opportunities for entrepreneurs in the formal and informal sectors across the supply chain (Barwell, 2016). Increasing demand has made the sand a highly valuable resource that has become a multi-billion-dollar industry

due to its widespread availability, combined with minimal regulations, enforcement, and monitoring (Beiser, 2018). In the context of South Asia, hundreds of people being beaten or murdered over sand mining have been documented, including local citizens, police, and government officials (Beiser, 2018; Bendixon et al., 2019). The fear of this violence can make monitoring sand mining operations and trade practices challenging and dangerous. The methods of sand extraction occur more frequently where large machinery is unavailable or unaffordable, including small, illegal mining operations (Hezekiah et al., 2020). This method consists of an individual extracting the sand using tools such as buckets, bags, or shovels; it is the least environmentally destructive compared to another method. The lack of regulations and enforcement has enabled illegal sand mining activity to run rampant, also infiltrating legal trade (Gavriletea, 2017; Torres et al., 2017).

Illegal sand mining activities include stealing and corruption, both of which often occur in tandem. Stealing sand can refer to the practice of extraction from explicit no-take areas including private land not belonging to the miner, or areas in which policy exists to protect the area (for example, a marine protected area) (Beiser, 2018; Tweedie, 2018). Corruption refers to the insider network made up of miners, police, political leaders and government officials facilitating illegal trade of sand with tactics including forgery of documents that alter the export/import amount or the extraction location; or bribery of enforcement officials, government officials, and other stakeholders. Sand and gravel mining in Nepal is underway at as many sites and almost all of them are operated by so-called dons who get the tender in their names by any means necessary (Kathmandu Post, 2014). Illegal sand mining is often driven by “Sand Mafias” across the globe, mainly in developing countries (Salopek, 2019).

Individual who is a part of the Sand Mafia is challenging as there is no evidence to suggest these groups are religiously or ethnically defined (Mahadevan, 2019). Therefore, an illicit sand mining group is considered a “Sand Mafia” once they begin to threaten any opponents (Mahadevan, 2019). Illegal mining operates on an opportunistic basis and can occur wherever a suitable sand deposit can be found (Mahadevan, 2019). Due to the expansive and diffuse locations of deposits, the monitoring and enforcement of any regulations have proven to be challenging (Popesco, 2018). Both the legal and illegal sand mines have been increasingly reported to be extracted from established biodiversity reserves and protected areas where subsequent impacts on habitat and wildlife have been reported (Koehnken, 2018). According to Carroll (2008), corruption within some members of the local police force was believed to

be involved. The sand industry is very lucrative; India is projected to be the third largest construction market while the illegal Sand Mafia generates approximately 17 million USD per month in revenue (Mahadevan, 2019; Rege, 2015). Despite destroying environments that support farming and fishing, sand mining provides employment. India's construction industry (which is mobilized by sand) employs approximately 51 million people (Prakasan, 2020).

In the context of Nepal, Mahakali and India's Teesta rivers have already big governance challenges with sand mining in Nepal and India (Rai & Neupane, 2019). Policymakers have attempted to respond to this through stringent regulations but given the market forces growing demand and limited supply of sand, illegal sand mining flourishes. Furth more, the extortion practices seem in Nepal were particularly intensive during the period of the Maoist revolutionary period (Adhikari, 2010). Extortion practices raised to an alarming scale, with many business owners from various industries such as the tourism, food, and beverage industry or yarsegumba trade complaining about the new "violent entrepreneurs" (Volkov, 2002) who had "captured" the political-economic landscape of the country throughout revolutionary time. Maoist ideology has inflected upon both the everyday textures and the organization of work. More specifically, radical political formations did manage to change the conditions of work for the industrial working classes (Hoffmann, 2020). According to Hoffmann (2020), the current economic situation of the sand miners cannot be understood without taking into account the broader political developments of the country.

In Nepal, working in a sand mine can provide an income as much as a field hand, and can be less physically demanding depending on the position. These factors make employment in sand mining very enticing which exacerbates it even further. Some impacted communities protest against both legal and illegal sand mining and look to their government for support, often to no avail. Local communities use social media to draw attention to and protest illegal sand mining. The mining of the Indrawati River in Sindupalchowk district is creating ecological damage to the habitats, grasses, and displacing poor people. Illegal sand mining can occur globally, however, it is especially noticeable in many developing countries the resources to monitor or enforce regulations are less common (Barwell, 2016; Besier 2018a; Torres et al., 2017).

In turn, officials are therefore perhaps more easily bribed to look the other way in exchange for a cut of the profits. There are often allegations of corruption and partnerships between illegal mining operations and government officials or other authorities, adding to the

challenge of managing illegal mining in the surrounding Indrawati River. As a result, illegal sand miners have acquired significant power and involvement and donation from a political leader in Nepal. Sometimes Protests often erupt into violence and even death with many instances of protesters and journalists being beaten or killed threat when they are against sand mafias due to political conservation. The fear-mongering and corruption that the Sand Mafias have created make it difficult to research, as well as manage the sand industry. A lack of research on the sand industry has resulted in the unknown magnitude and scale of sand mining - a knowledge gap that contributes to not sustainability and poor governance of the government. Moreover, there is currently no tracking of the paths that sand travels through importing and exporting, making the scale and scope of the issues challenging to assess in this study area. Sand can be mined from one country, and then cross several regions to another and there is no official method of tracking, thus leaving much of the trade undocumented in Nepal. These compounding impacts have made sand mining ecological, economic, and social issues in Nepal that are difficult to effectively govern.

2.2.4 Legal Framework and Guidelines for Sand Mining Activities in Nepal

Sand and gravel extraction is regulated by law in many places, but is often done illegally and in traditional ways. In Nepal, sand mining activities are under the direction and supervision of the Ministry of Federal Affairs and general administration, whereas Districts Supervision Committee, District Disaster Management committee and Local Governments are watch bodies for the entire activities. Land degradation and other environmental burdens resulting from the extraction of sand have been significant and remarkable. Sand, gravel and boulders mining activities create potential negative impacts multiple times on the environment both during the mining operations and years after the mines are closed. These impacts have led to most of the world's countries opting for regulations to moderate the negative effects of mining operations. Various environmental standards, regulations, laws and guidelines enacted by the three-level government of Nepal for the control and management of the environment and natural resources. Under the sand and gravel extraction Local Government Operation Act 2074 BS, all mining groups or contractors are supposed to submit contract papers for their requests to the local municipality. The local municipality is a responsible government organ for directions and decision making though for a long it is mistakenly in the exercise of its duties since often the activity is carried out improperly. Consequently, a massive Environmental Impact has been detected in respect of sand mining (Mandal, 2021**)**.

It must therefore be noted that the Local Government Operation Act 2074 has given the authority to the Local Government to register, permission and dismissal permission for excavation and utilization of sand and gravel. Under this act, the Government of Nepal has promulgated Standard Related to Stone, Gravel, Sand Excavation, Sales and Management, 2077 to regulate sand and gravel mining and it addresses all the provisions related to revenue collection, environmental concerns and the right to introduce other directives or procedures for regulating sand and gravel excavation, sales and management to local governments. According to Melamchi Municipality (2022) in Sindupalchowk District, it is stipulated that the sand and gravel contract paper of the contractor should undergo an Environmental Impact Assessment (EIA) and IEE to determine its impacts on the environment. This means the Ministry of federal affairs and General Administration through the Standard Related to Stone, Gravel, Sand Excavation, Sales and Management, 2077 does not intervene directly to regulate sand and gravel extraction. Standard Related to Stone, Gravel, Sand Excavation, Sales and Management, 2077 has developed guidelines to provide procedures to streamline sand and gravel extraction and management in the country with the view of making it a sustainable industry that supports economic development for enhanced livelihood while safeguarding the environment. The sand and gravel supervision related standard report was launched on Bhadra 5, 2070 decision by the Government of Nepal during a stakeholder forum that comprised owners of Lorries, transporters, loaders and land owners. The acts have been accepted as applicable, inclusive and friendly to the environment by the stakeholder. It is therefore incumbent upon the players to comply with guidelines to ensure sustainable environmental management. Sand and gravel extraction guidelines ensure sustainable utilization of the sand resource and proper management of the environment under Melamchi municipality's internal revenue collection and contract management-related procedure. The content of the contract paper used in the preparation of sand and gravel extraction for the IEE report was as follows:

2.2.4.1 Proper planning and management of the decided area can minimize environmental impacts.

2.2.4.2 Ensure a balance between environmental protection and the demand for sand as a significant socio-economic item.

2.2.4.3 Making compensation for and or replacement of resources and progressive reclamation of disturbed land.

General speaking from the above act statements Melamchi municipality, Sindupalchowk district in recent years, land degradation and environmental burden caused by the extraction of sand resources activity have been significantly checked. Currently, Nepal does not have a precise national policy or law that regulates sand and gravel mining. The major concern is that sand is a resource that contributes to the economic growth of rural areas contributing to the environmental degradation of the river drainage basin. According to District Supervision committee for river mining materials has been given the mandate to ensure that: environment impact assessment, Sand and gravel extraction permission procedure, revenue leakage and fraud delivery, road rules and security for vehicles, contract paper follow up, dams and gabions are constructed in designated sand and gravel extraction site, lorries are supposed to use designated access in the river, not for long period to sand and gravel mining sites, designated sand and gravel mining site are rehabilitated appropriately by local level government or Municipality under it, District supervision committee and approved dealer under close monitoring and supervision by local government in compliance with the crusher industries. Sand, gravel and boulders extraction is restricted to riverbeds without an EIA or IEE report to prevent the widening of the river. As far as social justice is concerned, the District Supervision Committee is supposed to ensure that sand loaders are over 18 years, drinking water, toilet, security, health and insurance, and approved sand dealers will pay a negotiated and agreed-on wage to sand loaders.

The committee is also supposed to approve sand dealers who are encouraged to support a local community project in consultation with the local government. According to Standard Relating Stones, Gravel and Sand Excavation, Sales and Management**,** 2021, no person is allowed to mine sand and gravel from any area not designated as a sand excavation site by Municipality and the site must have an Environmental Management Plan (EMP) to guide in the rehabilitation of the sites (MMO, 2021).

In addition, the crusher industry should exceed 1500 meters from chure hill and 500 meters from the river bank, bridge, lake and highway in distance; designated sand collection sites should be at least 2 km from the social organization like schools, hospitals, cultural sites, security area, residential area, conservation area, border areas (SGESMS, 2021) and mining should be done concurrently with the restoration of areas previously mined. Sand, gravel and boulder mining crusher industry in the area should be strictly open-cast harvesting. In the case of underground tunnelling or excavation of sand appropriate technology should be done

to safeguard human safety. According to Sand and gravel excavation, sales and management standard of local municipality (SGESMS, 2020) river sand and gravel mining reserve should be taken in a way that ensures adequate reserve of the sand and gravel is retained to ensure water retention. Sand and gravel mining reserve should not be allowed on river banks, harvesting should take place within 500 meters of either side of physical infrastructure including bridges, roads, and high-tension lines (SGESMS, 2020).

The guidelines state that vehicle entry permission to the river should as per the contract compromise letter between the crusher industry and the local municipality where extraction is to be done between 6 a.m. to 6 p.m. In the guidelines, it is also stipulated that any person who sells sand will require issuing a receipt to the purchaser and keep records of such for periodic inspection by relevant authorities. Vehicle overloading is one of the main problems related to the life of the road pavement and bridge structure. In most cases, the vehicle overloading is caused by freight vehicles, i.e., trucks, tipper-trucks, dump trucks etc. Vehicle overloading is taken as one of the causes of the premature failure of pavement which results in the huge amount of cost of pavement maintenance and vehicle operation (Hamal, 2021). Department of Transport Management (DoTM) is responsible for the overall traffic control, traffic management, and other vehicular as well as transport service inspection. As per the prevailing rules for controlling vehicle overloading is one of the important mandates for DoTM in the preservation of pavement structure.

The National sand and gravel guideline cannot be enforced because they have not been gazetted to become law under the Sand and Gravel Extraction and Sales Management Standard act. As a result of the lack of statutory provision and coordination at the local level, massive sand and gravel mining has led to the drying of many rivers because sand is the natural tank for storing water. Although sand and gravel have a positive impact on the socio-economic conditions of the local population, it is causing massive environmental degradation as a result of haphazard scooping in the Indrawati River. This resulted in the banning of transportation, and reserve sand for sand and gravel extraction inside the river (MMO, 2022). The indicators for Sustainable Land Management in Nepal's Context admitted that sand and gravel as much as it was economically beneficial and improved the living conditions of the people living around the river banks, would not be sustainable in the long run if proper measures are not taken to control environmental degradation that was threatening agricultural activities. Agriculture was in the 4200 hectares of the paddy area of Melamchi where 50% of

the land is surrounded by the Indrawati River necessary for the improvement of the people's livelihood and better health through the growing and availability of enough food (MMO, 2022).

Sand and gravel extraction is of great socio-economic importance to Nepali citizens and can improve the overall life quality of the people in the areas where harvesting is done. It should, however, be recognized that the processes involved in prospecting, extracting, refining and transporting involves a variety of stakeholders from the point of extraction through transportation to the middlemen and finally to the users though it affects the economic lives of the people who deal in such activities. We contend that effective regulation can only be realized if there exists an explicit, well-established and strong regulatory system that is targeted specifically at sand mining operations. Such a regulatory framework should reflect specific policy intentions at three specific scales, including the strategic, institutional and operational levels.

2.2.5 Rehabilitation of Mined Sites

The rehabilitation of drastically disturbed terrestrial systems, such as land mined for sand, coal and minerals requires sire-specific knowledge to ensure that the reclamation strategies chosen will be sustainable. In Nepal, a large proportion of post-mining landscapes are rehabilitated into the forest. Therefore, the rehabilitation practices and measures included forestation, agro-forestry, replanting vegetation on mined areas to prevent further damage and the use of open pits as dumping sites and landfills.

2.2.6 Forestation and Tree Planting

Natural regeneration of secondary vegetation on degraded mined site lands is often a slow and uncertain process, impeded by a combination of factors including human, recurrent fires, livestock pressure, unfavourable micro-climatic conditions, soil infertility, soil profile disturbance and exhaustion of soil seed bank among others. Therefore, deliberate tree planting and forestation efforts are needed to reverse further erosion.

2.2.7 Agro-Forestry

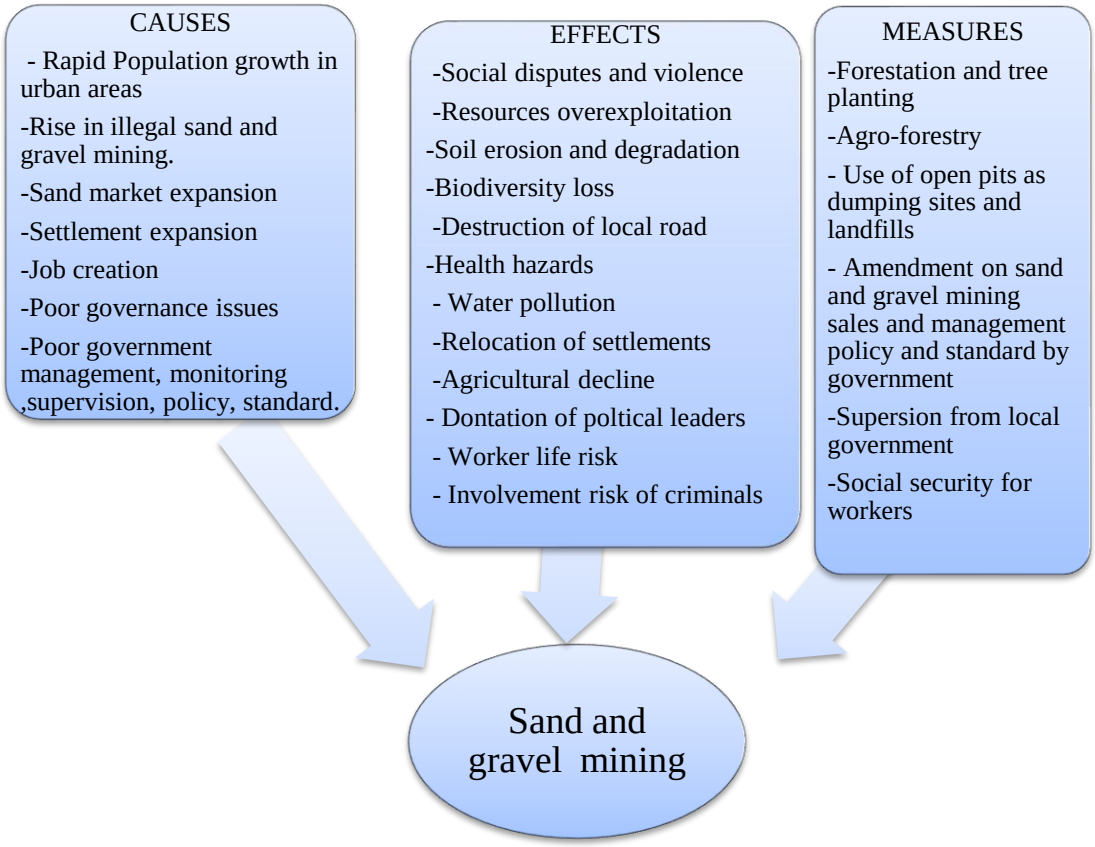
Agro-forestry is a collective name for land use systems and technologies in which trees, shrubs, palms, bamboo and other plant species are deliberately grown around or among crops or pastureland. In agroforestry systems, there are both ecological and economical interactions between the different components. Reclamation through agro-forestry can be used to restore sand pits after abandonment since the technology involves the planting of trees on degraded land with the objective of checking erosion and restoring soil organic matter and the fertility status of the soil. Agroforestry, being one of the several approaches for improving land use, is also frequently cited as an answer to the shortage of fuel wood, cash income, animal fodder and building materials in Sub-Saharan Africa (Chaturvedi et al., 2014). Thus, agroforestry appears to have an enormous potential for reclaiming the abandoned sand mined sited.

2.3 Conceptual Framework

A conceptual framework represents the researcher's synthesis of the literature on the way to describe a phenomenon. In other words, the conceptual framework is how the other researcher is aware the specific variables in his examination connect to every other. Therefore, it identifies the variables required in the study's investigation. It is the researcher's map in pursuing the investigation. Many parts of the Sindupalchowk, Indrawati River were experiencing the impacts of sand and gravel extraction. These influences are soil erosion, water pollution, lack of biodiversity, destruction of roads and river banks, deforestation, and soil exhaustion. The study has independent and dependent variables. The independent variables in this study include; the causes of sand and gravel mining activities include (the rise in population, the social and economic status of the people and the demographic characteristic changes). The dependent or outcome variable depended on what the independent variable did to it (Fraenkel and Wallen, 2000). The dependent variables in this study were the impacts of sand and gravel mining activities on the people's livelihood and environment in the Indrawati River, Sindupalchowk district

Figure 2.1

Conceptual framework



Source: Modified from Transport and Environment Report European Environmental Agency (EEA, 2021)

2.4 Summary

Many studies have been conducted to investigate the issues relating to the causes and effects of sand mining activities worldwide but in the context of Nepal limited studies have been conducted. The revolutionary government of Nepal, non-governmental organizations and other stakeholders from different groups are in a struggle and some have already developed comprehensive environmental laws that can support the management of sand resources. In spite of those efforts, it is not yet clear that Nepal had already developed a control for all per cent over the problem of sand mining activities and its negative effects. This study, therefore, intends to fill the gap by providing the insight causal effect analysis on the socio-economic

dynamism and sand mining activities in Sindupalchowk District, Melamchi municipality of Indrawati river as an area of study.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Chapter Overview

This chapter discussed the methodology employed in the data collection process on research to analyze the causal impact of sand and gravel mining activities. This chapter also describes fully the overall plan of how the whole research was carried out including research designs used, methods of data collection and analysis of the results.

3.2 Research Design

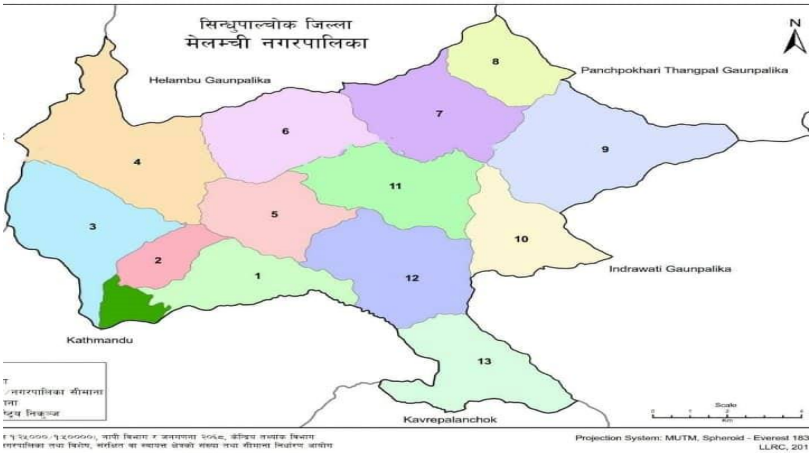
This study used a mixed method as a research design both quantitative and qualitative data collection techniques have been used. A combination of quantitative and qualitative data collection techniques namely faces to-face interviews, focus group discussion, and direct observations were employed. The instruments used in the process were structured and semi-structured questions.

3.3 Study Area

This study was conducted in Sindupalchowk district in the Eastern Region of Nepal which covers an area of 25,542 km^2 (DCCO Sindupalchowk, 2022). The district has an altitude ranging from 300 m to 7080 m above sea level. It is bordered by Kathmandu, and Nuwakot districts to the West, China County to the East, Kavre, Dolakha and Ramechap districts to the South and Rasuwa and Nuwakot districts to the North. It is located in coordinates between 270 46’ N and 850 42’0” E, (Department of hydrological station, 2021). Melamchi municipality, Indrawati River surroundings on which this study focused lies 27.83 0 N and 85.56 0 E. Melamchi municipality has a total population of sixty eighty thousand, eight hundred (68,800) people with a participating total country growth rate of 0.93% per year based on the 2078 BS population and housing census. Indrawati River was selected because sand mining was reported to take place unregulated thus causing negative environmental effects on the river and social conflicts between the sand miners and the locals on economic and environmental grounds. The following Picture shows the study area.

Figure 3.1

A Map Showing the Location of Melamchi municipality, Sindupalchowk district



Sources*:*(CBS,2068)/ www.google.com

3.4 Data Gathering Process

The sample frame of this study consisted of Municipality ward communities close to Indrawati River's major sand mining sites in the Melamchi municipality. In view of the vast nature of the area, a three-day reconnaissance survey was carried out in the area. Among all, thirteen (13) wards, three (3) ward communities were visited based on the presence of a sand crusher industry close to them. Most of these sand and gravel mines are large in size. Out of this, ten (10) crusher industries were purposively selected for the study on the basis of their proximity to mining sites. Sampling size is a research concept, which means the selection of a given number of subjects (respondents) from a defined population in the area of study as representative of that population. Based on purposive sampling fifty (50) respondents were included, ten (10) were sand miners; three (3) were ward leaders and three (3) District disaster management committee; two (2) were members of the Nepal Police local unit, six (6) were from the Office of the Melamchi municipality; and ten (10) crusher industry stakeholder. A total of (15) households were involved; one respondent was obtained from each household. These respondents were usually those whose farms and settlements were located close to sand mining sites. Also, ten (10) near the mines communities apart from the above-stated households were involved in which a total of five (5) respondents were obtained

from each of the communities; making fifty (50) respondents in total. The reconnaissance survey helped in determining the sand mining sites in respect of their age groups. These sites were identified to measure both the short and long-term environmental impacts of the sand mining activities. The sites were located in the following communities: Melamchi wards 11, 12 and 13.

3.4.1 Primary Data

Primary data was collected from the respondents by closed and open-ended questions, direct observation and photographs. Primary data was the main data that was gathered for the purpose of the research and provided much of the actual facts from the field. The data collected was called raw data since it had not been interfered with in any way and was only made available by the research study. Questions consist of questions which were sent to the respondent to seek information from them and later tabulated and subjected to a statistical analysis under the study. Semi-structured questions were used since the method was easy to compute and permits respondents to give their opinions freely. A question is a set of a few questions asked in a logical sequence but put in a writing form (Cooper, 1988). They required brief and direct answers. The questions had both closed and open questions. Questions were used since the study was concerned with variables which cannot be directly observed such as the views, opinions, perceptions and feelings of the respondents. Questions encouraged each participant to provide accurate information. The whole of the target population was expected to be literate and unlikely to have difficulties responding to the questions posed to them.

3.4.2 Secondary Data

This data is normally stored in archival records, publications, books, journals, articles and scholarly internet sources. Data were obtained from libraries, Government Ministries, departments and organizations. Literature published by United Nations environmental programmes, other organizations of environmental programmes and other affiliated organizations especially on environmental impact assessment methods were reviewed.

3.4.3 Data Collection Techniques/Instruments

A combination of quantitative and qualitative data collection techniques namely focus group discussion, and direct observations were employed. The instruments used in the process were structured and semi-structured questions. A Series of questions with open-ended and close-ended questions were distributed to the respondents as an instrument to collect the data and interviews with key informants as I interviewed the Municipality chief of the Environment Section, Agriculture Section, Revenue Section and all the Wards Chairman.

3.4.3.1 Interviews

A question is a research data collection instrument comprising of a series of questions (or other types of prompts) that the respondents have to answer in a set format for the purpose of gathering information from respondents. In questions, the distinction is made between open-ended and closed-ended questions. An open-ended question asks the respondents to formulate their own answers, whereas a closed-ended question demands the respondent to pick an answer from a given number of choices or options. Questions data collection instrument was applied in this study because it is cheap, which do not require as much effort as the questioner-like interview method, and most important has standardized answers that make it simple to assemble data.

3.4.3.2 Focus Group Discussion

A Focus Group Discussion involves gathering individuals from similar backgrounds or experiences together to discuss a specific topic of interest. It is a form of qualitative research where various questions are asked about their perception, attitudes, beliefs, and ideas about the problem studied. In a focus group, discussion participants are allowed and free to talk with other group members; unlike other research methods or techniques, it encourages discussions with other participants. It generally involves group interviewing in which a small number of usually 8 to 12 people is taken into account. It is led by a moderator (interviewer in a loosely structured discussion of various topics of interest. Two Focus Group Discussions (FGDs) were held in 11,12, and 13 wards, two in ward 11 Melamchi, and two in 12 and 13 ward communities in the municipality. The purpose of this was to validate some of the pertinent responses given during the interview administration. Also, during this organization

of FGD, the researcher gathered unbiased and balanced views from all segments of the adult population with regard to current realities in the localities. It also provided the opportunity to directly observe the group process and actions.

3.4.3.3 Observation

The direct observation data collection method only involves the researcher making observations. Observational research findings are considered strong invalidity because the researcher is able to collect a depth of information about the problem studied. This technique was applied because it often overcomes the problem of external validity. The researcher travelled to the mining sites observing the continuation of the sand mining activities. Both descriptive, and or imagery information was collected which were very constructive to the development of this research paper.

3.5 Data Analysis and Interpretation

This study involved both qualitative and quantitative analysis. Qualitative data were collected through interviews (face-to-face and interviews); focus group discussions and direct observation was subjected to content analysis. According to Cohen et al, (2007) content analysis is a research technique for making valid inferences from the meaningful matter to the contexts of their uses. Therefore, its use enabled the researcher to summarize data from the field and report them as findings. In the second stage the summarized data from tables, bar graphs and pie charts, as well as taking photographs, were analyzed and interpreted as findings. This was managed with the support of both Microsoft Excel Software and Statistical Package for Social Science (SPSS) which were applied to obtain sum, percentage and frequency distributions which were then computed and data were tabulated to summarise the raw data in compact form. The information gathered was used to suggest solutions and make recommendations for mitigating negative impacts.

The researcher employed statistical tools in the data analysis; these were IBM Statistical Package for the Social Science (SPSS) and Excel Software Package. Whiles descriptive analysis was used to describe the socio-demographic characteristics mainly in the form of bar graphs, and pie charts for the purpose of visual expression. IBM Statistical Package for the Social Science (SPSS) and Excel software packages analysis was also carried out to assess

the significance of residents' perception of the impacts of sand mining in the district. They were also used to determine the homogeneity of respondents from different sand mining communities and to assess the significance of the impacts of sand mining on people's livelihoods.

3.6 Ethical Consideration

The aim of this research was to analyze the causal impact analysis of sand mining activities on the socio-economic dimension of the population surrounding Indrawati River, Melamchi municipality, Sindupalchowk district. The consent of the respondents was bargained physically to discuss verbally before involving them in the research. It included briefing the respondents about research objectives and how they are going to be benefited from the research. The respondents were assured about the confidentiality of the information, which may be collected from them. The interview with respondents was set to be in a private way. Recorded information, photos and narrations from respondents were used only for the purpose of this study. Respective all local government authorities where the study was consucted were consulted for permission of to conduct this study.

CHAPTER IV

SAND AND GRAVEL EXTRACTION IN MELAMCHI

4.1 Introduction

This chapter presents the findings and discussions for the causal–impact analysis of socio-economic dynamism and sand mining activities surrounding Indrawati River, Sindupalchowk district. This chapter discusses the results and findings of research on Socio, economic and environmental impacts of sand, gravel and boulders extraction and governance issues of illegal mining in Melamchi Municipality. Data was collected through individual interviews, questionnaire surveys, field measurements and observations. The chapter is divided into the following sections: the socio-demographic characteristics of the respondents (Age distribution of respondents; sex distribution of respondents; principal occupation of respondents; and distribution of respondents by their positions in the villages), the effect of sand mining activities on socio-economic changes, the impacts of sand mining on biodiversity, the impact of illegal mining issues and finally the rehabilitation measures towards sand mined sites. The results are presented starting with the background information of the respondents and sand mining activity in the study area. The results are also presented and discussed as per the study objectives in order to draw the study conclusions. Interviews were conducted on people who are directly and indirectly involved in sand mining and gravel extraction. The following sections are key thematic areas of the study outcome:

4.2 Socio-Demographic Characteristics of Respondents

Respondents in this study were both males and females. The inclusion criteria for the questionnaire survey were on any male or female above 18 years who was available in a sampled household and voluntarily take part in the study. Social demographic characteristics of the respondents included the description of age, gender, position in the villages, principal occupation of the respondents and visit to sand mining sites attitude. Table 4.2 shows the dominant age group of 36 - 59 years of age. The 19-35 age groups had a high frequency and consisted of young literate adults who could understand the questions and are aware of environmental issues. Of the 50 who formed the final sample, 64% were males and 36% were females. More males were willing and interested in taking part in the research because sand

mining is a male-dominated activity. Very few women are involved in sand and gravel extraction and rarely visit the areas so are not aware of what exactly happens at mining sites. This is because the respondents in this age group were readily available and willing to take part in the study since they are affected most when sand is mined in or near their agricultural lands and fishing off the "Danuwar" caste living near the Indrawati River. This age group is, however, the one which is highly involved in sand mining activities. The next large age group is 41-50 years

Table 4.1

Distribution of respondents by gender

Gender	Frequency	Percentage
Male	32	64
Female	18	36
Total	50	100

Source: Field data, July (2022)

Table 4.1 shows 32 males and 18 females were considered for data analysis. The sample size for the questionnaire survey was 53 but only 50 respondents were considered for the analysis of results because three questionnaires were discarded since respondents misplaced their copies. Of the 50 who formed the final sample, 64% were males and 36% were females. More males were willing and interested in taking part in the research because sand mining is a male dominated activity. Very few women are involved in sand and gravel extraction and rarely visit the areas so are not aware of what exactly happens at mining sites.

Table 4.2

Distribution Age of the respondents

Age in Years	Frequency (n=50)	Percentage (%)
18 and below	0	0
19-35	33	66
36-59	17	34
Above 60	0	0
Total	50	100

Source: Field data, July (2022)

In table 4.2, most of the respondents were between the ages of 19-35 (66%). This implies that the majority of the sand miners in the study area are youths. This finding agrees that people's age has a significant influence on their job selection. The youths and the middle-aged expressed different interests in the sand mining activity. For instance, most of the youths expressed satisfaction with the sand mining occupation they pursued contrary to the middle-aged respondents, most of whom expressed dissatisfaction and a lack of better alternative jobs to engage in for an income. A higher percentage of youth involvement in sand mining can be attributed to the rising levels of unemployment in the country currently. Additionally, it may also be attributed to its high economic advantage over other economic activities in the area such as farming. This may help check the possibility of an increase in the crime rate in the study area since the unemployed youths are able to generate some income hence being self-reliant.

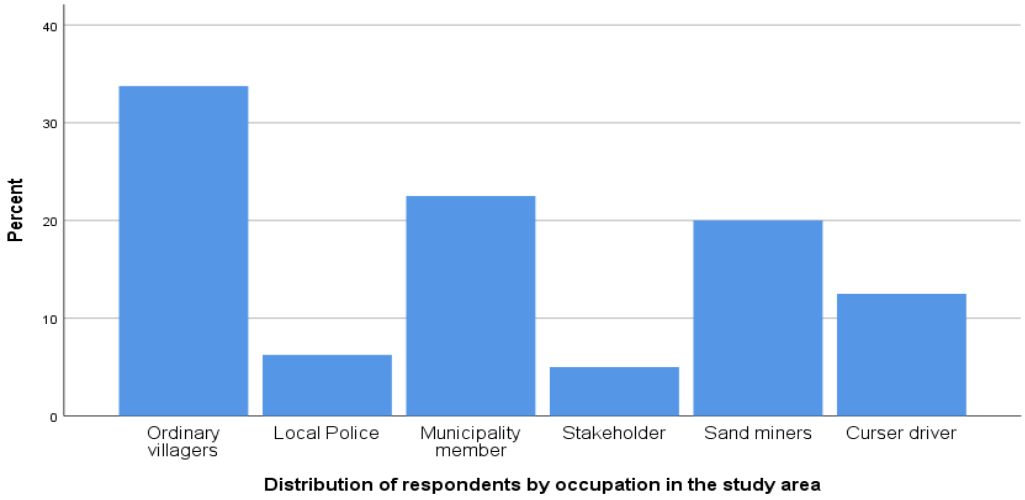
4.3 Distribution of Respondents by Position in the Community

The highest percentage of respondents about 34 % consisted of ordinary villagers who form the majority of the population and are the owners of agricultural fields where sand and gravel are mined and deposited. Although in the beginning, the respondents were not willing to spend their time being interviewed because they were busy with official and domestic work but later on with the help of Ward chairmen, they voluntarily took part in the study because many of them were not happy with sand mining in their areas and were willing to suggest

solutions and make recommendations to lawmakers, communities and to the local governments.

Figure 4.1

Distribution of respondents by position in the community



Source: Field data, July (2022)

Data collected and displayed in Table 4.3 show those residents of Melamchi Municipality visit gravel extraction and sand mining areas regularly for various purposes. The main activities are farming and herding livestock by mostly male mature respondents with 22% and 18% respectively. Soil mining is done by a few villagers (12%) as private businesses and for domestic purposes. Respondents gave other activities (10%) as they visit mining areas for fishing and (14%) respondents on their way to getting domestic water. Local police officers patrol mining areas during the day and at night to arrest and confiscate sand from illegal miners. This is done with help from neighbouring farmers who formed watch groups to guard the extraction sites near their fields.

Table 4.3

Activities of respondents around mining areas

Activity	Frequency	Percentage
Livestock production	9	18
Fishing	5	10
Farming	11	22
Soil mining	6	12
Transport rental	5	10
Grocery shop	4	8
Getting domestic water	7	14
Others	3	6
Total	**50**	**100**

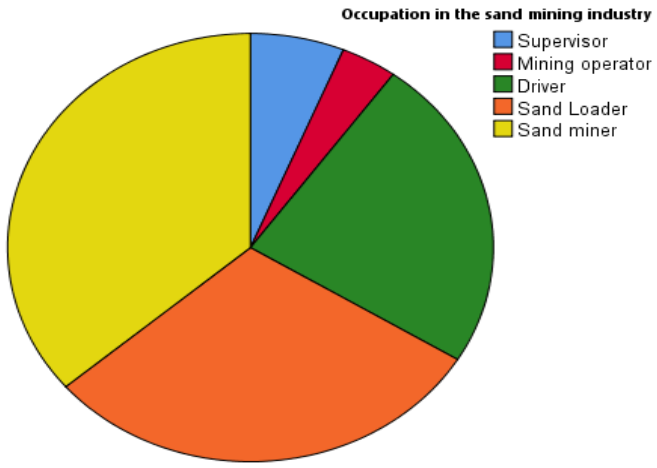
Source: Field data, July (2022)

4.4 Occupation in the Sand and Gravel Mining Industry

The study sought to establish the occupation of the respondents in the sand and gravel mining industry and the results are presented below.

Figure 4.2

Occupation in the sand and gravel mining industry



Source: Field data, July (2022)

Figure 4.2 shows that 23.8 % of the respondents worked as drivers, 36.3 % of the respondents who participated in the study were sand miners 30% were sand loaders 3.8% were mine operators 6.3% were supervisors working in the industry. The study shows that all the categories in the sand and gravel industry were well represented in the study and therefore the findings were as representative as possible. Sand and gravel mining is an activity that involves many stakeholders from harvesting to the users and includes prospecting, extracting, refining and transporting involves a variety of stakeholders from the point of harvesting through transportation to the middlemen and finally to the users though it affects the socio-economic lives of the people who deal in such activities (Macharia, 2004)

Table 4.4

Number of trucks passing through the area per day

Number of truck per day	Frequency	Percent
0-50	5	10
51-100	6	12
101-150	8	16
151-200	12	24
Above 200	19	38

Source: Field Survey, (2022)

Table 4.4 show that all respondents have observed tipper trucks passing through the village though they could not state the exact number. About 38% respondents indicated that more than twenty (200) trucks pass through the villages which form the modal class. Data collected from interviews show that less mining is done during the day by licensed companies. Illegal mining is done at night and on weekends which made observing and giving exact number of trucks difficult. Some villagers indicated that more than four hundred trucks pass daily on approximation. The conclusion is that a lot of sand and gravel are mined every day by both legal and illegal miners.

4.5 Respondents' General Views on Sand Mining and Gravel Extraction

The study was carried out to find the socio-economic impacts of sand and gravel mining. Respondents had realized both positive and negative impacts of the activity and were asked to

give general views on the mining of soil as well as possible solutions and rehabilitation programs that can be implemented.

4.5.1 Positive Impacts of Sand Mining Activities on Socio-Economic Changes

The study revealed some positive impacts of sand mining activities surrounding the Indrawati River through face-to-face interviews and a questionnaire survey. Respondents were asked to outline the advantages of extracting sand from the environment and these were the responses obtained: Respondents through face-to-face interviews addressed a number of issues about benefits delivered from the extraction of soil. From the field study (Table 4.5), about 26% of the respondents said that many people are affording to build modern, durable and strong houses at cheap costs as sand is readily available locally. Meanwhile, From the field study, 36.3% and 30% of the respondents said that sand mining activities create employment opportunities for youth as Sand miners and loaders. Sand mining acts as a source of employment for many youths in and out of the Sindupalchowk District. Many residents benefited from sand mining as highlighted through face-to-face interview results that the resources are cheap and accessible. Youth and children are also often the people illegally mine because it is a widely available way to help their family income. This is simply a new way for youths to make money relatively easily. The average cost for a small truck of sand per trip was reported to be approximately Nepali Rs 4,000 to 7,000, while a truck with three tons of sand costs anywhere from RS 100,000 to 150,000 (personal communication with a respondent July 13, 2022).

It is, however, 6% of the respondents addressed that sand mining acts as a source of income for individuals who mine and sell sand or transport for people on small scale using small trucks and tractors. Lastly, 12% of the respondents observed that making of alternative sources like a stone for sale is a cheap small-scale business for individual villagers. Table 5 summarizes the results.

Table 4.5

Benefits of Sand Mining to the Residents

Benefits of sand mining	Frequency	Percentage
Creation of employment opportunities	11	22
Utilization of abundant high-quality river sand and gravel in building durable structures	6	12
Development of infrastructure	8	16
Villagers buy sand at cheap prices	3	6
Many people from local and urban areas are affording to build modern houses at a cheap cost	13	26
Sand mining acts as a source of income for individuals who mine and sell sand on a small scale	3	6
Making of alternate sources like a stone for sale	6	12
Total	50	100

Source: Field Study, (2022)

Respondents through face-to-face interviews and questionnaire administrations realized that sand mining activities have a lot of benefits to the community. The majority of the respondents observed that sand mining activities provide an opportunity for the community to afford to build modern houses at cheap costs because sand aggregate is mined in or near to their areas of residence and other parts of the country. While the second highest percentage of the respondents observed that sand mining created employment opportunities in and outside the mining areas' communities. This is because the youths are employing themselves as Sand miners, Sand operators, supervisors, manual truck loading, and drivers for sand transportation. Lastly, a good percentage of the respondents saw that sand mining led to the expansion of local areas, Kathmandu and other parts of the country in form of infrastructures such as road, malls, schools, hospitals, and residential houses which may standardize the social welfare of the population.

Generally, the villagers were aware of sand mining and the benefits of the activities. Development of infrastructure, use of cheap resources in building, employment creation and source of income for Municipality were noted as positive impacts of sand mining activities.

With regard to positive effects of sand exploitation to the socio-economic changes, the researcher put emphasis on the fact that this industry has to be operated in a sustainable way that the present communities benefited from the utilization of sand resources but without compromising the future generations. Many global and national researchers outlined that sand mining processes have positive impacts on society, but the negative effects are much disastrous. Taking into consideration that this study is referring to the socio-economic effects of sand mining, a causal – impact analysis; several other studies revealed these issues in detail. Caroline Ladlow, (2015) has revealed the same positive impacts of the sand mining activities in some areas based on her areas of study in Unguja Island. She mentioned few positive effects but the major ones were the negative effects such as loss of vegetation cover, soil erosion, absence of trees, ground water intrusion, loss of biodiversity, and the destruction of the natural habitats.

However, for the case study of China, Marius Dan Gavriletea, (2017) in his writing "Environmental Impacts of Sand Exploitation; Analysis of Sand Market", described that "…. Worldwide sand resource's exploitation has considerable impacts on environment…" he further put an emphasis on the negative impacts rather than the positive impacts of sand mining activities.

4.5.2 Negative Effects of Sand Mining on Socio-Economic Changes

Respondents were also asked to share their views on the negative impacts of sand extraction in their lives as well as to their socio – economic changes. Findings in Table 6 indicated that, the majority of the respondents observed that serious deforestation and loss of vegetation cover are direct economic impacts of sand mining activities in Indrawati River, Sindupalchowk. Continuous clearing of vegetation exposes the land to erosion which in turn causing a decline of agricultural crop yields and grazing lands carrying capacities. This however, cause natural ecosystem's imbalance that may have consequences to humans, other animals, plants and insects. Nevertheless, the second group of respondents complained about the prevalence of both communicable diseases such as diarrhoea and malaria as well as sexually transmitted diseases and HIV/AIDS. While another high percentage of respondents said that; sand mining is usually associated with pollution (land and noise pollution). For example, the uses of heavy machines, tipper vehicles, and excavator loaders produce a lot of noise when loading and transporting soil processes are carried out; this aspect has something

to do with the health of the residents in nearby communities where sand, gravel and boulders are being mined. From these negative effects, over-exploitation of river sand in regard to a lack of control and proper sand regulations in Indrawati River, the activities may result in worse if not disappearances the fishing traditional occupation of caste "Danuwar" inside Melamchi municipality. Meanwhile, the rest respondents observed many ugly deep sand depressions left uncovered for conflict between communities and illegal mining as well. During the rainy seasons, these pits are filled with rain water and become dangerous zones to both people and livestock. These areas are also breeding grounds for mosquitoes which spread communicable diseases.

Figure 4.3

Children from fishery caste at Sand Mined playing in the Abandoned Sand Mine Pit

Source: Field Survey, (2022)

It is, however, that many accidents had been reported in and around sand mining areas. Children visit sand mined pits covered with water to swim or fishing and end up drowning. Residents (respondents) who took part in the study indicated that the activity had caused many accidents and some leading to deaths in their communities involving both humans and livestock (Figure 4.4). Land degradation was also noted during the study. Lands for grazing and crop production (fields) turn into gullies as more sand is mined, which negatively affects the economic status of the population. Sand mining is reported to have increased illegal mining in the villages as many young people come to wait for trucks going to collect sand to

be hired as manual loaders but when not hired they resort to stealing in households and crops at night. Lastly, many road accidents have been reported as caused by slow-moving tipper trucks and they also cause traffic congestion. These trucks carry uncovered sand when being transported; it may cause an accident for other vehicles and pedestrians (Table 4.6).

Table 4.6

Negative Impacts of Sand Mining

Impact Areas	Frequency	Percentage
Deforestation	10	20
Diseases	7	14
Shortage of water resources	6	12
Reduced farm size	4	8
Increased risks of floods and erosion	6	12
Accidents	5	10
Pollution	7	14
Road destruction and traffic congestion	3	6
Increasing crimes	2	4
Others	0	0
Total	50	100

Source: Field Data, (2022)

This study stated that “the mining of sand resources from Indrawati Rivers in Melamchi municipality is a common practice and have resulted to the destruction of public assets as well as increase stress on commercial and noncommercial living resources that utilize these areas. The other effects included health hazards, destruction of riparian vegetation, pollution, instability of structures and the physical disturbance of the habitats**.**

Figure 4.4

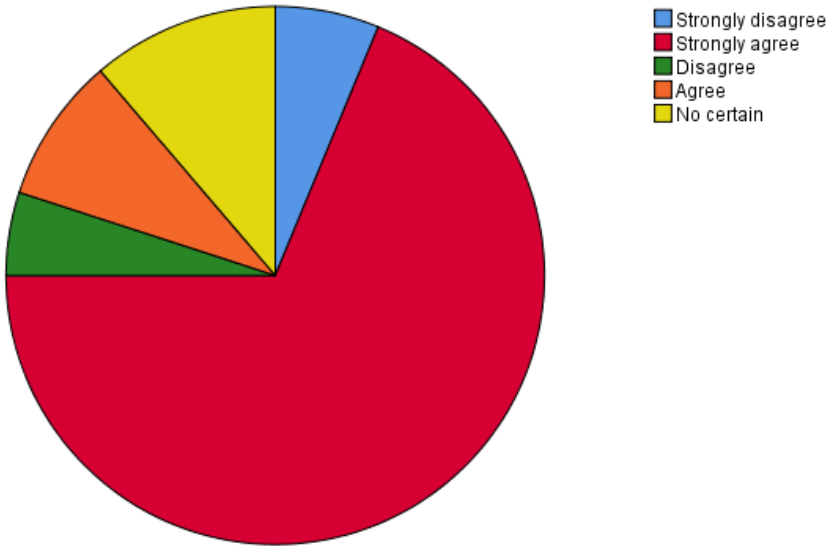
Sand Miners at Site Loading the Trucks with Sand using Excavator Machine

Source: Field Data, by the researcher (2022)

Figure 4.4 shows licensed sand miners loading sand into their trucks ready to sell it to individuals and companies. The Figure above demonstrates a real condition at the sand mining site causing a number of negative impacts on the people's socio-economic changes as mentioned by respondents in Table 6. A researcher (through Figure 4.5 above) shows serious deforestation and loss of vegetation cover which in turn may lead to land fragmentation and the destruction of natural habitats surrounding the Indrawati river as indicated by the respondents. Respondents were aware of the negative impacts of sand mining activities with the majority complaining of serious deforestation and loss of vegetation (Loss of biodiversity and loss of natural habitats) while the second group of respondents complained of diseases eruption in their areas basically diarrhoea, cholera and other communicable diseases from accumulated water in the sand mined pits. Somehow, there are some children and youth who have a high case of dropping out the education of school and college. More effects highlighted were land degradation, pollution, road accidents and an increased rate of crimes. The method used in sand and gravel extraction is more responsible for land degradation, pollution, road accident, diseases and crime.

Figure 4.5

Negative impacts of mining observed by respondents



Source: Field Data, (2022)

Figure 4.5 indicates respondents' responses on the accidents, land degradation, pollution, road accident, diseases and crime reported due to mining activities. The majority (60.9%) of the respondents who participated in the study strongly agreed occurring land degradation, pollution, road accident, diseases and crime where sand is extracted and, on the roads, are caused by the method used in it.

From the FGD the respondents said that they were not pleased and disturbed by the sand mining activities which destroy their agricultural land, cause many accidents leading to deaths of people in the surrounding communities, cause unpleasant topographical appearance and various types of pollution. Therefore, the appropriate mining sites should be chosen with the suggestions of the villagers. Respondents suggested that miners should ask for the permission from municipality and be given a limited and controlled area to mine. Respondents proposed that villagers have to report to the village leaders and police so that such illegal sand mining activities can be stopped by the lawmakers. Respondents also suggested that miners (illegal miners) be jailed for not less than ten years.

Lastly, they proposed that the trucks should be serviced every period of time in order to avoid unnecessary accidents. Many residents indicated that they are aware of and not happy with

the accidents occurring involving children, livestock, and miners themselves due to sand mining activities. The accidents are often on the roads and on destruction by heavy vehicles surrounding sand mining areas. It is realized that there should be more police patrols and provision of public education specifically for children on the dangers of swimming and fishing in stagnant water.

4.5.3 Impacts of Sand Mining Activities on the Environment

Respondents who participated in the study were asked to share their views through questionnaire and focus group discussion methods about the negative effects of sand mining on Environment (however direct observation method was applied), these were the responses:

4.5.3.1 Soil Erosion

The respondents addressed the problem of soil erosion which has become a great environmental issue near the mining sites and has caused trees to begin falling as their rooting structures and become less stable. Many of the economic and social issues are also having been destructed due to the environmental degradation that has taken place after mining. The most surprising trend found was that while approaching the Indrawati River, the opinions on sand and gravel mining were expected to become worse and worse day after day. On the contrary, some of the respondents interviewed agreed that it was having negative impacts on the environment, but that people were in need of money and the sand mining industry provided that. The people of the village would be paid to go out into the mining sites and shovel the sand into the trucks, making them feel blinder to the negative impacts it has on the environment.

4.5.3.2 Loss of Trees and Vegetation Cover

Respondents participated in the study and the majority of them were aware of sand mining activities in the district. A significant proportion observed a lack of trees and vegetation cover at various abandoned sand mining sites. The respondents were predominantly farmers who cultivate food crops (maize, rice, groundnuts, beans and fruits) on one side and livestock keepers on the other. Respondents within the study areas normally assessed the negative impacts of sand and gravel extraction by loss of tree cover, low yields of crops after harvest

and lack of vegetation on soils. There were few but no trees present on river bank mining sites as compared to un-mined sites. This could simply be deduced that sand mining may have contributed to the low numbers of trees as most of the trees were removed before the sand is mined. These massive losses of vegetation cover in and around the mining sites also negatively affect the socio-economic aspects of the people whose livelihood largely depends on these trees (Figure 4.7).

Figure 4.6

Sand Mined Site with Lack of Tree Cover

Source: Field Data, (2022)

The researcher observed that mining is going on as the depth, width and length were increasing due to the erosion. The area is now a huge water logging site with no economic importance, affecting a lot of the lives of terrestrial biological diversities of plants, animals and micro-organisms.

4.5.3.3 The Eruption of Diseases Caused by Sand Mining

Respondents gave their views about some disease eruptions influenced by sand mining in the district (Figure 4.8). In the study area, the majority of respondents principally attributed the prevalence of some diseases such as dysentery and cholera to sand mining. They observed that over the years, sand mined sites are used as damping grounds, which collect water during the rainy seasons. These, therefore, serve as breeding grounds for vectors and/or parasites responsible for the transmission of the above-mentioned water-borne diseases.

Figure 4.7

Standing Water in Sand Mined Site near Communities

Source: Field Data, (2022)

Figure 4.7 indicates opinions of the respondents through focus group discussion revealed that sand mining could be the possible source of diseases such as dysentery, cholera, and malaria because sand pits are usually used as waste dumping grounds close to the communities and waterlogged areas.

4.5.3.4 Destruction of Natural Habitats

The respondents showed depressions left by sand mining activities were turned into unpleasant topographical landscapes. Mining in Figure 9 was in progress, trees residues were seen on the ground as evidence. Some miners were seen but the depression was enlarging in length and depth due to continuous mining.

Figure 4.8

Melamchi River, an Example of Human Destruction on Natural Habitats

Sources: Field Data, (2022)

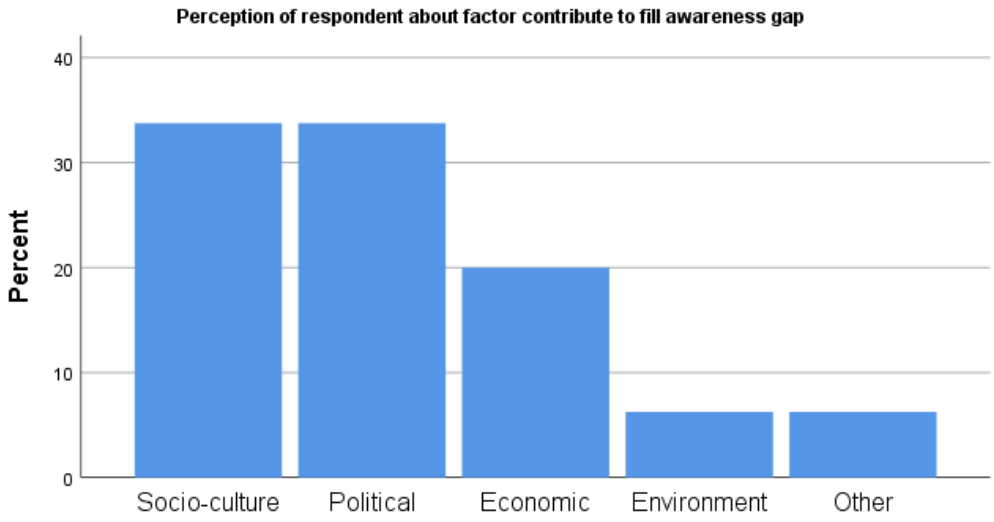
There was massive destruction of vegetation and land natural structures (natural habitats) leading to unprecedented loss of natural habitats for hundreds of amphibians, mammalians, reptiles, birds and insects in the area (Figure 4.8).

4.6 Sand and Gravel Mining Governance

Awareness and knowledge of the challenges of sand mining are required in order to guide research that will inform governance to manage the social and ecological impacts of sand mining and shift towards sustainability. The study allowed the villagers to give suggestions on solutions to sand and gravel activities in their areas. When asked about what they can recommend as the immediate solutions to the negative impacts of sand mining and gravel extraction, respondents gave suggestions.

Figure 4.9

Awareness gap observed by respondents



Sources: Field Data, (2022)

The figure 4.9 shows 34% of respondents responded to socio and political factors to contribute to awareness about sand and gravel extraction to maintain sand governance. Whereas 20 % of respondents admit that economic issues contribute sand and gravel extraction awareness gap. Similarly, 6 % of respondents emphasize the environment and another factor to maintain sand governance. Poor governance is one result of these awareness challenges. According to the expert panel, and as reflected in the literature (Beiser, 2017a; UNEP, 2019) awareness regarding the social and ecological impacts of sand mining is low, although, it is slowly increasing.

4.6.1 Different Governing Authorities

Central level and local level government were indicated as a more responsible level for supervision and control of sand mine sites. The results are presented in Table 4. 7.

Table 4.7

Responsible level observed by respondent

Governing authorities	Frequency	Percent
Central Government	15	30
Provincial Government	5	10
Local Level Government	14	28
Community	3	6
Security force	12	24
Other	1	2
Total	50	100

Source: Field Data, (2022)

The above table shows that the central government got 30% of the respondent which is higher than other frequencies as well and indicates more responsible for supervision whereas the local level government seems responsible 28 % of the respondent interview. Whereas, Data about the security force is 24% should be also more responsive to supervision and control. The respondent explained that there are laws to govern mining activities such as the need for an Environmental Impact Assessment report from the Municipality Department of Environmental Affairs before a license is issued. The miner must include in his plan, an environmental reclamation plan, methods of mining, and how to access the mining area from one side to reduce damage to the environment.

4.6.2 Respondents' Suggestions for Resolving Sand Mining Problems

Respondents through face-to-face interviews offered several suggestions that they thought could address problems posed by sand mining in Melamchi Municipality. Findings in Table 4.8 showed that about 32% of the respondents suggested that sand miners should be given environmental education on the short and long-term negative impacts of continuous mining from the same areas. First, in order to have transparency, stakeholders must be able to communicate with each other about their needs and concerns. This is not possible if stakeholders are uneducated on the social and ecological impacts of sand mining. About 19 %

of the respondents suggested that replanting of vegetation in mined areas can prevent further damage. Also, respondents of about 18 % saw that special sites for sand mining should be allocated to reduce multiple sand mining sites which destroy a large area of riverbank land in the district. Also, perpetrators must be stopped from mining in the residents' fields. While 11.6% of the respondents suggested that close monitoring and evaluation of sand mined areas be done intensively, this can reduce the severe environmental impact. 10.5% proposed that the construction of regular roads for tipper trucks to the mining sites is a suitable way to reduce accidents and further erosion. It is, however; about 5.8% of the respondents suggested setting out punishment for offenders of the crime and illegal sand miners. Lastly, about 3.8% of the total respondents suggested that the use of open pits dumping sites and landfills will reverse the severe ugly landscape resulting from sand mining activities in the Indrawati River.

Table 4.8

Suggestions for solving problems observed by respondent

Suggestions for solving problems in sand and gravel extraction site	**Frequency**	**Percentage**
Environment education	16	32
Allocation of special sites	10	20
Replanting vegetation	8	16
Monitoring and evaluation of sand mine site	6	12
Construction of road	5	10
Punishment for illegal and crime	3	6
Open dumping pit site	2	4
Total	50	100

Sources: Field Data, (2022)

Meanwhile for further suggestions proposed that there must be regular formal meetings between miners and other sand stakeholders to discuss the impacts addressing new challenges of stake holder come up with a way forward to the issue. Respondent also suggested that there should be regular meetings between District supervision committee, Municipality, security force and village leadership to discuss the sand mining activities and its possible

impacts. While some other percentage of the respondents proposed that there should be a special minimum number of permits and licenses to be issued; sand mining must not be done on one area but altering sites to reduce over extraction which destroys the environment beyond rehabilitation; and finally, the Central government should give full authority to compensate the sand mining affected citizens for their loss. The respondents suggested that all trucks transporting sand should pass through police stations for inspection and verification of licenses since some miners use fake documents. Others suggested that villagers should be volunteered to form committees in order to monitor, supervise and guard mining areas with help of a trained local security force. Consultations should be done by the municipality with the help of government officials on issuing sand mining permits so that they may be involved in Surveying the river and recommending where to mine. The regulations for sand mining are not enforced or are overlooked by officials who are paid a portion of profits by an illicit sand mining operation. The community members must cooperate and report such official and illegal miners to the responsible authorities instead of harbouring them as well as the mining activities should be only controlled by the Government

4.7 Summary

The research assesses the opportunities and challenges associated with the current approach (or lack of approach) to the governance of sand resources. In assessing challenges within the current structure of sand governance several significant insights emerged: the lack of reliable data and research concerning sand stocks, flows, and current regulatory frameworks; limited regulations coupled with poor enforcement and monitoring; the number of diffuse mining locations which make tracking resource flows difficult; illegal mining and; a lack of communication within and between governments and stakeholders. By outlining these challenges, complementary opportunities to improve sand governance were identified as increasing and improving research and accurate data collection and making this data accessible to the public, increasing the enforcement and monitoring of improved regulations along the entire value chain, improving documentation of material flow analysis, increase and improve collaboration and communication between stakeholders, encourage the collection and sharing of best practices and develop a global standard certification framework. The loss of trees, loss of fertility of lands, loss of farming lands, increased disease, loss of life, and accidents were reported as the most common impacts caused by sand mining activities in the areas. The effects of mining at Indrawati River are overall more extensive and severe than all

the current mining sites in Sindupalchowk District. Nevertheless, local people, stakeholders and government officials from Melamchi Municipality gave many suggestions as solutions to sand mining. Environment education, allocation of special sites, strict laws, regular meetings and consultations, and restriction of mining time were some of the solutions provided. Furth more, Stakeholders must be able to communicate with each other about their needs and concerns in order to have transparency. This is not possible if stakeholders are uneducated on the social and ecological impacts of sand mining. All of these means that, the residents were aware of the socio-economic impacts and were willing to be involved in reducing the negative effects of sand mining overexploitation

To address the impacts of sand, gravel and boulders mining activities, regular research should be done at the central government level that each mining area has a different pattern of impact. Local government and agencies only look after the recent consequences and do not consider the long-term effect of sand, gravel and boulders excavation where the mine activities on lower land can affect higher land with very long distances which may be out of the jurisdiction of particular local government. So sand, gravel and boulders extraction are not the only business of a particular local government which affects the global people directly or indirectly so central government and related ministries on the policy level should formulate a comprehensive legal framework considering its social, economic, and environmental impact. There is a need for local government to adopt a new directive and effective sand, gravel and boulders extraction policy which should state and address clearly the challenges regarding sand management and exploitation and address the challenges of stakeholders because the central legal framework may not cover all local specific shortcomings of sand, gravel and boulders excavation, sales and management. Political and religious leaders have more influence on the people. The local government should strongly implement IEE or EIA. Proper implementation of EIA could minimize or eradicate possibilities for mismanagement of sand resources while ensuring the sustainability of the people and their resources. A local level watch body including representatives of local affected people, local political parties, local security agencies and local government should be formed to monitor all impacted areas which ensures sand miners have fulfilled all social responsibilities and compliance with all legal provisions. The municipality should declare compensatory programs to address affected people who are suffering from sound and air pollution, who cannot use the roads during the evening time, and who have abandoned the occupation of fishing in the dry season.

CHAPTER V

SUMMARY AND CONCLUSION

The research was carried out to investigate the causal effects analysis of sand mining activities in Sindupalchowk district: a case study of Indrawati river, Melamchi municipality where sand resources are extracted for the development of the city. The study was guided by two specific objectives; the first objective was to assess the impacts of sand and gravel extraction on biodiversity and socio-economy; and the second objective was to evaluate the legal provisions for sand and gravel extraction and management by the Local government and suggesting rehabilitation measures to the sand mined sites and as well as recommendations to decision-makers, local government and the responsible community.

5.1 Summary

Contemporarily, riverbed material extraction is one of the serious environmental problems globally. The use of such river materials from the Indrawati River in Melamchi Municipality is also the key component supporting the urban infrastructure development supporting rapid urbanization in nearby Kathmandu Metropolitan City (KMC) and other areas. The indirect challenges to the socio-economy and impact on the air, water and biodiversity are key concerns in the area. The qualitative study helped understand the perception of sand mining in the study area leading to a broader need for attention to the governance and coordination between the stakeholders and government agencies for enhanced social and environmental management.

The main objective of this study was to investigate the cause and effects of sand resource extraction in the Indrawati River as a major supplier of sand materials. The study was conducted in Sindupalchowk District at Melamchi municipality wards, 11,12 and 13 Indrawati river mined sites where severe deterioration of river bank and land resources have increased to an alarming rate while the restoration and conservation measures are at a minimal level. The study employed a multi-stage sampling procedure involving the purposive selection of the study villages which are much more affected. The study adopted both qualitative and quantitative approaches for data analysis concerning mismanagement and overexploitation of sand resources. The study was guided by three specific objectives; the first objective was to assess the impacts of sand and gravel extraction on biodiversity and

socio-economy; and finally, the evaluation of the legal provisions for sand and gravel extraction and management by the Local government and suggested rehabilitation measures to the sand mined sites.

Sindupalchowk district is the sole district in Nepal and its Indrawati river has been changed to a non-renewable natural resource extraction area. The district provides sand materials used in different construction public and private where extracted areas were not yet rehabilitated. The findings have also identified a number of factors including The absence stable of standard statements regarding sand management in Melamchi municipality sand and gravel sales and extraction policy, sand being a common property resource, lack of EIA for many projects, lack of coordination between law enforcing body and ministry of agriculture have negatively influenced the implementation of various activities and enforcement of laws. The research assesses the opportunities and challenges associated with the current approach (or lack of approach) to the governance of sand resources. In assessing challenges within the current structure of sand governance several significant insights emerged: the lack of reliable data and research concerning sand stocks, flows, and current regulatory frameworks; limited regulations coupled with poor enforcement and monitoring; the number of diffuse mining locations which make tracking resource flows difficult; illegal mining and corruption within government and authoritative positions; and; a lack of communication within and between governments and stakeholders. . By outlining these challenges, complementary opportunities to improve sand governance were identified as increasing and improving research and accurate data collection and making this data accessible to the public, increase the enforcement and monitoring of improved regulations along the entire value chain, improve documentation of material flow analysis, increase and improve collaboration and communication between stakeholders, encourage the collection and sharing of best practices and develop a global standard certification framework.

Interviewing key people directly or indirectly involved in sand mining activities was one of the methods used to compile data in this research. The researcher interviewed various respondents from Melamchi municipality wards 11, 12 and 13. The researcher, however, interviewed the chairperson of these wards and the mayor of the municipality, on the background of sand mining activities in their communities and discovered that the activity started after the 2063 revolution of Nepal when majorly Kathmandu started to demographic expansion at a very fast rate. Since then, the miners were extracting mainly river sand and

open areas for the construction of residential houses, hotels and several other structures. From this study, the researcher discovered that the Indrawati River of Melamchi municipality have been heavily impacted by sand mining and has had very similar impacts on the surrounding communities. The loss of trees, less fertile lands, loss of farms, increased disease, loss of life, and accidents were reported as the most common impacts caused by sand mining activities in the areas. The effects of mining at Indrawati River are overall more extensive and severe than all the current mining sites in Sindupalchowk district. Nevertheless, villagers, stakeholders and government officials from Melamchi municipality gave many suggestions as solutions to sand mining. Environment education, allocation of special sites, strict laws, regular meetings and consultations, and restriction of mining time were some of the solutions provided. Furth more, Stakeholders must be able to communicate with each other about their needs and concerns in order to have transparency. This is not possible if stakeholders are uneducated on the social and ecological impacts of sand mining All this means that, the residents were aware of the socio-economic impacts and were willing to be involved in reducing the negative effects of sand mining overexploitation

5.2 Conclusion

The study on the impacts of sand mining and gravel extraction in Indrawati River and surrounding areas revealed both positive and negative effects. The study on the socio-economic effects of sand mining activities has revealed both positive and negative impacts of sand mining activities. It highlighted the views of affected people through questions, face-to-face interviews, focus group discussions and direct observation. Though the activities have positive effects (such as building strong structures, plastering, making foundations and bricks, and employment) the majority of the respondents were not happy with the severe environmental degradation, accidents caused, wastes disposed of by miners, threats from illegal miners, the prevalence of some mining-related water born diseases; loss and/or reduction of farmlands; existed a poor relationship between residents and sand miners; and low agricultural productivity. It is however sand mining activities resulted in general damage to the biodiversity and general ecosystems such as a significant reduction in above-ground plant biomass, and loosing of natural habitats. The need for sand for construction purposes across Nepal has been increasing exponentially without any change in the availability of sand resources supply. Utilizing non-renewable natural resources is one of the most challenging problems for a government to address, and the Revolutionary Government of Nepal has

formulated Standard Relating Stone, Sand and gravel excavation, sales and management that would lead to the successful management of this resource use and reducing extraction impacts by implementing existing standards and best practices if once strictly put in action.

The Sand and gravel sales and extraction standard in place suggested investing in sand production and consumption measurement, monitoring and planning, moderate consumption and rehabilitation of the area after use, which would be an effective method of utilizing a sand resource in the most beneficial way for all parties involved. However, it seems that the real management of the sand and gravel mining industry has become increasingly difficult. The Government of Nepal lacks key enforcement capabilities that could successfully control the issue of non-renewable resource uses. Possibly the most difficult aspect of attempting to manage sand mining is that the industry has become a vital component throughout the district and is a part of so many people's livelihoods. Overall, the social, economic and environmental impacts of sand mining are more severe as the scale is exponentially larger. Without a managed and well-controlled system for the Government of Nepal to sand mine, the severe effects it is having on the community will escalate more and more.

The sites should have more controlled methods of mining ensuring that only a certain amount is removed per day, and a fence or protective structure could be put in place at all legal sites to prevent any more illegal mining and unnecessary accidents to the community. Further investigation of the impacts of sand mining is necessary because currently little is being done to mitigate the problems. Severe socio-economic harm and permanent environmental damages being incurred on the people of the Melamchi Municipality need to be noticed and managed because the industry has become so extensive and severely impacts the communities. Without the implementation of mitigation practices, the communities across the Indrawati River, Sindupalchowk district will begin to permanently suffer from chronic environmental problems.

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APPENDIX-I

Questionnaire

Code No._____

PART A

Respondent's Characteristics

1. Village/Town Details
    a. Name…….
    b. Tole……
    c. District…….
2. Respondent's Details
    a. Name:…….. Gender(M/F):…….Age:…….. Education:…….No. of familymember:……Ocupation:……MobileNo.(Optional):…… …….
    b. Main business, job and services provided by respondent :
        i. Agriculture
        ii. Government
        iii. Local leader
        iv. Sand mining industry
        v. Labor
        vi. Other (specify);……

3. Employment amongst different age groups

	Gender	**Male**			**Female**		
Employment	Age group (yrs)	18 and below	19-35	36-59	18 and below	19-35	36-59
	Unemployed						
	Unpaid family Worker						
	Self Employment/Small Business						
	Wages/salaried						
	Other						

PART B

Introduction of the Research

1. Introduction
    a. Location: Ward no… Municipality....., Sindupalchowk
    b. Name of working organization or nearby.....
    c. Short summary of the socio-economic impact of sand mining (Objective of the study)
        i. The main objective of the study is to examine socio-economic impact of sand and gravel extraction in Sindupalchowk.
    d. Key words.....

1. Context
    a. Name of the area where the research takes place and feature of their territory(Forest/Urban area/main crop/habitation/population)
    b. Number of the beneficiaries.....
    c. Problems encountered: .....
    d. Awareness programmed.....

PART C

1. What are the major income generating /economic activities in the district in order to sustain?
    a. Livestock production
    b. Cultivation of food crops
    c. Fishing
    d. Rice processing
    e. transport rental
    f. Grocery shop
    g. Soil mining
    h. Other.....
2. Is there any evidence of people in the community engaging in sand mining in this community
    a. yes
    b. no
3. Was the sand mining site once used for farming and fishery activities?
    a. yes
    b. no
    c. If yes, what was the approximate average yield per ropani or metre? /Which crops were being cultivated?.....
4. Can sand mining create a reliable and alternative job opportunity for inhabitants in the district?
    a. yes
    b. no
5. How much does the sand miners/loader/driver earn per/day……..?
6. To what extent do you agree to the following regarding the job Creation?
    a) Family member occupied
    b) Family member earning increased
    c) New business start
    d) Youth involvement increase
7. Have you ever a visit to the site of sand mining in the community /district?
    a) Yes
    b) No

If yes, how can you describe the methods used in the sand mining activity in terms of its impacts on the soil and environment?

a) Very good

b) Good

c) Very bad

d) Bad

e) Not certain

8. Methods used by sand miners are responsible for the degradation of land in the area.

a) Strongly agree

b) Agree

c) Strongly disagree

d) Disagree

e) Not certain

9. Do you agree of sand miners are contributing to the scarcity of agricultural lands?

a) Strongly agree

b) Agree

c) Strongly disagree

d) Disagree

e) Not certain

10. Have there been any conflicts between miners and community members in the past?

a) Yes

b) No

If yes, what were the causes of the conflict?

.....

11. In your opinion does sand harvesting contribute to school drop outs among youths in the area? Yes …… No…….

If yes, please state

how……

……

12. Do you have occurrence of diseases in the area due to extracted Sand River's water?

a) Yes

b) No

c) If yes, what are the common diseases?

.....

13. What do you think insurance for workers?
    a. Important
    b. Not important
14. Do you have the following other positive benefits of sand mining in the area?
    a) Yes
    b) No
    c) If yes, what are the common benefits?
    .....
15. Do you have the following other impacts of sand mining in the area?
    a) Deforestation
    b) Diseases
    c) Shortage of water resources
    d) Reduced farm size
    e) Prevalence of accident
    f) Increased risks of floods and erosion
    g) Pollution
    h) Increasing crimes and conflict
    i) Traffic congestion
    j) Others.....
16. Do you have the following other impacts of sand mining on the environment in the area?
    a) Soil Erosion
    b) Lost of trees and vegetation
    c) Eruption of Diseases
    d) Destruction of Natural Habitats
    e) Pollution contribution
17. What are the institutional challenges associated with the Sand and mining industry during its extraction?
    a. Management
    b. Leadership
    c. Coordination
    d. Communication
18. Who is responsible for the response and supervision of the Sand and gravel extraction area?

a. Central Government
b. Provincial Government
c. Local Level Government
d. Community
e. Security forces
f. Others

19. Approximately, how many trucks pass through your village in a day?
    a. 0-5
    b. 6-10
    c. 11-15
    d. 16-20
    e. 20 and above
20. Does transport need a river entry permit or not?
    a. Always
    b. Never
    c. sometimes
21. In your opinion does sand harvesting contribute to illegal mining among the youth in the area? Yes……. No……. If yes, please state how……?
22.) In your opinion has illegal sand and mining contributed to environmental degradation? Yes …… No…….
    If yes, please state how……
23. Do you feel there is a lack of awareness locally about the issues of sand mining? a)Yes
    a) No
    b) If yes, which factors or critical issues (e.g., political, socio-cultural, biophysical) contribute to this awareness gap??
    a. Political
    b. Socio-cultural
    c. Environment
    d. Economic
    e. Other
24. What factors should be reflected in an ideal transparency and accountability framework for a resource such as sand that is mined regionally and traded regionally and globally?
    a. Strengthen standards and best practices to control irresponsible extraction

b. Invest in sand production and consumption measurement, monitoring and planning
c. Establish dialogue based on transparency and accountability

25. What governance arrangements (i.e., at local or global levels) for sand resources are needed to improve relationships among stakeholders and/or address critical impacts (e.g., new rules, governing organization)?
    a. New Rules
    b. Governing organization
    c. Amendments in the existing standard
    d. Addressing new challenges of stakeholder
26. What can you recommend as the immediate solutions to the negative impacts of sand mining and gravel extraction:

    (a) At Melamchi community level----------

    (b) At District level----------

    (c) At the national level.....

27. What do you think can be done generally to solve problems of the harmful effects of the phenomenon and to improve upon it?
    a. Avoiding unnecessary consumption.
    b. Recycled and alternative materials using to replace natural sand in construction.
    c. Reducing extraction impacts through implementing existing standards and best practices

    .....
28. What rehabilitation program me' can be implemented in your area---------- -
    ----

APPENDIX-II

Government of Nepal
Ministry of Home Affairs
APF Command and Staff College

Ph.No. :01-4513159
Fax No .:01-4414129
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Ref. No.: - (078/079)/ 600

Acedemic Section
Sanogaucharan, Kathmandu

Date:-2079/03/17

Respected Sir/Madam,

TO WHOM IT MAY CONCERN

I am pleased to introduce myself as the Course Coordinator of APF Command and Staff College, Sanogaucharan, Kathmandu, Nepal.

It is our pleasure to inform you that Armed Police Force, Nepal has been running APF Command and Staff College **"Master of Security, Development and Peace (MSDPS)"** a two year, four semester Master's Level program, affiliated to the Tribhuvan University, Faculty of Humanities and Social Sciences.

In this regard, the Student Officers of 6th APF Command and Staff Course are undergoing through a research-writing assignment according to the curricula of this MSDPS study. Regarding our Student Officers, they are actively serving Armed Police Force, Nepal for more than 15 years. They are all responsible government service holders and any information provided will be used for the research and study purpose only.

Therefore, I would highly appreciate if you provide some relevant information and data that may be required to their research study.

For any further query, it would be my pleasure to avail my service.

Anticipating and appreciating your kind cooperation and assistance to the student concerned.

Any information regarding the subject can be obtained from its official website: - **http://csc.apf.gov.np**

Name of the Student : **Radheshyam Dhimal**

Rank : **Deputy Superintendent of APF, Nepal (DSP)**

Thesis Title : **Socio-economy of the Indrawati River Sand and Gravel Extraction in Kavrepalanchowk District Respectfully,**

Raju Ram Suwal
Deputy Inspector General of APF, Nepal (Retired)
Academic Program Coordinator
APF Command and Staff College, Sanogaucharan, Kathmandu
Contact No. 9851269999

APPENDIX-III

Some Pictures

Some Pictures of Key Information Interviews

Interview with Mayor of Melamchi Municipality

Interview with Environment Officer of Melamchi Municipality

Interview with Local Police Officer

Interview with Agriculture Officer of Melamchi Municipality

Interview with Ward Chairman of Melamchi Municipality, Ward No.11

Interview with Ward Chairman of Melamchi Municipality, Ward No.12

Focused Group Discussion