LIVELIHOOD IMPACTS OF SAND HARVESTING ALONG KERIO RIVER IN KERIO VALLEY, KENYA.

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DECLARATION

DECLARATION BY THE CANDIDATE

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ABSTRACT

Sand in riverbeds is vital for human wellbeing and sustenance of rivers. The People living in Arid and Semi Arid Lands experience livelihood challenges due to frequent drought episodes. In response, inhabitants of these areas have evolved various coping strategies such as sand harvesting. Sand harvesting is inevitable due to its ever increasing demand attributed to rapid population growth and urbanization which has led to expansion in infrastructure and construction industry. It focused on the livelihood impacts of sand harvesting along the Kerio Valley. The objectives of the study were to examine the impacts of sand harvesting on the livelihood of the community; to compare sand harvesting with other livelihood strategies in the study area and to examine the existing policies/legislation and their implications on sand harvesting. The study used descriptive design, purposive and snowball sampling designs. The study involved 136 respondents and used questionnaires, observation schedules and key informant interviews. Data was analyzed descriptively using Statistical Product and service solutions IBM SPSS Statistics version 20. The findings showed that, sand harvesters operate and earn in different levels of income leading to income disparities. Despite low income from sand harvesting, the results showed that it had enabled harvesters to acquire assets with key financial capital in the form goats and sheep. It also showed that sand harvesting is dominated by male with females only engaged in economic activities that complimented it. Sand harvesting from the findings recorded the highest percentage on a likert scale to have helped families very much in handling the very basic needs hence presenting a viable livelihood option besides farming the most prominent livelihood strategy in the study area. The existing, and enactment of new laws to be used to manage sand harvesting is lacking. In conclusion, the full potential of sand harvesting is yet to be realized. On the basis of the findings, the study recommends, the strengthening of control of sand harvesting; increasing access to an appropriate combination of assets, creating an enabling policies environment and supporting local institutions.

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ABBREVIATION AND ACRONYMS

SRL	Sustainable Rural Livelihoods.
DFID	Department for International Development.
SLA	Sustainable Livelihoods Approach.
FAO	Food Agricultural Organization.
PIP	Processes, Institutions and Policies.
FGDS	Focused Group Discussions.
TSHC	Technical Sand Harvesting Committee.
RRMA	Riparian Resource Management Associations.
EMCA	Environment Management and Coordination Act.
DEC	District Environmental Committee.
NET	National Environment Tribunal.
IIED	International Institute for Environmental Development.
SPSS	Statistical Package for Social Science.
DDP	District Development Plans.
NEMA	National Environment Management Authority
EMP	Environmental Management Plan
KSHS	Kenyan Shillings
USD	United States Dollars
USA	United States of America

OPERATIONAL DEFINITION OF TERMS

Household; A group of people who live in the same dwelling or compound and eat together and consider themselves a unit in making plans and decisions about their daily life and activities like, production, consumption and reproduction. The main breadwinner and key decision maker in a household is a household head (Carney, 1998).

Livelihood comprises of the capabilities, assets (including both material and social resources) and activities required for living. According to Ellis, a livelihood is comprised of; the assets, the activities, and the access that, together determine the living gained by the individual or household (Ellis, 2000).

Sustainable Livelihood; A livelihood is sustainable when it can cope with and recover from stresses and shocks and manage to enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (Chambers and Conway, 1991)

Sand is a naturally occurring granular material composed of finely divided rock and at times mineral particles. It is also a substance consisting of loose grains of rock or minerals, usually quartz fragments, found on beaches, in deserts, river course and in soil, sometimes used as a building material (Bagnold, 1941).

An arid condition is a state of land being deficient in moisture leading to scarcity of vegetation (Kibuuka, 2004).

Arid and semi-arid lands are those areas or regions which receive between 100-600mm annual rainfalls, more specifically, Semi-Arid lands are those areas falling in the rainfall zones of 300-600mm, while arid areas are those falling between 0-300mm (FAO, 1987).

Asset refers to valuable or a property owned by an individual considered being of value in meeting debt and commitments (concise oxford English dictionary, 2011).

Livelihood strategies are defined as a portfolio of activities and the social relations by which families secure or improve their wellbeing or cope with crises **(**Valdivia and Gilles, 2010).

Loaders are sand harvesters involved in manual works

Transporters are those sand traders who ferry sand to the markets.

Land owners are the harvesters whose land sand harvesting takes place or whose land tributaries to Kerio passes or those who provide access routes for the trucks.

Social capital includes the social resources (membership of groups, networks, relationships of trust, access to wider institutions of society) upon which people draw in quest of livelihoods (DFID, 1999).

Financial capital is the financial resources which are accessible to people (whether savings, stocks, supplies of credit or regular remittances or pensions) and which give them different livelihood options (DFID, 1999).

Physical capital includes; important infrastructure like (roads, water, and shelter, energy) that help people in their quest for livelihoods (DFID, 1999).

Human capital involves the skills, ability, knowledge and good health which enable an individual or a household to pursue and sustain livelihoods (Scoons, 1998; DFID, 1999).

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CHAPTER ONE

1.0 INTRODUCTION

This chapter outlines the background of the study. It gives an overview of sand harvesting globally, regionally and locally. It also covers issues concerning the contribution of sand harvesting to the livelihoods of the local community; compares sand harvesting with other livelihood options like farming and the legislations relating to sand harvesting. In this chapter, the research problem will be highlighted. Arid and semi arid lands (ASALs) poverty levels, their environment and challenges in as far as livelihood options are concerned focusing on Kerio Valley as basis of the study will be used to illustrate the research problem. Moreover, the research problem, objectives, questions, justification, significance and the limitations of the study are also included in this chapter.

1.1 Background to the Study

Sand is a naturally occurring granular material consisting of a finely divided rock particles and is composed of silica (silicon dioxide) a very hard substance that does not wear out easily and originates from weathering of rocks (Bagnold, 1941).Sand harvesting involves a type of open cast extraction, which means the actual removal of sand in their natural configuration (Mwaura, 2013) from streams, creeks, beaches, rivers and lakes; it is also harvested from inland dunes and dredged from ocean beds.

In the recent past, there has been a sharp increasing demand for sand resource around the world due to rapid economic development and the subsequent growth in the construction sector (Ibid). By 2025 the global construction industry is expected to grow by about 70 percent to 15 trillion USD (Global Construction Perspectives, 2013).

The exploding global demand has led to the harvesting of sand from various sources faster than it can replenish itself. Pereira and Ratmayake (2013) noted that, sand

underpins the ‘development’ engine and without it, construction industry, which is one of the largest industries in the world, will come to a grinding halt. Generally, the construction industry is the pillar of economic growth and is widely considered a prime engine of growth and an important indicator of development.

The high demand has placed enormous pressure on sand resource particularly in newly developing and economically advancing nations like China and India as economic developments calls for strong growth in construction and infrastructure developments (Ibid).

However, sand harvesting has caused serious environmental concerns in the recent past globally. It has often led to land degradation; loss of agricultural lands and biodiversity as well as increased poverty among people (Mwaura, 2013). The sand harvesting activity is therefore becoming an environmental issue as the demand for sand shoots up in construction industry and infrastructure development (Kondolf, 1997).

In India, sand harvesting has negatively affected the rivers, sea, forests and other components of the environment. Unlawful harvesting of Sand and the poor governance enormously causes land dilapidation and endangers the rivers with extinction (Pereira and Ratmayake, 2013). Sand harvesting is depleting the waters of the rivers. Weak governance and uncontrolled corruption are facilitating unrestrained and illegal sand harvesting in the rivers, jeopardizing their very existence (Padmalal, Maya, Sreebha, & Sreeja, 2008)

Sand harvesting provides the main material for the construction in Ghana. The construction sector in Ghana relies heavily on sand in the building of bridges, roads and houses. The contribution of sand to industrial output in Ghana has risen over the past. In 2009, Musah noted that, sand harvesting has caused serious impacts in Ghana and around

the globe in the recent years. Musah in his 2009 research in Northern Ghana and the East Gonja District held that the impacts ranged from loss of biodiversity, land degradation and loss of agricultural lands. The study suggested the establishment of pragmatic and explicit laws in a participatory manner in order to allow for enforcement at all levels. Sand harvesting has also increased coastal degradation significantly in many areas of Ghana for instance, in many coastal spots near coastal area of Accra. In response, the government of Ghana has been forced to use millions of dollars to combat sea erosion (Mensah, 2002).

According to a study by O'king (2012) harvesting of sand in Kenya uses open cast method, owing to its nature and existence. Occasions of environmental degradation due to sand harvesting are therefore more pronounced and are reflected in the waterways of most nearby environment.Sand harvesting has caused soil erosion in many parts of Kenya, for instance in Machakos County. Machakos is the main supplier of sand to the construction industry in the city of Nairobi. Sand harvesting adversely affects surface water quality, quantity and interferes with aquatic ecosystem. The moving of sand by lorries leads to environmental degradation by hastening soil erosion and interfering with soil stability. Heaping of sand causes damage of surface areas through removal of vegetation; it also robs land that can be utilized for agricultural production (O'king, 2012).

Despite the adverse environmental impacts associated with sand harvesting, it is very important for human economic welfare and sustenance of rivers. According to a study on Frac sand mining and community Economic development by Deller and Schreiber (2012) in the USA, communities experience helpful impacts when sand harvesting is in operation and unhelpful impacts when the activity is closed. Deller and Schreiber in their

study revealed that sand harvesting in many ways can provide well paying jobs which results in low poverty levels; however, the study showed that the activity is associated with poorer overall health of the community.

There has been more consistent evidence that, sand harvesting has a positive impact on employment and income growth rates (Deller and Schreiber, 2012). As noted by Mwaura (2013), sand harvesting is of great economic importance in Kenya. He further observed that, harvesting of sand is one of the alternative livelihood activities of the rural people and has become a source of livelihood for many rural communities in Machakos County.

Countries that are not endowed with mineral deposits, or abundant natural flora and fauna have turned to exploiting the little natural resource endowments that exist in their territories. Kenya finds itself in this group of resource "deficient" nations and citizens exploit any naturally occurring resources within their proximity (Mwasaa, 2012) for instance, the naturally occurring sand in Kerio Valley.

Kerio Valley falls under arid and semi-arid areas of Kenya. All over the world arid and semi-arid areas (ASALs) experience challenges brought about by extended drought and inadequate rainfall made worse by flash floods. These conditions lead to low soil moisture and the consequent reduced biological productivity. The arid conditions due to deficient moisture on the land experienced in these areas limits the livelihood options. Therefore, diversification of livelihoods has been put forward as one way of dealing with challenges to typical production patterns as noted by World Bank (2008).

The limited livelihoods in Kenya's ASALs is of great concern since a study by Muthui (2009) affirms that, African rural livelihoods are largely derived from rain fed agriculture

with 70% of the continent's population relying on agriculture. In Kenya, research shows that over 80 percent of the population earns their living by engaging in agricultural activities or employed in agricultural sector (Mose, 1999).

The unreliable rainfall in ASALs has made the inhabitants of these areas have come up with coping strategies (Kiptui, 2008) hence Kerio Valley is not an exception. Sand harvesting has the potential of being exploited as an alternative livelihood option in Kerio Valley as confirmed by Mwaura (2013) to be the case in Machakos. There is need therefore to sustainably maximize on the sand as one of the available resources in the ASALS to sustain livelihoods due to the readily accessible market.

1.2 Statement of the Problem

The rapid expansion of towns near Kerio Valley has significantly increased demand for sand along Kerio river. Extensive sand harvesting is ongoing with the booming infrastructure and construction industry mainly in Eldoret and other neighboring towns. Such extensive and unregulated harvesting is detrimental to the environment and significantly affects livelihood aspects of the community.

Sand harvesting for a very long time has not been recognized as an issue of concern. Furthermore, it's classification as a low value resource has made many governments and economies to be slow in recognizing the linkages between sand harvesting, livelihoods and environmental issues; surprisingly, not much literature exist on such linkages (Pereira and Ratmayake, 2013).

Sand harvesting has become an important activity in the development of many societies. However, it's unsustainable harvesting has caused significant livelihood and environmental effects. Sand harvesting from streams or rivers can decrease water quality for downstream users; damages aquatic ecosystem and result in the destruction of

underground aquifer. Moreover, it leads to loss of agricultural land; other risk effect like, formation of deep holes and hollows that frequently collapse leading to injury and loss of lives to human beings and animals.

In spite of sand harvesting impacting on the environment negatively, it has continued to earn income to the inhabitants of the places where it is harvested. Sand harvesting in the study area presents an alternative livelihood due to challenges in production patterns. ASALs are characterized by frequent droughts leading to crop failures and the subsequent famine. Communities in these areas rely heavily on natural resources and have devised ways of survival, one being the diversification of livelihoods.

The extensive sand harvesting, possibly uncontrolled coupled with the impending impacts which has already taken toll in areas like Machakos County; the potential of sand resource in improving the lives of the community and the inadequate documentation of the livelihood impacts using sustainable livelihood approach framework (SLA) informed the decision to carry out this research.

The gap that was acknowledged in the United Nations [UN] convention of 2012 in India) of inadequate documentation of sand harvesting issues has been filled by the study. This gap was also acknowledged by and Mwaura (2013) in his study on impacts of sand harvesting on economic growth in Kenya. Another gap that has been filled by this study is the use of sustainable livelihood approach framework (SLA) in assessing the livelihoods and how they have been impacted by sand harvesting. SLA framework is capable of methodically breaking down an otherwise complex social phenomenon into parts that can be used to spot areas of probable intervention for sustainable development (Maseko, 2013).There has also been an indication of possible significant impact of sand harvesting on livelihood due to the fast growing construction industry in the towns near Kerio valley.

1.3 Objectives of the Study

The main objective of this study was to investigate the impacts of sand harvesting on the livelihoods of the community along the Kerio River in Kerio Valley.

The Specific Objectives are:-

1. To examine the impacts of sand harvesting on the livelihoods of local community along Kerio river in Kerio Valley
2. To compare sand harvesting with other livelihood strategies along Kerio river in Kerio Valley
3. To examine the existing policies and legislations and their implications on sand harvesting.

1.4 Research Questions

The study was guided by several questions as follows;

1. What are the impacts of sand harvesting on the human, social, physical, natural and financial capitals/assets?
2. What are the other livelihood strategies employed by the people in the study area?
3. How is sand harvesting contributing to livelihoods compared to other livelihood options?
4. What are the regulatory mechanisms established for sand harvesting in the area?
5. Does the sand harvesting activity conform to the established regulations?
6. What are the proposals for policy on sand harvesting in ASALs?

1.5 Justification of the Study

Limited livelihood options are a common phenomenon in the ASALs and the survival of the inhabitants in these areas are often determined by the available natural resources. The

people living in arid and semi-arid lands will always depend heavily on the environmental resources. Therefore, Kerio Valley residents are not an exception given its arid and semi arid conditions.

Individuals and Private companies have accelerated demand on sand for construction purposes and have consequently placed massive pressure on sand resources. Sand harvesting is becoming an environmental concern as the demand for sand increases in the infrastructure development construction industry (De Leeuw, 2009).

The ever increasing demand of sand for the expanding economy and the ready availability of sand can be sustainably harvested to support livelihoods and at the same time environmental conservation be guaranteed. The rationale behind this study rests on the contribution of sand harvesting in improving livelihoods guided by sustainable livelihood framework.

1.6 Significance of the Study

This study generated relevant information on the livelihood impacts of sand harvesting in comparison with other livelihood options in ASALs using sustainable livelihood approach framework and the impact on the environment. It also enriched and updated literature on sand harvesting as an alternative sustainable livelihood options in ASALs and its challenges. The ultimate information generated will be useful in influencing policy and intervention by development agencies. Sustainable utilization of the sand resource may be enhanced as an important livelihoods option to the community in the study area owing to rainfall unreliability which leads to arid conditions. This challenges calls for diversification of livelihoods as a survival strategy.

1.7 Limitations and Scope of the Study

The study was conducted using a non-probability sampling, the snow balling technique owing to the non-existence of a list of sand harvesters and therefore the generalization of the results will require replication of results.

The biases associated with the snowball technique were addressed by using a considerably larger sample size. Furthermore, Snowball was done using various waves to allow the composition of respondents to be independent of the initial subject.

The study covered Kerio Valley along Kerio river. It was confined to sand harvesters and it focused on examining the on livelihoods impacts of sand harvesting, using sustainable livelihood approach framework developed by the Department for International Development [DFID] (1999) with a focus on capital assets and transforming structures. It also compared sand with other livelihood strategies and examined the policies and legislations on sand harvesting in order to enhance its sustainability.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter focuses on available literature on sand harvesting globally, theoretical and conceptual framework of the study.

2.2 Sand

During ice age, there were beaches and dunes. The calcium carbonates mixed with sand locked up in beaches and dunes are radio-carbon dated to about 9000 years old, referred to as modern Holocene sand. The ice age ended by 6000 years ago and the sea level rose pushing sand toward s the land and the beaches and dunes formed essentially where they are today (Ferguson, 1974).

The present day sand which adds into the pool of existing sand, originate from weathering of rocks under the soil and vegetation, and washed down the rivers to the ocean and seas. Weathering of the rocks involves the changes in physical and chemical components of rocks. The process of weathering on the earth's surface is caused by mechanical forces like heat, cold, wind, water, ice and plant roots, which gradually break down rocks through physical means. Chemically, liquids dissolve and disintegrate rocks for example plant-like organisms such as lichen and acid rains leading to breaking up of rocks due to changes in their chemical makeup, resulting in the formation of sand (Ibid). Biological weathering is not a process in itself but rather composed of both mechanical and chemical weathering. For instance, mechanical fracturing of rocks may be caused by the tree roots, also fungus and moss grows on rocks and they produce weak acids that make the rocks to disintegrate hence chemical weathering.

Sand is mainly composed of silica (silicon dioxide). This substance is extremely hard,

hence resistant to erosion and its origin dates back to approximately a million years ago from volcanic eruptions. Silica has got no carbon in it making it difficult to carbon date, but in between the sand particles is organic matter and calcium carbonates which allows for carbon dating (Ferguson, 1974).

Uncontaminated sand is certainly rare on land, but common in sand dunes, rivers and beaches. The constituent of sand greatly varies, dictated by the local rock sources and conditions, but the most common composition of sand in inland continental settings is silica (silicon dioxide) more often in the form of quartz which is chemically inert and substantially hard, hence the main mineral known to resist weathering (Heyworth, 2007).

The white sand in tropical and subtropical coastal areas comprises of eroded limestone and may have coral and shell fragments together with other fragmental material of organic origin. The gypsum sand dunes of the White Sands National Monument in New Mexico are prominent for their bright, white color. Arkose is a sand or sandstone with a substantial feldspar content, originating from the weathering and erosion of a (usually nearby) granitic rock outcrop. Some sands contain magnetite, chlorite, glauconite or gypsum. ISO 14688 grades sands as fine, medium and coarse with ranges 0.063 mm to 0.2 mm, 0.25 mm to 0.50 mm and 0.63 mm to 2.0 mm respectively (Ibid*)*.

2.3 Sand harvesting

Sand harvesting is the practice of the actual removal of sand from the foreshore including rivers, streams and lakes. Sand is extracted from beaches and inland dunes and excavated from ocean beds and river beds. Harvesting of Sand has become a very important resource for our society due to its many uses. It can be used for making concrete, filling

roads, building, making glass, sandpapers, reclamations, the protection of the coastal environment through, acting as a barrier against strong tidal waves and storms by lessening their impacts as they reach the shoreline. Sand is also a home for crustacean species and breeding grounds for other aquatic organisms an example being turtles; furthermore, it has a significant role in tourism industry as it is a central part of our beach attractions; for example sand is suitable for activities like sand bathing (Sadasivan, 2003). In china, sand harvesting has been reported in Poyang Lake. The pressure on sand is caused by economic advancement in the lower Yangtze River valley, surrounded by rapidly growing major cities including; Wuhan and Hangai. Sand harvesting was banned in Yangtze River due to uncontrolled extraction hence focus shifting to Lake Poyang. In 2005, an estimate of 236 million cubic metres of sand per year was extracted from Poyang River, which contributes to about 9% of China's total sand demand, making Poyang Lake as one of the largest harvesting operation in the world (De leeuw, 2009).

Sand harvesting in United States of America (USA) has been growing tremendously, estimated to be over a billion dollars a year. The major market share of sand harvesting business is held by Illinois and Texas. Wisconsin is one of the five states that produce nearly two thirds of the nation's silica. As of 2009, Wisconsin, along with other northern states, is facing an industrial sand harvesting boom, being dubbed the "sand rush" because of the new demand from large oil companies for silica sand (Schreiber, 2012).

The recent boom in silica sand harvesting has caused concern from residents in Wisconsin that include; quality of life issues and the threat of silicosis disease. Silicosis results from long term (chronic) or even shorter but intense exposure(acute) to high levels of inhalable dust that contains a significant proportion of silica (Akgun *et al*., 2006). Sand harvesting in the USA has also resulted in erosion and collapse of beachfront houses and properties as the activity distablelizes the grounds of the nearby areas.

According to some experts, more than 70% of the world's beaches are under threat of vanishing completely. Many already require repeated artificial replenishment of sand taken from other beaches and degrading those (Schreiber, 2012).

Other areas where sand harvesting has been studied include; offshore New Jersey and offshore of Maryland and Delaware. Environmental concerns associated with potential sand mining operations in the offshore New Jersey where sand harvesting is done for beach replenishment has been noted and documented. The sand harvesting impacts on the possible changes to physical oceanographic processes that might resulting from modification due to dredging or sand mining in the offshore of Maryland and Delaware has been noted (Schreiber, 2012).

Rivers of India are currently degraded because of uncontrolled sand-harvesting on their banks and beds; badly impacting their capacity to sustain the current levels of economic activities. Intensive sand harvesting has therefore been experienced. The Washington Post states that; after China and the United States, India has the world's largest construction business which accounts for 9 percent of its 2 trillion USD economy. The country plans to invest 500 billion USD in building up its infrastructure and 500 million USD has been earmarked for the construction industry alone.

Sand is considered as a 'minor mineral' in India and its harvesting is controlled by State Governments. However, the Ministry of Environment and Forests of India lacks an efficient regulatory framework to control it. At one point the Supreme Court of India ordered the regulation of sand harvesting following the murder of a Police officer who tried to control sand harvesting in his jurisdiction and the National Green Tribunal passed orders banning sand harvesting in river beds.

There has been no serious measure put in place to address the effects of sand harvesting

in India. This negligence of sand impacts exists despite the large volumes of sand and gravel being extracted from rivers to meet the ever increasing demand from the construction industry (Padmalal *et al*., 2008).

A number of sand harvesting impacts have been documented in India through various studies. A study of the lthikkara river (Kollam district) noted that, out of the 25 freshwater fishes recorded in the river, a total of l6 fish species are under threat, mainly, due to habitat loss resulted from sand mining. Another study in Kulsi river Assam revealed that, one of the causative factors for the decline of river dolphin population was indiscriminate sand extraction and related disturbances in the river. Other research have found out that illegal sand harvesting was taking place on the banks of Shimsha river near Kokkare Bellur in Bangalore, Padamalal *et al*., (2008) painted a picture on the environmental effects of river sand mining from the Pamba river and stressed the need for regulating the mining activity on an environment-friendly basis (Ibid).

Fishermen and other coastal dwellers that have lived for centuries in harmony with their natural environments have seen their traditional fishing businesses decline. Consequently, former fishermen have been turned to be sand miners instead, actively degrading their environment due to short term gains. Proliferation of child labour has been experienced in sand harvesting trade due to the readily available cash and the consequent serious effects on health include; silicosis and cancer is a common phenomenon (Sadasivan, 2003).

Sand harvesting in India has impacted heavily on the infrastructure as exemplified by harvesting at the foot of a main railway bridge north from Mumbai. Sand harvesting in

this area has threatened the security of long and short distance commuters and has led to the vanishing of a small island in Vaitarna River completely. Extensive sand harvesting has also eroded the stability of road and railway bridges in many parts of India.

Mangrove forests have begun shrinking as the sand dredgers cut through fragile creeks near Narangi, north of Mumbai. In many places across India, farmers experienced the river water engulf their rice farms because of too much sand excavation. Fishermen say it is killing fish, and wells in riverside villages are drying up in many areas, the nearby residents are at the risk of losing farmland and their livelihood (Sreebha and Padmalal, 2011).

In the Convention of Biodiversity hosted by India in 2012, sand harvesting was raised for the first time as one of the most severe threats to coastal environments at a side event by Awaaz Foundation and the Bombay Natural History Society. In the main Convention, although coastal issues were one the top focus areas contained no mention of sand harvesting at all. Conceding the seriousness of the issues, individual members of UN bodies represented at the Convention acknowledged that sand harvesting did not form any part of their numerous studies and documents on coastal environment and sand was not covered under any International Convention in spite of trade between countries (such as sand imported into India from Pakistan or into Singapore from Indonesia.

'Sand Wars' a film directed by Denis Delestrac and 'Mumbai' for the French 'Arte' are two documentary films which recorded for the first time the extent of sand harvesting in many parts of the world. Sand harvesting is an increasing menace all over the world, as documented by Denis Delestrac's 'Sand Wars' premiered in Paris in May 2013. Allegedly, Singapore has expanded its coastline through illegal sand harvesting in Indonesia and Cambodia, and as a direct result, Indonesia has lost entire islands (Delestrac, 2013).

In United Kingdom, under the project 'Effective Development of River Mining', a number of efforts have been put to control sand and gravel mining operations with a view of protecting local communities; reduce environmental degradation and aid long-term rational and sustainable use of the natural resource base. The multidisciplinary studies carried out as part of this project generated a wealth of information on the impact of river sand mining. A set of proposed planning guidelines for the management of river mining in developing countries taking the case of a few Jamaican rivers has been put forward (Harrison, Fidgett, Scott, MacFarlane, Mitchell, Eyre, and Weeks, 2005).

Sand harvesting in Ghana uses a type of open-cast method that provides material for the construction sector in Ghana. The construction sector in the coastal areas of Ghana relies heavily on coastal sand and pebbles in the building of houses, bridges and roads. The contribution of sand to industrial output in Ghana has risen.

A research by Musah (2009) in Northern Ghana and the East Gonja District noted that, sand harvesting has caused serious environmental impacts in Ghana and around the globe in the recent years ranging from loss of biodiversity; land degradation and loss of agricultural lands. The study suggested the establishment of pragmatic and explicit laws in a participatory manner in order to allow for enforcement at all levels. Sand harvesting has also increased coastal degradation significantly in many areas for instance, in many coastal spots near coastal area of Accra. In response, the government of Ghana has been forced to use millions of dollars to combat sea erosion (Mensah, 2002).

Sand harvesting is common in Kenya's arid and semi-arid areas but left uncontrolled depletes water catchment areas hence, there is need to strike a balance between it and environmental conservation and use of sand resource in order to promote sustainability. Sand harvesting employs thousands of people owing to the current booming construction

industry however, the share of monetary benefits is very minimal (Mbathi, Ngau, Gichuki, Mungai, Gachene, and Thomas, 2000).

Sand harvesting is common mainly in Machakos due to the pressure from expanding city of Nairobi and the high poverty levels due to ASAL conditions. At one point sand harvesting in Machakos was banned due to massive environmental degradation as a result of haphazard scooping which leaves holes that may collapse on the extractors or even leads to land dereliction and robs farmers of agricultural land.

Sand harvesting has also resulted in a lot of soil erosion in many parts of Kenya for instance, Machakos district which is the main supplier of sand to the Nairobi construction industry. Sand harvesting also adversely affects surface water quality, quantity and interferes with aquatic ecosystem. The moving of sand by Lorries leads to environmental degradation by hastening soil erosion and interfering with soil stability. Heaping of sand causes damage of surface areas by removal of vegetation; it also robs land that can be utilized for agricultural production (O'king, 2012). Kerio Valley is increasingly experiencing the pressure of sand harvesting, necessitated by the expansion of the surrounding growing towns especially Eldoret town. Furthermore, its proximity to the town and the cost implications makes it a better option than sand from other harvesting areas like Kisumu.

2.4 Impacts of Sand Harvesting

According to geologists, unsustainable sand harvesting from the riverbed leads to the damage of the entire river system. If sand is extracted in quantities higher than the ability of the river to replenish them, it leads to changes in its channel form, physical habitats and food webs in the river's ecosystem (Meador, 1998).

Harvesting of river sand has become an issue of attention in the recent times, because of the increasing demand and rising cost of river sand for construction purposes. Off shore sand harvesting is often anticipated to be substitute to beach sand harvesting. Broad research must be carried out before any river sand harvesting can be attempted. Offshore sand banks, coral reefs and sea-grass beds disperse the force of storm waves and if large quantities of sand are harvested from offshore sand banks in locations where replenishment would not occur, serious coastal damage would result in the event of a major storm (Ponce, 2002).The impacts of sand harvesting can be grouped into physical, biological, socio-economic and livelihood.

2.4.1 Physical impacts

The scooping of sand from the river beds accelerates the speed of the flowing water; it damage flow-regime and ultimately erodes the river banks. Beside these effects, there are other associated off-site impacts for instance, Sand acts similarly to a sponge which aids in recharging the water table hence, its progressive depletion in the river consequently leads to sinking water tables in the nearby areas, adversely impacting people's daily lives, even their livelihood (Mbathi *et al*., 2000).

Extraction of streambed materials through harvesting/dredging below the existing streambed, and the modification of channel-bed form and shape leads to several impacts. These impacts are; the wearing out of channel bed and banks; enlarged channel slope and change in channel morphology. Consequently the above impacts may lead to; the undercutting and crumpling of river banks and the damage to the nearby land and/or structures. Upstream erosion is also experienced as a consequence of an increase in channel slope; changes in flow speed and downstream erosion due to enhanced carrying

capacity of the stream and also downstream changes in sites of deposition. Persistent harvesting may also cause the whole streambed to wear out to the depth of excavation (Kondolf, 2001) and also impact on bridges and other structures by destabilizing them. The changes in stream bed and the nature of habitat during bed degradation and bed coarsening lowers water tables near the channel bed causing channel instability (Ponce, 2002).

A study in Tamil Nadu India showed that sand harvesting had led to the undercutting and collapse of riverbanks and the loss of adjacent land and or structures. Increase in channel slope and changes in flow velocity respectively leads to upstream erosion and downstream erosion is experienced due to increased load carrying capacity of the stream and downstream changes in patterns of deposition and changes in channel bed and habitat type (Padamalal *et al*., 2008).

Channel cutting not only result in vertical unsteadiness in the channel bed but also leads to lateral instability in the form of accelerated stream bank wear out and channel expansion. Vertical cutting lengthens stream bank heights leading to bank collapse as the mechanical properties of the bank composition fail to hold the weight of the material. Channel broadening causes siltation of the streambed as deep pools fill with sediments. Raising the river bed and broadening of the channel in addition, enhances stream temperature extremes, and channel instability accelerates transport of sediments downstream.

The wearing out of the river bed slows water flow speed and reduces flow energies causing sediments originating from upstream to deposit at the harvesting site. As stream flow advances past the site and flow energies gain momentum, in response to the "normal" channel form downstream, the quantities of transported sediment leaving the

site is now less than the sedimentcarrying capacity of the flow. The stream flow deficient of sediments or ("hungry") picks up more sediment from the stream reaches below the extraction site, furthering the bed degradation development (Kondolf, 1997).

Kondolf (1997) explained mining in a stream to be a major source of environmental impacts which comprise of channel modifications. The modifications are; widening or deepening of the channel; creation of deep pools; alteration of bed load; alteration of channel flow; degraded natural vistas; upstream and downstream erosion bridge scours and impacts on infrastructure. Also, mining result in the modification of channel characteristics particularly the extraction of more material than the system can naturally replenish. This can result from removal of too much material at one site or the combined result of many small but intensive operations (Rowan and Kitetu, 1998).

Furthermore, sand harvesting in the streams will have an impact upon the river's water quality. They include; increased short-term turbidity at the harvesting site due to suspension of sediment. Sedimentation resulting from stockpiling and discarding of remaining extraction materials; organic particulate matter and oil spills or leakage from excavation machinery and transportation vehicles may cause a number of impacts. This impact includes; reduced water quality for downstream communities and aquatic ecosystem; increased cost for downstream water treatment plants and poisoning of aquatic life. The impact is mainly major if water users downstream of the site are abstracting water for household use (Ponce, 2002).

2.4.2 Biological impacts

Biological impacts are experienced as sand harvesting result in the removal of channel substrate; re-suspension of streambed sediment; removal of vegetation and stockpiling on the streambed. These impacts may have an effect on the direct loss of stream reserve

habitat and interruption of species attached to streambed deposits. It also lessens light penetration; dwindling primary production, and diminishes feeding opportunities (Meador, 1998).

Sand harvesting promotes extra vehicle traffic, which negatively impairs the environment particularly where access roads cross riparian areas. Harvesting of sand turns the riverbeds into huge and deep pits hence, the groundwater table drops leaving the nearby drinking water wells to dry up. Bed degradation from in-stream harvesting reduces the elevation of stream flow and the flood plain water table which in turn can get rid of water table-reliant woody vegetation in riparian areas, and shorten wetted periods in riparian wetlands. For areas near to the sea, saline water may intrude into the fresh water body. Harvesting of sand in streams leads to the destruction of aquatic and riparian habitat due to large changes in the channel morphology (Ponce, 2002).

The physical effect of bed degradation; bed coarsening; lowered water table near the stream bed and channel instability leads to degradation of riparian and aquatic life. Other impacts include; modification of aquatic habitats including spawning bed nursery habitat; riparian habitats and degradation of water quality including; increased turbidity; reduced light penetration; increased temperature and re-suspension of organic or toxic materials (Meador, 1998). Meador and Layher (1998) found out that erosion caused by in-stream mining can cause bank failure which can cause loss of riparian habitat and loss of shade along the stream banks. Fine sediments of sand and gravel mining is one of the major environmental factors in the degradation of stream fisheries (Waters, 1995)

2.4.3 Socio-economic and livelihood impacts.

Besides the environmental impacts associated with the sand harvesting activity, sand has got a number of impacts to the society. This is supported by the findings from various parts of the world for example Togo, Ghana and Kenya as discussed below.

Sand harvesting and transport industry in Togo has played an important role in the boosting of local economy for many years. Sand harvesting and quarrying in Togo has been rated second after agriculture as a source of rural employment nationally. The Togo National Report (2007) revealed that one of the largest employer is sand and gravel harvesting and it identified a lot of jobs associated with the activity of sand and gravel harvesting ranging from laborers to firm managers and truck drivers.

The study also noted that the activity is dominated by males however, there were a number of women who are engaged in small business enterprises associated with sand harvesting activity. Sand and gravel harvesting in Togo has significantly created jobs for youths. The other associated benefits of sand harvesting include; generation of income and local revenue which is used in to meet the very basic needs of the families including; food, school fees for children and even entertainment (Ayenagbo, Kimatu, Gondwe, and Rongcheng, 2011).

In northern Ghana according to Musah (2009) sand and gravel harvesting has had both socio- economic and ecological impacts. Ecological impacts of sand mining included; creation of open pits which provide breeding grounds for mosquitoes and spread of other waterborne diseases. Also the other impacts are; Soil erosion; loss of vegetation; landscape destruction; biodiversity loss; loss of grazing land; dust pollution ; routes of conflicts and loss of economically important trees are the other impacts of sand

harvesting. The positive impacts of mining are enhancing infrastructural development such as roads (Musah, 2009).

Although sand harvesting cannot be completely stopped, the government and other stakeholders should develop new laws and policies which should aim at promoting sustainable harvesting by striking a balance between environmental conservation and business proceeds. Sand needs to be exploited to satisfy human demand but this requires efficient and effective resource management to ensure economically and environmentally sustainable utilization (Musah, 2009).

A research conducted on the environmental impacts and the socioeconomic impacts of sand harvesting in semi arid areas of Kenya by Mutisya (2006) revealed that sand harvesting activity had impacted on the community socio economically. Mutisya noted that sand harvesting had provided a source of income and employment opportunities. However, other negative social problems like conflicts between the harvesters which often lead to deaths are associated with the sand harvesting activity. Other consequent issues include prostitution, alcohol and drug abuse.

Sand harvesting has contributed significantly to the economic development in areas where it is done. The economic impact of sand harvesting has been realized through the creation of employment opportunities; creation of local supply of raw materials for the construction industry; generation of export revenue and alleviation of poverty (National Environment Management Authority [NEMA], 2004). However, sand harvesting has recorded negative social and health problems including prostitution; high school dropout rate; rise in alcoholic and substance abuse; sexual misbehavior and drug addiction.

Sand harvesting has been associated with a number of health impacts. Dust from sand harvesting has been the main source of air pollution. Outdoor air pollution alone causes an estimated 8000 deaths each year especially in the developing world. Furthermore, noise pollution from the trucks is a nuisance to the human and it is a major threat to the quality of human lives. Although noise is a significant environmental problem it is often difficult to quantify associated costs.

2.5 National Sand Harvesting Guidelines

Section 42 (4) of the Environmental Management and Coordination Act (EMCA) mandates the Director General of the Kenya National Environment Management Authority(NEMA) to issue the National Sand Harvesting Guidelines. First, the Technical Sand Harvesting Committee (TSHC) as per the guidelines should be formed in every Counties with members carefully selected as specified by the guidelines.

2.5.1 The Technical Sand Harvesting Committee will be responsible for the following;

i) The proper and sustainable management of sand harvesting within the County in respect of which it is appointed.

ii).The designation of authorized sand harvesting sites on riverbeds, lakeshores, seashores, farms, Government or Trust land, subject to the provisions of the Constitution of Kenya, Government Land Act, Trust land Act and Mining Act, Forest Act and any other relevant legislations, and define the extent of each Riparian Resource Management Association's area of operation.

iii). Perform any functions as may be prescribed by the County Environment Committee.

The Technical Sand Harvesting Committee will report to the respective District/County Environment Committee and its operations will be guided by the following

environmental and social considerations.

2.5.2 Environmental Considerations

The Technical Sand Harvesting Committee will ensure that:

a.) Sand dam(s)/ gabion(s) are constructed in designated sand harvesting sites;

b.) Where more than one sand dam/ gabion are to be constructed, they shall be at most 200 metres apart;

c.) Lorries will use designated access roads only to sand harvesting sites;

d.) Designated sand harvesting sites are rehabilitated appropriately by the Riparian Resource Management Association, County government and approved dealer under close monitoring and supervision by the Technical Sand Harvesting Committee in compliance with Environmental Management and Coordination Act [EMCA] (1999);

e.) Sand harvesting or scooping is restricted to the riverbeds with no harvesting allowed on riverbanks to avoid widening of rivers;

f.) It specifies the area of sand harvesting and the depth to which the harvesting will be done.

g.) The requirements of an environmental impact assessment/environmental audit pursuant to the Environmental Management and Co-ordination Act No. 8 of 1999 have been fulfilled (NEMA, 2007).

2.5.3 Livelihoods

The word livelihoods can be linked to many of other words to build complete fields of development research and application. These fields includes; rural or urban livelihoods; occupations (farming, pastoral or fishing livelihoods); gender/age-defined livelihoods; livelihood pathways and trajectories and sustainable or resilient livelihoods**.**

A variety of Livelihoods definitions exist in the literature. According to Chambers (1995).it refers to ‘the means of gaining a living’ or ‘a blend of the resources used and the actions/activities undertaken in order to live’. But a more elaborate definition was given by Chambers and Conway (1992):

“A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living”.

According to FAO, Livelihoods consist of the capabilities (knowledge and skills); material and above definition by adding a more precise concern of the claims and access issues, and specifically the effect of social relations and institutions that mediate an individual or family's capacity to secure a means of living.

Ellis (2000) defined livelihood as;

“A livelihood comprises the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household”.

This definition is supported by Sarou (2009) defining it as: “Livelihood is about ways and means of making a living based on the assets available and how people use these assets”.

2.5.4 Sustainable Livelihood

Sustainable development came as a result of the conference on World Commission on Environment and Development in 1987 and has since been the central idea in the interactions between the economy and the biophysical environment besides being a commonly accepted aim of environmental policy.

A widely accepted consensus of the meaning of sustainable development is that it entails economic activities being in harmony with; sustainable utilization of renewable natural resources; safeguarding of ecosystem features and functions; preservation of biological

diversity; a level of harmful emissions remaining below critical (assimilative) thresholds and averting of irreversible damage to the environment and nature (Daly, 1990).

Non-renewable resources present some challenges in the perspective of sustainable development. The following measures can be taken; minimize their utilization as much as possible or restructure their use to the direction of being totally independent of utilizing them possibly achieved through exploration of renewable alternatives as per their potential uses and the technological advancement (Daly, 1990). Sand harvesting from rivers can be an alternative livelihood option due to its ability to replenish itself hence; it presents a viable livelihood o p t i o n in areas experiencing water deficiency. The term "sustainable" refers to different aspects of longevity: economic, institutional, social and environmental issues (Carney, 2002).

The term 'sustainability' entered the global arena following the rapid emergence of environmental and development movements in 1980s and 1990s with specific concerns on poverty alleviation and development with longer-term environmental shocks and stresses. It mainly followed the 1987 publication of the Brundtland report (World Commission on Environment and Development [WCED], 1987) and became a main policy concern with the UN Conference on Environment and Development in Rio de Generio in 1992 (Scoones, 1998).

But it was not until 1992, when Chambers and Conway formed a working paper for the Institute of Development Studies that a current frequently used definition of sustainable livelihoods came into being. According to Chambers and Conway (1991):

"Sustainable livelihood is when it can cope with and recover from stresses and shocks and manage to enhance its capabilities and assets both now and in the future while not undermining the natural resource base".

Scoones (1998) agreed with the definition that livelihood is sustainable when it can cope

with the existing stress and recover from stress and shocks maintain or enhance its capabilities and assets both now and in the future while not undermining the natural resource base. Scoones further explained that 'Sustainable systems', whether livelihoods; communities/societies or nation economies often amass stocks of assets and enhance the capital base after a while. Unsustainable systems deplete or run down capital. These unsustainable systems spend assets as if they were income and so leaving less for future generations (Scoones, 1998). Thus a sustainable livelihood or livelihood security is realized when the livelihood provides sufficiently for both current and future generations right through all seasons and times **(**Mwasaa, 2012**)**.

2.5.5 Sustainable Livelihood Framework.

Sustainable livelihood Approaches became prominent in 1987 during the United Kingdom- focused discussion about development carried out by the Department for International Development (DfID). This discussion was mandated by the development ministry under the leadership of a vocal and committed minister Clare Short with the guidance of a White Paper that was dedicated clearly to poverty and livelihoods focus (Soles bury, 2003).

The departure from diagrammatic checklist to framework specifically the Sustainable Livelihoods Framework or the Sustainable Livelihoods Approach (SLA) took place in the course of 1998. With the establishment of the new DfID mandated with the development of a sustainable livelihoods approach to dealing with poverty; an advisory committee led by Diana Carney was put in place in the then overseas Development Institute in London. The committee deliberated on how to operationalize a 'sustainable livelihoods approach'. The conclusion was that a simple integrated approach was needed.

The Sustainable Rural Livelihoods (SRL) approach consequently emerged in the early 1990s by Robert Chambers and others at the Institute for Development Studies at the

University of Sussex (Chambers and Conway, 1992). It was adopted into the Department for international development (DFID) orthodoxy in the late 1990s and then became a mandatory element in the planning and evaluation of all DFID-led projects. During this time, other global organizations, among them the United Nations to NGOs such as Oxfam, came up with ideas on the livelihoods approach. In the late 1990s, DFID summarized the state of the art in a wide-ranging publication (Carney, 1998).

2.5.6. Babington Capitals and Capabilities Approach

Capitals and capabilities' framework for analyzing rural livelihoods and poverty in the Andes was developed by Babington. This framework takes a wider view of assets as was championed by Babington (1999). It looks at assets as vehicles for instrumental action (making a living), hermeneutic action (making living meaningful) and emancipator action (Challenging the structures under which one makes a living).

The framework holds that when analyzing rural livelihoods, we need to understand them in terms of peoples access to five kinds of capital asset; the ways in which they combine and transform those assets in the development or building of livelihoods; the ways in which people are able to develop/expand their asset bases by liaising with other actors via relations governed by the logics of the state, market and civil society and the ways in which they are able to organize and develop their capabilities both to make living more meaningful and to change the dominant rules and relationships governing the ways in which resources are controlled, distributed and transformed in society.

In Babington's capitals and capabilities approach, specific interest is paid to the significance of social capital as an asset by which people are able to extend their access to resources and other actors. The framework thus understands these assets not only as things that allow survival, adaptation and poverty alleviation but are also a foundation of agents' power to act and to reproduce, confront or change the rules that govern the

control; use and transformation of resources (Babington, 1999).

According to Babington, those situations where there has been some accomplishment in composing a feasible livelihood, the success hinged on matters of access and specifically relative success on the part of households and their members to maintain or enhance their access to the following:

First, The various resources (credit, land, skills, labour etc. depending on which of them are most appropriate to the kind of livelihood that people are composing). Although, different options always sacrifice one or another of these assets in order to build up another more suitable for the livelihood strategy; Second, different opportunities to transform those resources into sources of livelihood development (for instance by accessing new labour and product markets); thirdly, means of enhancing the existing ways in which those resources add up to their livelihoods (for example, by negotiating improved terms in transactions through a renegotiation of the power relations that underlie those transactions and finally, in order to achieve each or all of these, people have been significantly reliant on an capacity to gain these different forms of access. This has emanated mainly from kin and ethnic networks, social organizations, intermediate state and non-governmental organizations and also intermediary market actors (Babington, 1999).

In the framework by Babington, people's capacity to get access to those fields to a great extent is influenced by the capabilities they possess as a result of their initial endowments of the different types of capital asset For instance, people with significant endowments of land (natural capital) or financial resources (produced capital) or strong social networks (social capital) and university degrees (human capital and social capital) are in general better able to gain access to the institutions of the state and market and thus influence their subsequent effects on patterns of access (Babington, 1999).

2.6 Theoretical Framework

The theoretical framework underpinning the study is the Sustainable Livelihood Approach (SLA).The obligation to supply the present generation with its livelihoods wants and needs without Jeopardizing the ability of the nature to provide for future generations is still one of the prime development challenges.

Among the most frequently used approaches is the Sustainable Livelihoods Approach (SLA) developed by the department of international development in London. The (SLA) framework has been in recent times notable as capable of addressing the development agenda while integrating people oriented approaches, governance; pro-poor marketing; social protection; disaster risk reduction; climate change and adaptation. Its ability to incorporate all these new challenges and approaches to development makes it a robust livelihoods assessment and interventions design tool. This study will base its collection of data on livelihoods on the selected SLA Framework as defined by (Krantz, 2001,) cited by (Mwasaa, 2012) and (Maseko, 2013).

The framework provides a procedure of comprehending the experiences people come across particularly in the poverty stricken and underprivileged situation. It is participatory and based on the principle that people going through poverty possess abilities and assets which can be used to assist them make a sustainable livelihood for themselves and their families. The SLA approach has additionally been deemed as a changing of focus on agrarian development and expansion to accommodation of livelihood diversification (Knutson, 2006).Furthermore, SLA framework is capable of methodically breaking down an otherwise complex social phenomenon into parts that can be used to spot areas of probable intervention for sustainable development makes it one of the most excellent tools for analysis (Maseko, 2013).

2.7 Sustainable Livelihood Approach Framework

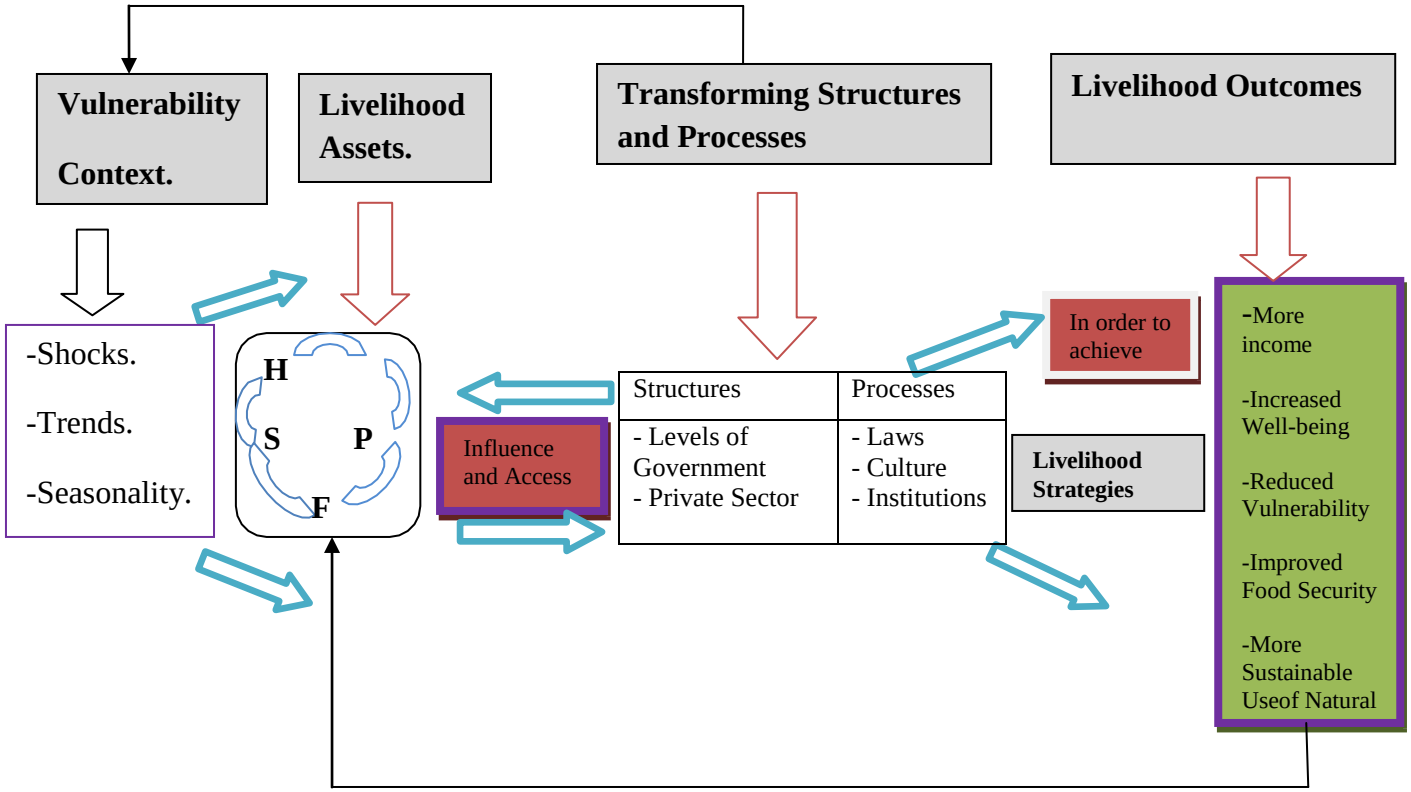

Figure 2.1 Sustainable Livelihood Framework Diagram. Source: Krantz, 2001

This framework divides livelihood into five key parts namely;

2.7.1Vulnerability Context

Vulnerability refers to the ‘degree’ of exposure to stress, shocks and proneness to food insecurity. This part of the framework analyses the inherent risks and susceptibility of the community to shocks (Allison and Ellis, 2001). Chambers and Conway identified two factors that renders a livelihood vulnerable including shocks and trends whereas in the DFID 1999 Sustainable Livelihood Framework, identifies three factors including; shocks trends and seasonality.

2.7.2 Livelihood assets

Assets are considered to be stocks of different types of capital that can be used directly or indirectly to generate livelihoods. They can give rise to a flow of output possibly becoming depleted as a consequence or may be accumulated as a surplus to be invested in future productive activities (Elasha, Elhassan, Ahmed and, Zakieldin, 2005).

Livelihood Assets may also refer to the endowments or resources a community possesses. Assets or capitals forms both the core of sustainable livelihood framework and forms the basis for rural livelihoods. These capital/assets are represented in a pentagon and they include; human, natural, physical, social and financial capital assets.

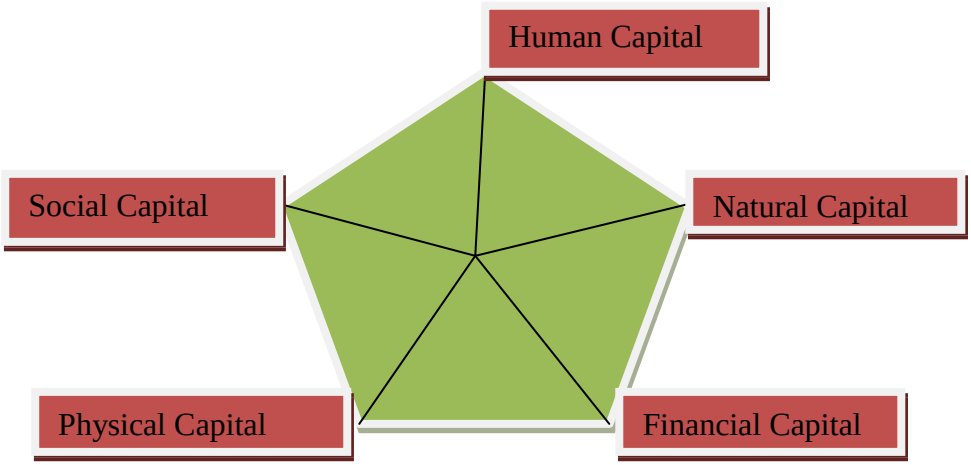

Figure: 2.2 Livelihood Asset Pentagon Adopted from DFID (1999)

The pentagon represents the Capital assets. At the center of it denotes zero capital asset for any individual or household and as individuals or households advance away from the centre the chances of gaining assets increases.

However, the capabilities and chances of gaining assets vary and therefore the shape of the pentagon differs from individual or households. Access to one capital might facilitate the access to other capital assets (DFID,1999).The significant importance of using capital assets to maintain livelihood is that they can be converted into liquid or consumption assets to meet the demand and maintain livelihood (Dorward, Anderson, Clark, Keane, and Moguel, 2001).

In the Department for International Development (DFID) framework these assets are explained as follows:

Human capital **(H)**: the skills, knowledge, ability and good health important in pursuit of various livelihood strategies;

Physical capital **(P)**: the essential infrastructure (shelter, water, energy, transport, and communications) and the making equipment and means that help people to pursue

livelihoods;

Social capital **(S)**: the social resources (membership of groups, networks, relationships of trust, access to wider institutions of society) upon which people draw in quest of livelihoods;

Financial capital **(F)**: the financial resources which are accessible to people (whether savings, supplies of credit or regular remittances or pensions) and which give them different livelihood options; and

Natural capital **(N)**: the natural resource stocks from which resource flows useful for livelihoods are derived (e.g. land, water, wildlife, biodiversity, environmental resources).

These assets combine both the tangible productive assets associated with economic analyses (e.g. land, labour, capital, and stocks) and the intangible assets more familiar to sociological and anthropological enquiry (e.g. social capital, health and educational status).

While most of these assets are considered in terms of the household or its membership, some assets may be held in common with a broader user group. This does not invalidate the focus on individual household livelihood strategies but it serves to remind us that resource management solutions may be collective as well as aggregated. These assets can be considered at a number of levels from individuals to households, to groups and communities. The centrality of the asset base to sustainable livelihoods is self-evident (Dorward *et al*., 2001).

2.7.3 Transforming Processes, Institutions and Policies.

These include systems and policies that characterize and determine the use of the assets existing to earn a living. They vary from traditional regulations and institutions to government policies and structures. It is not in order to just focus on assets and forego the

enabling factors also known as PIPs and the people's interaction with their assets to end up with a certain livelihood outcome.

2.7.4 Livelihood Strategies

Livelihood strategies involve "various activities undertaken by the household to generate a living. These activities are a pattern of behaviour adopted by a household as a result of mediation processes on the household assets. Livelihood strategies are generally adaptive over time, responding to both opportunities and changing constraints (Maseko, 2013). It looks at the efforts a community puts in place to transform the assets it possesses and thus signifying its living standards.

The strategies are fundamentally influenced by the vulnerability context and the transforming structures and the livelihood outcomes; which mean the final result of the livelihood efforts and that could result in improved wealth; living standards and status thus lessening vulnerability. Sustainable Livelihood Framework looks at livelihood strategies that are taken to achieve desired outcomes. The sustainable livelihoods framework in particular links inputs (designated with the term 'capitals' or 'assets') and outputs (livelihood strategies), connected in turn to outcomes, which combine familiar territory (of poverty lines and employment levels) with wider framings of well-being and sustainability (Elasha *et al*., 2005).

2.8 Why Sustainable Livelihood Framework and focus on livelihood Assets?

The SLA framework is useful in ensuring that when analyzing a livelihood system a biased view on assets is made and foregoing the enabling factors also known as Processes, Institutions and Policies (PIPs) and the people's interaction with their assets to end up with a certain livelihood outcome. Thus the framework provides a holistic system

of understanding a community's way of life and enhances the unraveling of complex aspects and interactions of the society (Mwasaa, 2012).

The reality that the SLA framework is capable of methodically breaking down an otherwise complex social phenomenon into parts that can be used to spot areas of probable intervention for sustainable development makes it one of the most excellent tools for analysis (Maseko, 2013). In summary the SLA framework is generally People-centered in the sense that it puts people at

the centre of development. The framework is also flexible/dynamic and can be easily followed and adopted by individuals or organizations and apply it in any context. It is further able to builds on the strengths of the poor; links the "micro" with the "macro" and is sustainability focused (Maseko, 2013).

The emphasis on assets is attributed to a number of reasons. People's ability to escape poverty depends on access to assets. Also, livelihoods are affected by the diversity and amount of assets and the balance between assets. Furthermore, assets help to determine livelihood options and assets are transformed into livelihood outcomes.

2.9 Conceptual Framework

The figure below is a conceptual framework of the study

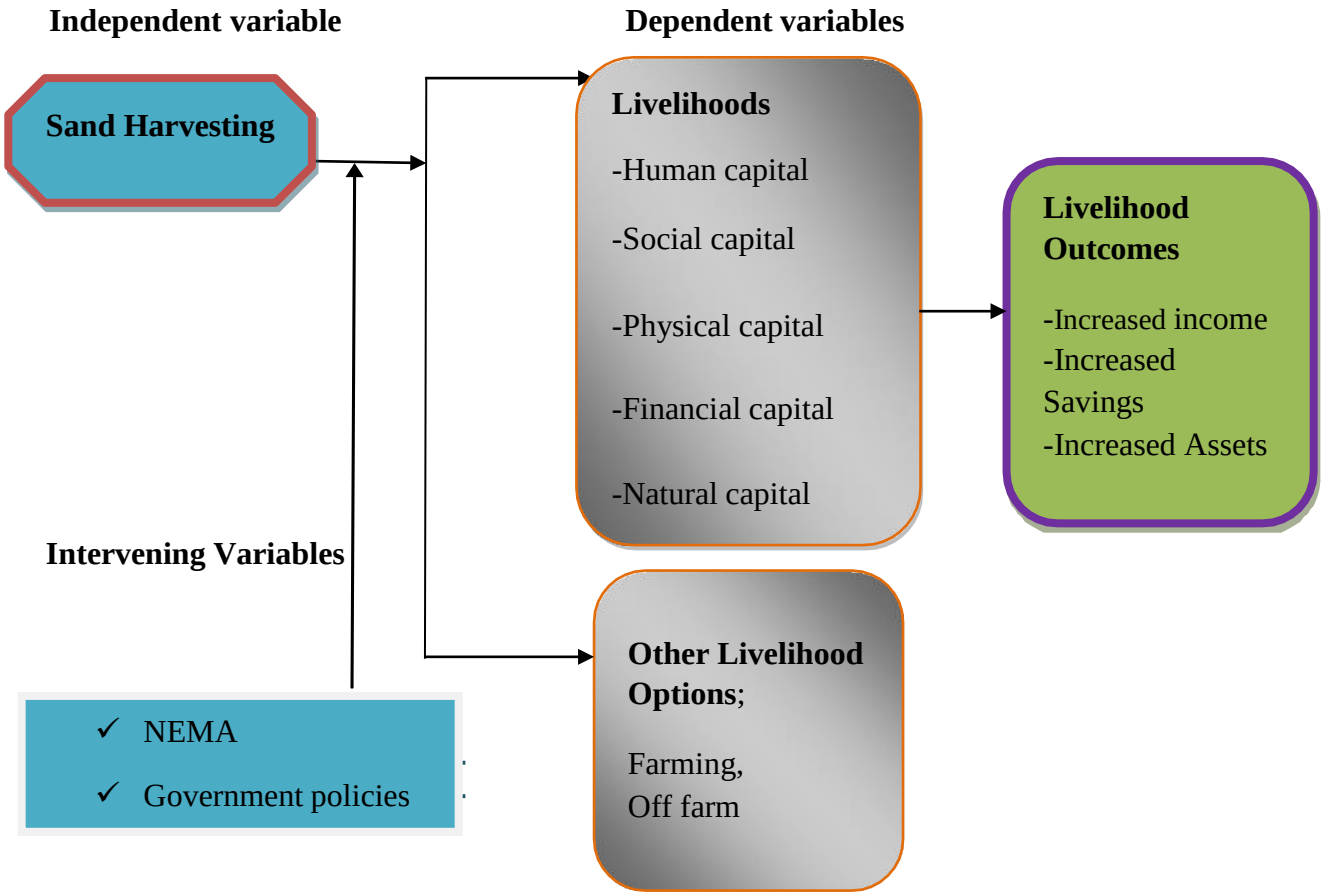

Figure 2.3 Conceptual Framework. Source; Researcher 2014, Modified From Krantz, (2001)

The above conceptual framework is guided by definition of livelihoods by Ellis (2000): "A livelihood comprises the assets (natural, physical, human, financial and social capital); the activities and the access to these (mediated by institutions and social relations) that together determine the living gained by individual/ household" (p.378).

In the above framework sand harvesting activity directly affect the natural capital particularly land and the river. It also affects other livelihood options of the community members for example, farming. Other capitals for instance, the physical, financial and social, are impacted by sand harvesting as well. Institutions like National management authority and sub national government entity like the County government has some influence on sand harvesting and all these interactions influences the livelihood outcomes of the community.

This study therefore, sought to use SLA framework in collecting data on the socioeconomic and livelihood impacts of sand harvesting that was defined by DFID (1999) and adopted by Krantz (2001), Mwasaa (2012) and Maseko (2013) in analyzing livelihoods. The framework splits livelihoods into five components; Human capital, Physical capital, social capital, financial capital and natural capital as explained earlier. The study focused on the impacts of sand harvesting on livelihoods that is; financial in terms of income and other assets bought; natural capital in terms of land; physical capital in terms of infrastructure and social capital in terms of membership to groups or networks. It also looked at the other livelihood options in comparison with sand harvesting and the institutions, processes and policies.

Furthermore, it dwelt on the overall livelihood outcomes of sand harvesting. The gap to be addressed by the study is that of a few documentation of sand harvesting issues as

acknowledged in the UN convention of 2012 in India and Mwaura (2013); the use of sustainable livelihood framework in assessing socio-economic and livelihoods impacts of sand harvesting and the focus of one livelihood against the other livelihoods with use of SLA determinants in analyzing livelihoods.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the methodology that was used in conducting the research. It further focuses on the study area, research design, scope; population and sample size; data types; data collection methods and analysis methods.

3.2 Research Design

The study employed descriptive design. Moreover, the study adopted a livelihood analysis framework which defined variables of study and formed the foundation for analysis and discussion. The descriptive design helped in explaining phenomena and descriptive statistics (which refers to the clarification of hidden but significant relations between the variables i.e. organizing data in order to represent trends) was used to explain outcomes and relations in the study area.

3.3 Scope of the Study

The scope of the study was limited to the livelihood impacts of sand harvesting among the Sand harvesting communities along Kerio River in Kerio valley. The study was largely guided by SLA framework.

3.4 Study Area

The location of the study area is shown in the figure below.

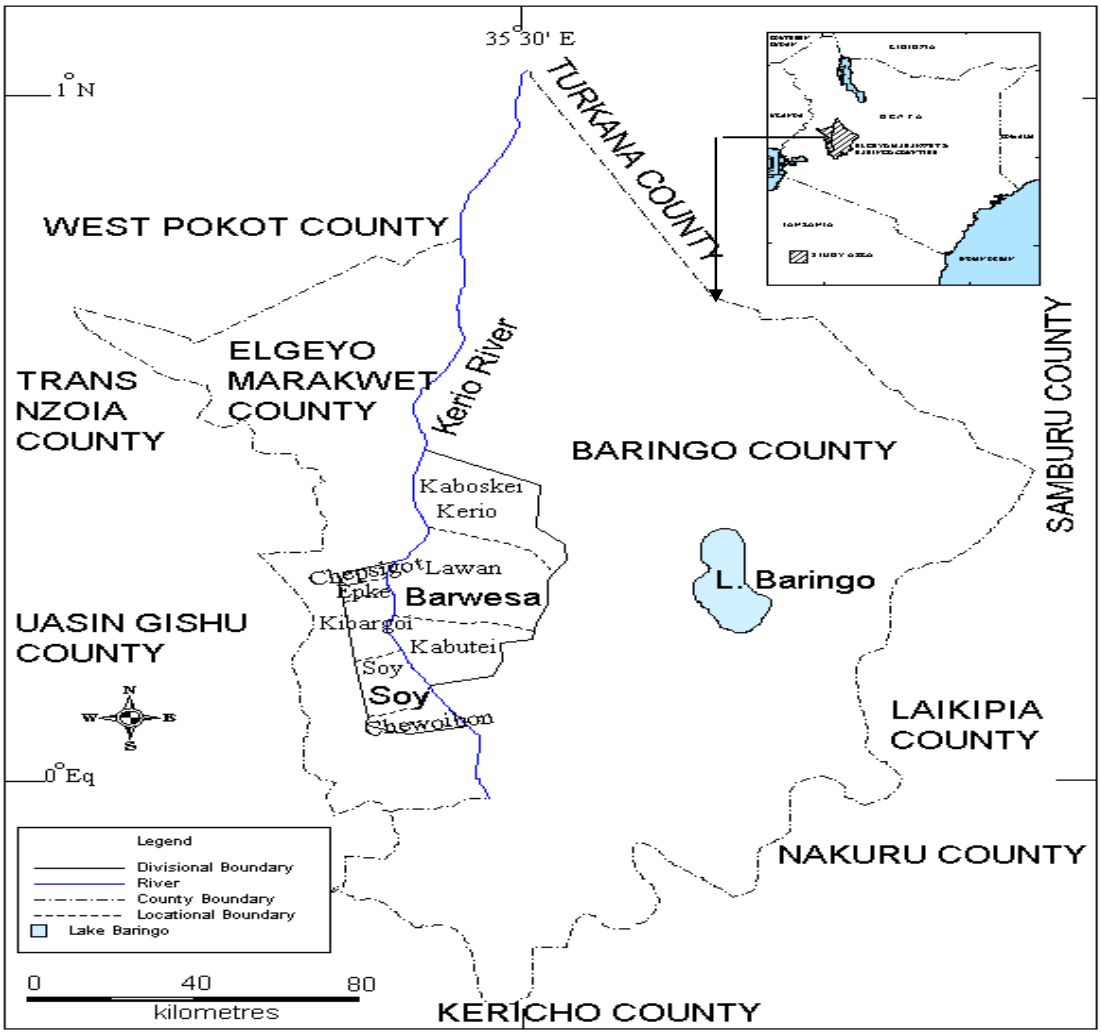

Figure 3.1 Map showing the location of Kerio Valley along Kerio River. Source: Moi University Geo. Depart.GIS lab

3.4.1 Background Information

Environmental characteristics for Elgeiyo-Marakwet and Baringo counties are significantly influenced by the arid conditions of Kerio Valley. The study area falls along the Kerio Valley with an altitude of about 110 Metres above the sea level; hence the valley presents dry conditions, temperatures ranging between 30˚C-40˚C unreliable rainfall of about 700 mm per annum, un-cohesive top soils and with a general drainage

linked to Kerio River. As a result population is low, depicts poor productivity and experiences high temperatures and low rainfall. On the other hand, the highlands are wet all year round, generally vegetated; soils are highly productive and relatively cooler weather conditions. As a result, the population density is relatively high, agricultural and livestock productivity significant while institutional presence is notable.

Geology in the area can be described as ancient Basement systems that were later overlain by volcanic ash. While the base rocks are hard, the top soils are volcanic in nature and hence fertile but un-cohesive, especially at the Kerio Valley bottom (Keiyo District Strategic Plan, 2005 – 2010).

3.4.2 Physiography and Topography Keiyo Sub-County

The physical land surface of the Sub-County in general could be described as double-drained.

The eastern half of the County drains into the Kerio River and eventually to Lake Turkana from the Tugen hills, Lembus forest and Elgeyo escarpment and constitutes the eastern boundary of the Sub-County. The western half drains into Lake Victoria drainage system. The land surface constitutes part of the watershed for Kipkaren, Sosian, Nzoia, and Yala Rivers among streams draining directly or indirectly into Lake Victoria. The high edges of Elgeyo escarpment is generally flat to the north. The escarpment (dropping from an average of 2,800m above sea level in the south to a low of 1,100m above sea level in the northern end (Keiyo District Strategic Plan, 2005 -2010).

General topography in Keiyo is characterized with mild slopes and shallow valleys to the west. The valleys and slopes are dry. Notable hill peaks include Kiptabus Irongo (2,600m above sea level), Kipchawat (2,600m above sea level) and Nyaru hill (3,000m above sea

level). The average altitude ranges from 900m above sea level in the north to 2,800m in the south while the elevation is lower to the east than to west (Keiyo District Strategic Plan, 2005 -2010) Administratively, the Keiyo sub-county is divided into five divisions namely Chepkorio, Kamariny, Tambach, Soy and Metkei. The five divisions have 26 locations and 92 sub-locations.

Climatic conditions are also double faced due to the influence of the low lying Kerio Valle (dry and hot) and the highlands (cool and wet) to the west. Temperatures in the valley and escarpment range between 30 C – 35 ˚C degrees and are associated with long dry periods, while the highlands experiences between 18 C – 26 ˚C with high levels of humidity. Overall, the average temperature in Kerio district is 15.1 C – 23.5˚ C. Rainfall also varies from the low lying Kerio Valley those experiences 800 – 1,000mm per annum (mostly dry due to poor distribution in time). While the overall average of 900 mm – 1,500 mm (mean of 1,200 mm) per annum. The rain is bimodal occurring from March – June for the long rains and June – December for the short rains (Keiyo District Strategic Plan, 2005 -2010).

The most reliable sources of water on the western highlands of the county are springs and streams that constitute Misiki, Ellegirini and Endoroto that eventually drain into Sosian and Kipkaren rivers. To the east, there are numerous streams discharging from Elgeyo Escarpment into Kerio River. While most of the streams are seasonal, they are significant silt carriers into Kerio basin. Among these streams include, Kipsaina, Torok, Tuluwei, Soigokwa, Cheptak, Kiplabot, and Ainamoi to mention a few. Ground water is also feasible in some part of the area (several shallow wells and borehole exist). However, this is not the case down in the Kerio Valley. Among the notable streams and sources of water include;

(i) Kobaemit stream from where water is pumped to supply Kapsoen market and the surrounding areas,

(ii) Kesup dam developed by the CDF in 2008 to service the communities around

(iii) Kameza Emiat stream on the Kiptingo forest that serves as a domestic sources and also livestock watering for the local community

(iv) Kamaua wetland area that have been reclaimed for farming.

3.4.3 Marakwet Sub-County

Marakwet Sub-County was created by an executive directive of 1994.The Sub-County, is bordered by the following Sub-Counties: West Pokot to the North, Baringo to the east and Tranzoia to the west. The Sub-County covers a total area of 1588 square kilometers and is divided into administrative divisions including; Tot, Tunyo, Tirap, Kapyego, Kapsowar, Kapcherop and Chebiemit.It ranges from latitude 0˚ 51’ to 1˚ 19’ North from 35 29’ to 35˚ 43’ East (Marakwet DDP, 1997-2001).

Marakwet has got three topographical portions. They include; Kerio valley escarpment, Highland plateau and Marakwet escarpment. The main Rivers in Marakwet Sub-County emanates from the watershed formed in the escarpment, Tunyo and Tot falls within Kerio valley and exhibits arid conditions. The main source of water in Marakwet comes from rivers like Kerio River, Embobut, Chesegor and Arror rivers. The rivers are vital for irrigation, watering livestock and for domestic purposes. (Marakwet DDP, 1997-2001).

3.4.4 Baringo Sub-County

Baringo Sub-County is located between 35˚ 30’ and 36˚ 30’ East longitude and between 0˚ 10’ and 1˚ 40’North latitude. Baringo covers an area of 8655 square kilometers, with administrative divisions including; Tenges, Kabartonjo, Tangulbei, Sacho, Kabarnet,

Nginyang, Marigat, Mochongoi and Barweso. It borders Keiyo, West Pokot and Marakwet to the west, Turkana to the North, Koibatek to the South and Samburu and Laikipia to the East (Baringo, DPP 2002-2008).

The main topographical features in Baringo Sub-county include the river valleys, plains Hills like Tugen hills, the northern plateau and the floor of the rift valley. The main river in the county is Kerio river.The Altitude ranges between 1000 Metres -2600 Metres in the highest areas like Tugen hills and Laikipia to between 762-1000 in the lowest areas above the sea level. Rainfall in Baringo on average range from 1000mm-1500mm in the highlands and 600mm in the lowland plains hence cannot support any significant crop production, but support livestock rearing and crop farming is more pronounced in the highlands. The water in Baringo exists in Dam s, rivers and lakes. The major rivers are Perkerra, Kerio and Me lowlands have got irrigation potential especially along Kerio river (Baringo, DDP 2002-2008).

3.5 Population, Sample Design and Sample Size

3.5.1 Study Population

3.5.1.1 Target population

The target population (which includes all the entire group of respondents from which the research findings are generalized) involves the sand harvesters.

3.5.1.1 Accessible population

The accessible population (Which is the portion of the population to which the researcher has reasonable access; may be a subset of the target population) was sand harvesters in living along Kerio river in Kerio Valley.

3.5.2 Sample Design, Sample Size and Sampling Techniques.

The study employed non probability sampling designs in identifying the sample for the study, where it Involved 136 individuals using sampling techniques discussed below.

3.5.2.1 Purposive sampling

Purposive or judgmental sampling technique entails an intentional identification of a certain members of the population on the basis of pre-defined characteristics. This technique is more acceptable for qualitative research especially when it involves selecting respondents for particular situations. It involves for instance, where researcher selects cases with a specific purpose in mind or uses judgment of an expert. Purposive sampling is applicable in situations where a researcher wants to select unique cases that are informative; members of a difficult to reach or specialized populations and when a researcher wants to identify particular type of cases for in-depth investigation. The main purpose is to gain deeper understanding of such particular cases and not to generalize the findings (Neuman, 2009).

In this research the pre-defined characteristic was sand harvesting where sand harvesters formed the target population and meets the purpose of the study. With the help of a key informant during a pre-visit, the accessible population was purposively determined having in mind that the research was targeting sand harvesters. Purposive sampling was appropriate since the population of sand harvesters is known and it tends to be homogeneous.

3.5.2.2 Snowball Sampling

Frank and Snijders' (1994) method for estimating the size of hidden populations through snowball sampling was used. This involves the use of a diverse set of initial subjects, each of whom then lists all members of the targeted population that they know. The size

of the hidden population is then estimated based on the amount of overlap among the members listed.

Snowball sampling with a diverse set of initial subjects therefore was used to list sand harvesting households a long Kerio river in Kerio valley with the help of Key Informant's and the Kenya Bureau of Statistics (KNBS, 2009). The technique was adopted due to the absences of a list of sand harvesters in the locations. A snowball sampling technique is usually used when the population under the study is not readily available and difficult to find and usually uncovered through social networks on the respondents (Goodman, 2011).

Snowball technique is a non-probability sampling suitable for hard to reach or equivalently, hidden populations. A population is "hidden" when no sampling frame exists so the size and boundaries of the population is not known; and the existence of strong privacy concerns as membership to such populations is stigmatized or involves illegal behaviour **(**Heckathorn, 2000). It is hard to sample such populations, since standard statistical methods require a list of population members (a sample frame) from which the sample can be obtained (Goodman, 2011).

Snowball sampling has had a number of advantages; it has in the past enabled access to hidden populations; it has been found to be efficient and effective in various studies producing internationally comparable data; it has produced in-depth results and can also be used to compliment non response in other methodologies (Van Meter, 1990).

However, snowball technique is associated with some shortcomings including; selection of the respondents is not done at random but dependent on the subjective choices of the respondents hence hinders researchers from making generalities from a particular sample (Griffiths, Gossop, Powis, & Strang, 1993). Secondly, additional individuals resulting from tracing chain is dependent on the initial sample hence, suffers the biases of

“masking”, biased towards more cooperative subjects and those with wider networks **(**Heckathorn, 2000).

The study reduced such biases in a number of ways; first by adopting a relatively high sample size; secondly, sampling was done using various waves to allow for the composition of respondents to be independent of the initial subject.

3.5.3.3.1 Sample size

The determination of a sample size depends on a number of issues like; time, resources and money. Nevertheless, a smaller sample size will affect the validity and credibility of the research outcomes. The smaller the population the larger the sample size since smaller populations exhibits greater variability or otherwise known as sampling error (Casley and Kumar, 1988). The research used Snowball sampling with a diverse set of initial subjects and the sample size arrived at was 136.

3.6 Key Informants

Some people like a chief, just by the virtue of their status, reputation, social status are known to be well versed with many issues. Key informants were engaged and gave as much information as possible that enriched the data. The study involved the following key informants; County revenue official, chief, village elder and NEMA official.

3.7 Data Collection Techniques

The study used questionnaires (attached as appendix 3), key informant interviews (attached as appendix 4), observation schedule, photography and documentary review (for instance, books, journals and theses).

3.8 Questionnaires

The questionnaires were administered to the identified household heads, sand transporters and loaders. The nature of the questionnaires was both open ended and closed ended. The themes that were addressed in the questionnaires included; contribution of sand harvesting to their livelihoods; how sand harvesting contributed to livelihoods compared to other livelihood options in the sand harvesting areas and the existing policies on sand harvesting for sustainable utilization.

3.9 Key Informant Interviews

Key informant Interviews were conducted to supplement questionnaires. Individual interviews were used. The use of interviews on selected individuals was aimed at achieving all the study objectives where questionnaires could not effectively apply on the basis of literacy levels and poor response to questionnaires.

3.10 Observations and Photography

This technique involved taking photographs and note taking guided by the observation schedule. It was also used to pick up number of observations during interactions with the subjects and study area in order to allow for further probing. These observations helped to give a full picture.

According to Babbie and Mouton (2001) a researcher who has earlier knowledge of an area will of course probe for more clarification, and tactfully crosscheck information for accuracy. The observation schedule below was used to guide on the important aspects relevant to the study.

3.10.1 Observation schedule

Table 3.1 Observation schedule

Activity	What to observe	What to write
Communal walks	• Community infrastructure such as roads, health centers and schools • Income activities linked to sand • Gender and sand harvesting • Other issues of concern associated with sand harvesting.	• The type and state of the roads networks • Enterprises resulting from sand harvesting • How sand harvesting affect male and female differently • Spillover effects of sand harvesting.
Visit to the quarries	• Any other activity that compliments sand harvesting near quarries • Health and safety issues	• Economic activity triggered by the harvesting activity • What endangers the health and safety of the harvesters
Household visit	• Presence of livestock enclosure	• Existence of livestock

3.11 Data Analysis and Presentation

After gathering the information, responses were extracted from questionnaires, observation notes and interview schedule. Data was analyzed using, frequencies and descriptive statistics and further interpreted along selected Sustainable livelihood approaches (SLA) determinants the capitals/assets on the appropriate questions. Secondary data was reviewed in the analysis of objective three. The study made use of the Statistical Product and service solutions IBM Statistics version 20 to analyze data. Tables, charts/graphs and narratives were used present the research findings.

CHAPTER FOUR

RESULTS

4.1 Introduction

The chapter presents the findings and the results of the study.

Communities in arid and semi-arid areas around the world have got limited livelihood options. Therefore, they have always devised ways of survival and diversifying their livelihoods. The utilization of the available natural resources has provided an important avenue to boost their livelihood options. However, the use of such resources should allow for its continuity. This study focused on the sand harvesting communities along Kerio River in Kerio Valley.

It sought to investigate the livelihood impacts of sand harvesting on the livelihood assets of local sand harvesting community using sustainable livelihood framework (DFID, 1999); the contributions of sand harvesting compared to other livelihood options and the existing policies and legislations on sand harvesting and their implications. The study sought to achieve the following objectives: To examine the impacts of sand harvesting on the livelihood assets of local community using sustainable livelihood framework (DFID, 1999); to compare sand harvesting with other livelihood strategies in the study area and to examine the existing policies and their implications on sand harvesting. The results and discussions are summarized in as per the research questions.

4.2 Demographic Characteristics of the respondents.

Various demographic characteristic of the respondents are presented in the sections that follow;

4.2.1 Age groups of the Sand harvesters

The figure below shows the age groups of the respondents

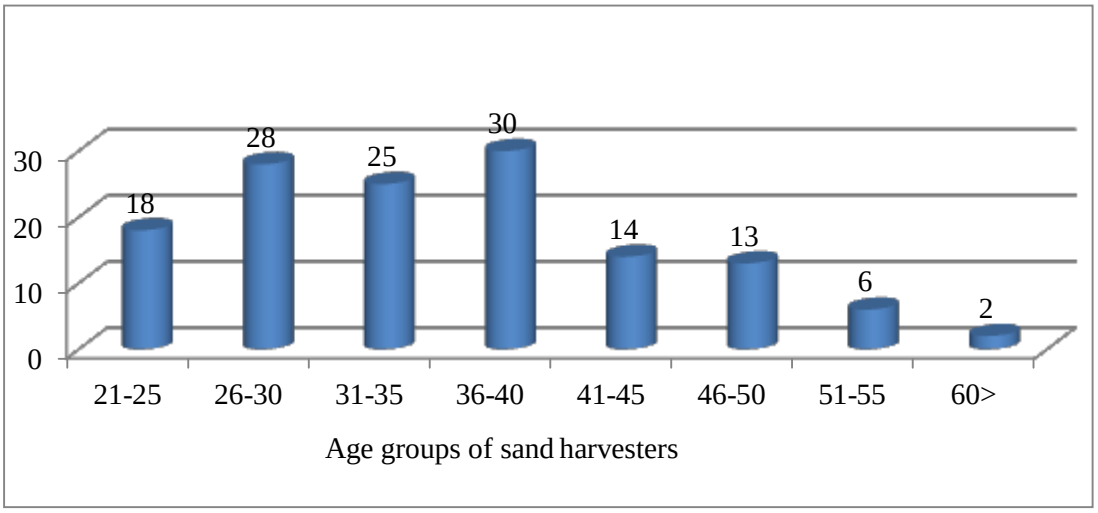

Figure 4.1: Age groups of the sand harvesters

An inquiry was made on the ages of the sand harvesters. Figure 4.1 shows that 2 (2 %) of the persons engaged in sand harvesting were above 56 years of age and 28 (21%), 30 (22%), of sand harvesters were between the ages of 26-30 and 36-40 respectively.

Sand harvesters were further divided into land owners, loaders and transporters. Land owners were taken to mean those whom sand is harvested from their lands or where tributaries of Kerio river passes through their land or whose land provides access routes; loaders are those who engage in manual work whereas transporters are the ones ferrying sand to outside markets.

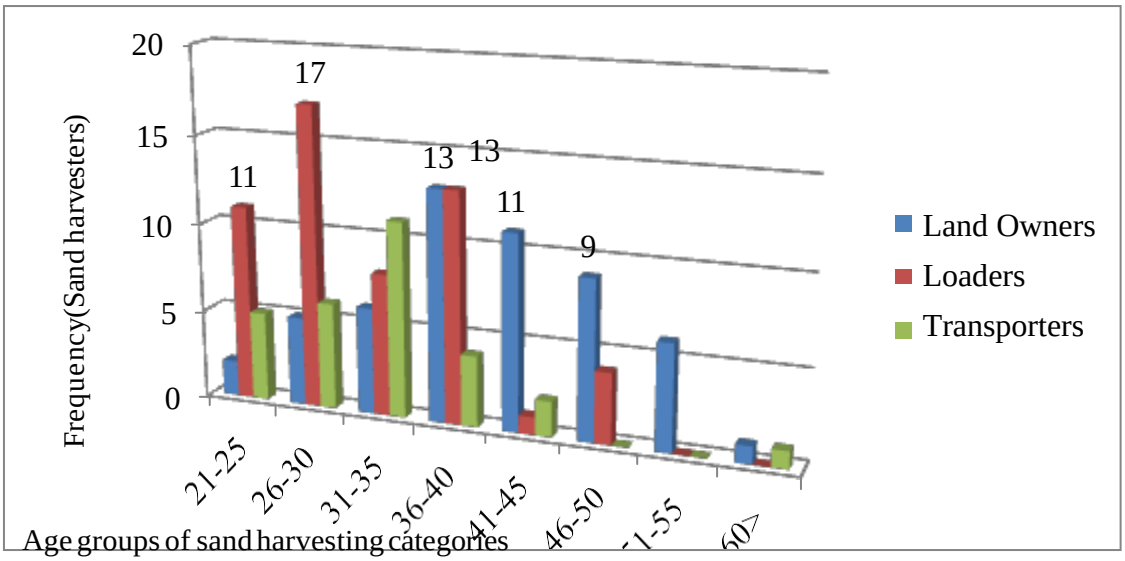

Figure 4.2: Age groups of Sand harvesting categories

The Figure 4.2 and as per the categories above shows that, most of the land owners were between the ages of 36-40 (13), Loaders were in ages of 26-30 (17) and transporters were in 31- 35(11) years of age.

4.2.2 Education levels of Sand harvesters

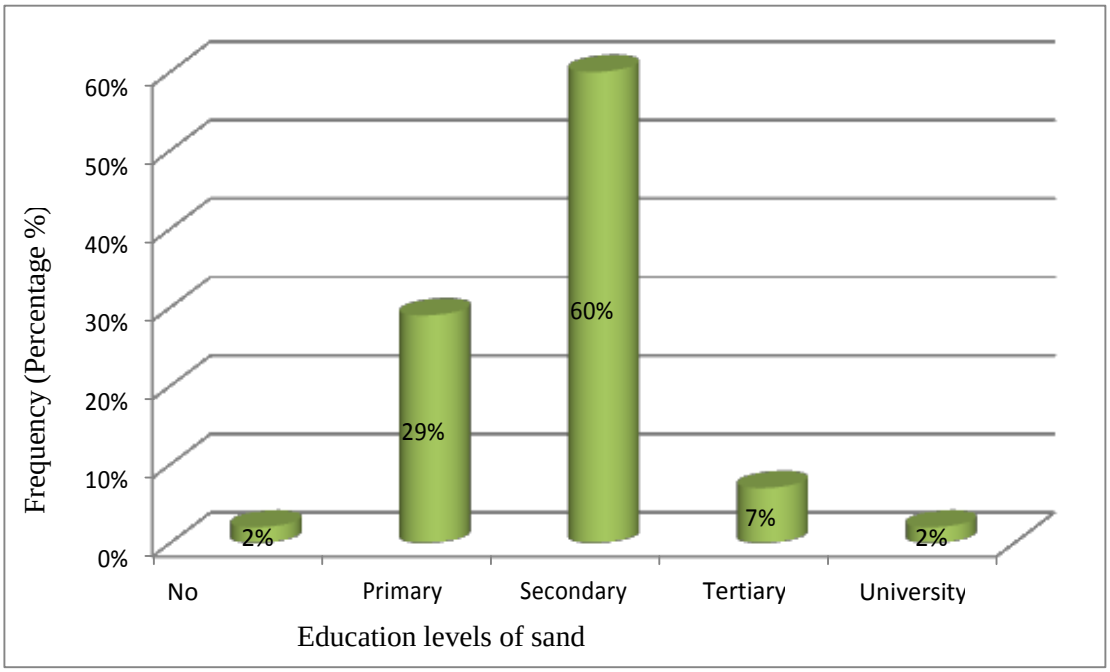

Figure 4.3 Level of education of sand harvesters

The level of education of the sand harvesting community in the area was also sought. Figure 4.3 shows that the respondents had diverse education levels with 60% of the respondents having completed secondary level of education; 29% had completed primary level of education; whereas 7% had completed tertiary education. Furthermore, 2%), had completed university education and 2 (2%) had no education.

4.2.3 Gender of the Sand harvesters

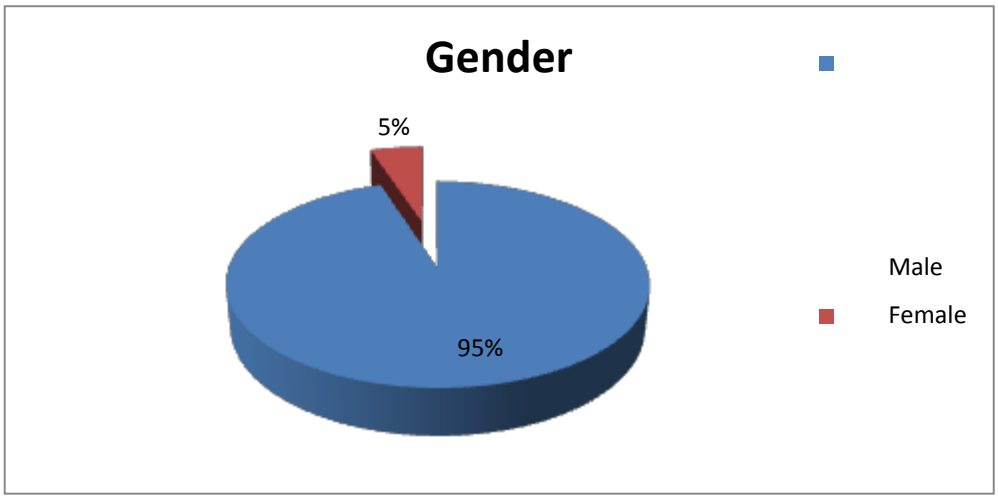

Figure 4.4 Gender of sand harvesters

The results showed that most of the respondents were male recording 95% whereas female were 5%.

4.3 Livelihood impacts of sand harvesting on the assets of local community using sustainable livelihood framework

This section shows the results of the impacts of sand harvesting on the major livelihood capitals/assets in the selected locations along Kerio river in Kerio Valley.

4.3.1 Impact on Financial Capital

Financial capital refers to the financial resources which are accessible to people (whether savings, stocks, supplies of credit or regular remittances or pensions) and which give

them different livelihood options (DFID, 1999).The figure below shows the range of income from sand harvesters.

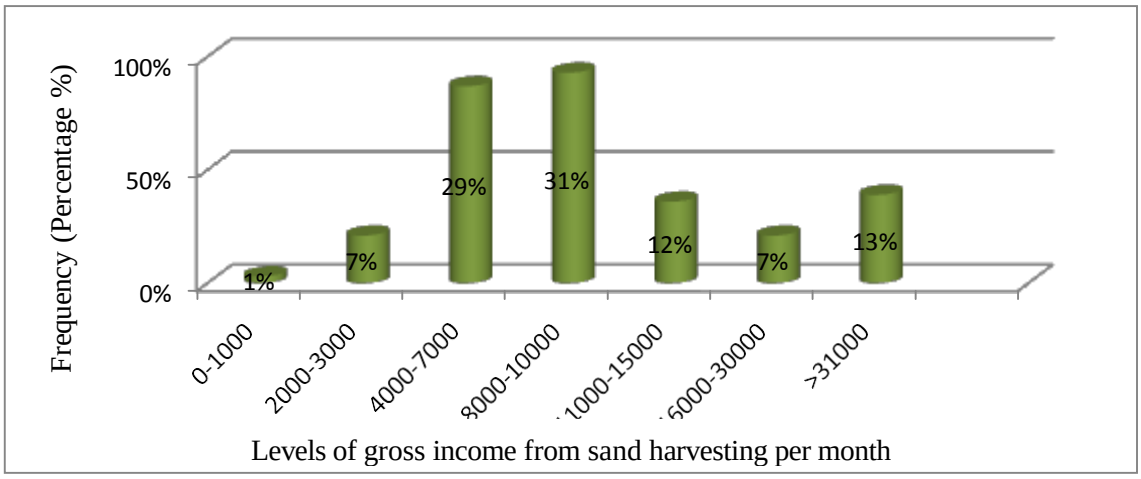

Figure 4.5 Income levels from sand harvesting

The response on the income from sand harvesting revealed that; majority 31% of the respondents fell in the range category of Kshs.8000-10000, and 29% earning between Kshs. 4000-7000. A significant number of respondents majority being transporters 13% earned Kshs. 31000 and above.

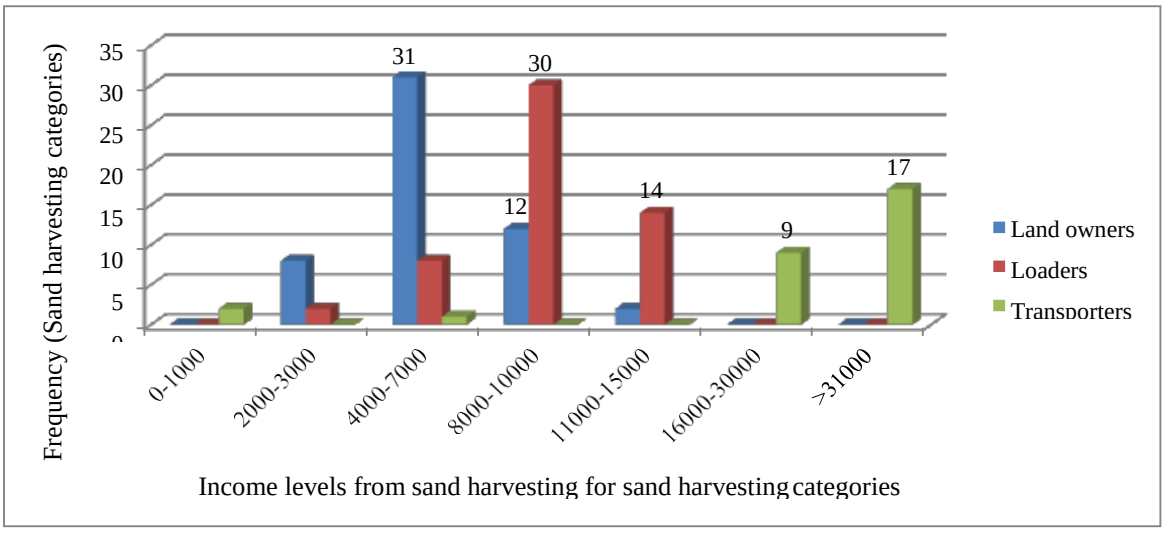

Figure 4.6 Income levels from sand harvesting categories

The earnings from sand harvesting as per the categories highlighted in the figure 4.6, indicates that a significant number of respondents majority being loaders and transporters earned Kshs. 8000-10000 and Kshs. 31000 and above respectively.

Table 4.1 Financial Assets owned by respondents as a result of sand harvesting

	Types and numbers of Assets owned by the respondents in each range category						
Range of the Number of assets owned in each category	**Cattle**	**Sheep/ Goats**	**Iron Sheets**	**Water tanks**	**Motorcycle /Bicycle**	**Chicken**	Total
1-2	23	3	0	23	42	1	
3-4	19	9	0	5	1	3	
5-6	28	26	8	0	0	8	
7-8	6	13	6	0	0	7	
8>	23	77	73	0	0	67	
Total	99	128	87	28	43	86	471

The respondents were asked about the assets they own as a result of sand harvesting and Table 4.1 revealed that; 99 respondents had purchased cattle with the majority (28) owning between 5- 6 cattle. Sheep and Goats had been bought by 128, the highest number of respondents to have purchased any asset of which 77 owned more than 8 goats/sheep; 87 respondents reported to have purchased iron sheet with 73 of them having purchased

more than (8) eight; 86, 43 and 28 respondents had purchased chicken, motorcycle/bicycle and water tanks respectively, with 67, 42 and 23 owning more than 8 chicken, 1-2 bicycle/motorcycle and 1-2 water tanks respectively.

4.3.2 Impact on Natural Capital

The table below shows the Natural Capital acquired through sand harvesting activity**.**

Table 4.2: Natural Capital acquired through sand harvesting activity.

Natural Capital		
Forms of Natural capital	**Frequency**	**Percentage**
Never purchased any land	104	77
Agricultural land	12	9
A plot in a Market centre	10	7
Plot in town	8	6
Grazing land	2	2
Total	**136**	**100**

Natural capital refers to the natural resource stock from which livelihoods are derived (DFID, 1999). They include; land, water, wildlife, biodiversity and environmental resources.

An inquiry was made on whether sand harvesting had enabled the respondents to acquire other natural assets particularly additional land in different forms for instance; Agricultural land, Grazing land, Market centre and a Plot in town. Table 4.2 shows the responses given by the respondents about land acquisition courtesy of sand harvesting.

A higher number of the respondents,77.8% reported to have not been helped by sand harvesting to acquire any form of natural capital, 9% reported to have purchased grazing land; a further 10 7% had acquired a piece of land in a market centre and 6% having purchased a piece of land in town.

4.3.3 Impact on Physical Capital

The table below shows the Physical Capitals built from sand harvesting

Table 4.3 Physical Capitals built from sand harvesting

Physical Capital		
Physical capital	**Frequency**	**Percentage response**
Build health centre	8	6
Build schools	10	7
Cattle dips	1	1
No Physical asset attributed to sand harvesting	117	86
Total	**136**	**100**

Physical capital includes important infrastructure like (roads, water, and shelter, energy) that help people in their quest for livelihoods (DFID, 1999).The study inquired on the contribution of sand harvesting in the community through the construction of the physical assets like schools, health centre, roads and other projects. These are the capitals that normally enable the community to develop the other capitals. Table 4.3 above shows the responses.

Most of the respondents held the view that sand harvesting has not facilitated the construction of physical assets with 86% not attributing the construction of physical

assets to sand harvesting. However, 7% were in agreement that it had built schools, with 6% agreeing on health centers, 1% cattle dips and no one citing road construction.

Further probe from Key Informants revealed that the agreement on the building of schools, health centers and cattle dip by some of the community members is not by use of the income from sand harvesting but the ready availability of the sand material that has eased the cost of construction in the area. However, the County government official reported that sand harvesting revenue had been ploughed back to build early childhood development centers of which the residents were not aware of.

4.3.4 Impact on Social Capital

Social capital includes the social resources (membership of groups, networks, relationships of trust, access to wider institutions of society) upon which people draw in quest of livelihoods (DFID, 1999).The study looked at the social groupings that were triggered by sand harvesting activity in the area. The responses are as per the Table 4.4 below. The most common social groupings the members started as a result of the income from sand harvesting are the self-help group with 17% being members,16% were in a savings and loan groups, however quite a number of the respondents 49% did their own self savings and 16% were not members of any grouping.

The results from Key informant interviews showed that there were informal groups that existed mainly comprising of the members from different clans or just group of community members mainly comprise of the youth who come together with a common interest. The main aim of such groups was the control and protection of sand harvesting sites from outsiders.

Table 4.4 Social Capital and group membership of the respondents

Social Capital and group membership of the respondents		
Social groupings	**Frequency**	**Percentage Response**
Cooperative society	2	2
Savings and loans group	22	16
Self-help group	23	17
Self-Savings	67	49
Not belong to any social grouping	22	16
Total	**136**	**100**

4.3.5 Impact on Human Capital

The figure below presents the Use of income from sand harvesting by the respondents

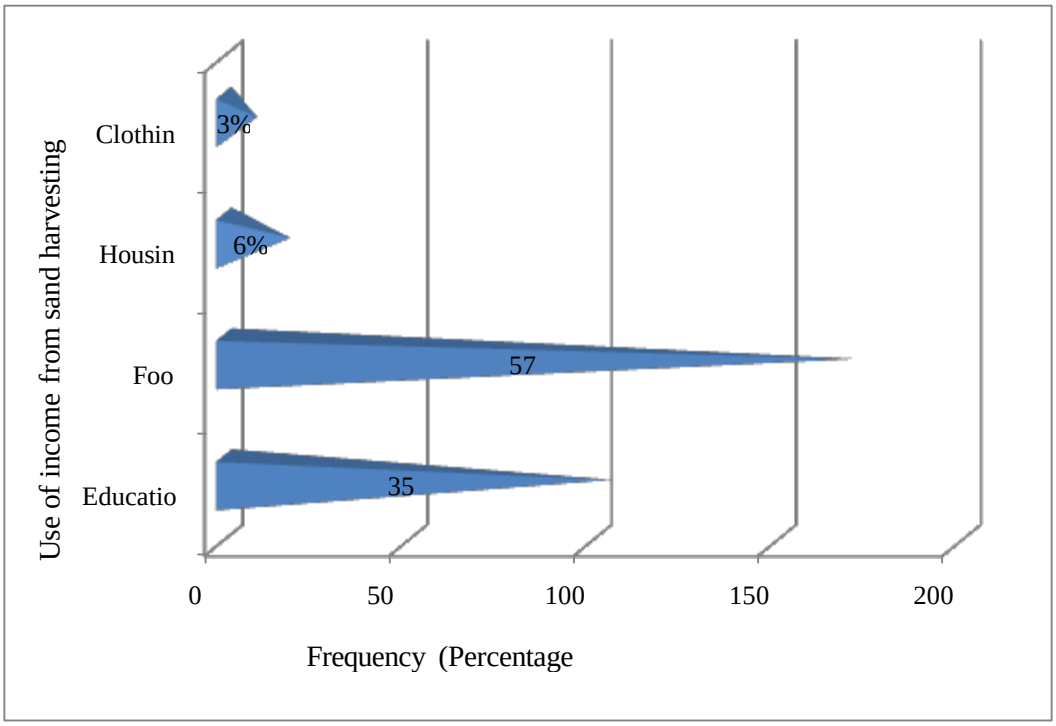

Figure 4.7 Use of income from sand harvesting by the respondents

Human capital involves the skills, ability, knowledge and good health which enable an individual or a household to pursue and sustain livelihoods (Scoones, 1998; DFID, 1999). Development of human capital can be achieved through schooling/trainings, medical attention, good housing and food security.The respondents were asked on how they spend the income they get from sand harvesting. The results revealed that, most of the respondents, 57% used income to buy food; also,35% use the money to pay for school fees for the children, with 6% and 2% using income for housing and clothing respectively.

4.3.5.1 Impacts of sand harvesting on human health

From Key informant interviews and observation, health and safety issues were evident. Extra traffic due to the intensive nature of sand harvesting in the area has led to dust and noise pollution which is detrimental to the health of the residents. Furthermore, creation of deep open pits was also observed, where scooping of sand went as deep as 7-10 feet, causing instability and occasional collapse of the riverbank. Deep open pits, were observed in different harvesting sites especially those on the banks of small seasonal rivers and streams that forms the tributaries of the Kerio river. Some of the pits were also observed in the individual farms. These open pits are dangerous and had caused injury to people and animals. One of the respondents recorded as case number 002 mention an incident that happened three years ago where the river bank crumpled burying one man who was fortunately rescued and rushed to the hospital. Figure 4.8 shows one deep open pit that collapsed on sand extractor at the river bank of Kerio river.

Figure 4.8 shows one deep open pit that collapsed on sand extractor

(Source; Author, 2014).

According to key informants and results from Observations, it showed that, there were other spillover effects of sand harvesting activity to the economy of the respondents; the most notable ones are the dust pollution, soil compaction and land dereliction. Dust pollution has not only caused health problems to residents but also led to big losses to their crop production as explained by one of the watermelon farmer. The farmer cited having experienced losses as trucks passed near his watermelon crops during flowering stage. Dust trapped in the watermelon crops facilitates the diseases causing agents which attack the crop hence reducing crop production.

Soil compaction and land dereliction was also observed. Poor road network particularly the feeder roads coupled with the lack of designated access routes in some places forced Lorries to cross farmlands causing soil instability and compaction on the already cultivated farms. The situation was made worst by the creation of deep open pits which renders land unfit for agricultural production.

Figure 4.9 Photo showing a route that crosses farmlands (Source; Author, 2014)

Key informants further cited conflicts between transporters and the farmers were evident in the study area concerning the lack of designated access routes forcing the trucks to cross farm lands; hence clashing with farmers in the research area. Small businesses mainly run by women was also observed and included; establishment of make shift mini hotels on the roadsides and also near harvesting sites. Shopping centers had also benefited from expansion in accommodation facilities and hotels. Fruit vendors in shopping centers mainly by women were also noted. All these enterprises complimented sand harvesting activity by providing food to transporters and loaders.

Figure 4.10 Photo showing women selling food stuffs to harvesters (Far top left side) (Source; Author, 2014)

4.4 Contributions of Sand Harvesting Compared to other Livelihood Options

Investigations into the other major sources of income engaged in by the respondents and their approximate monthly amount was carried out and compared with sand harvesting.

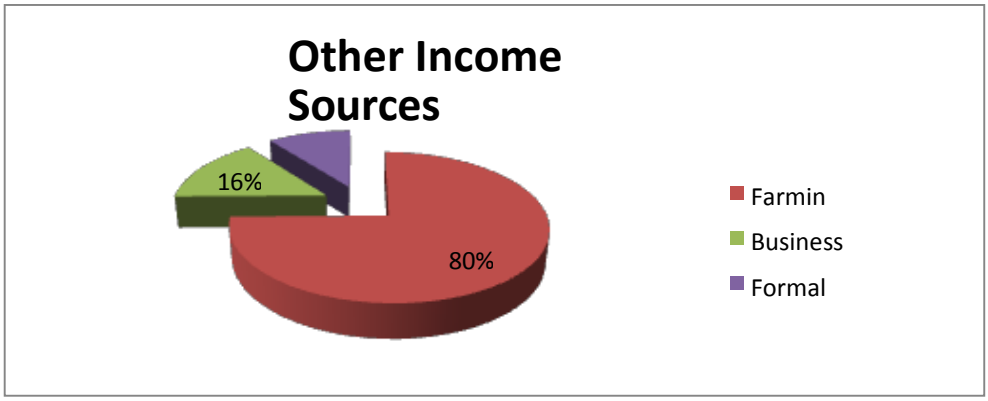

Figure 4.11: Other major occupations besides sand harvesting by the respondents

Figure 4.11 represents the major sources of income identified by respondents besides sand harvesting. It shows that 80% were farmers, 12% were engaged in nonfarm trade, and 8% in formal employment.

The study revealed that most of the respondents were farmers with the majority engaging in cattle rearing with much preference on sheep and goats. The other group includes; the fruit farmers who plants mainly mangoes; watermelon and pawpaw which does very well in the area. There was also some maize farmers whose success is determined by the amount of rain fall received as mentioned by one maize farmer.

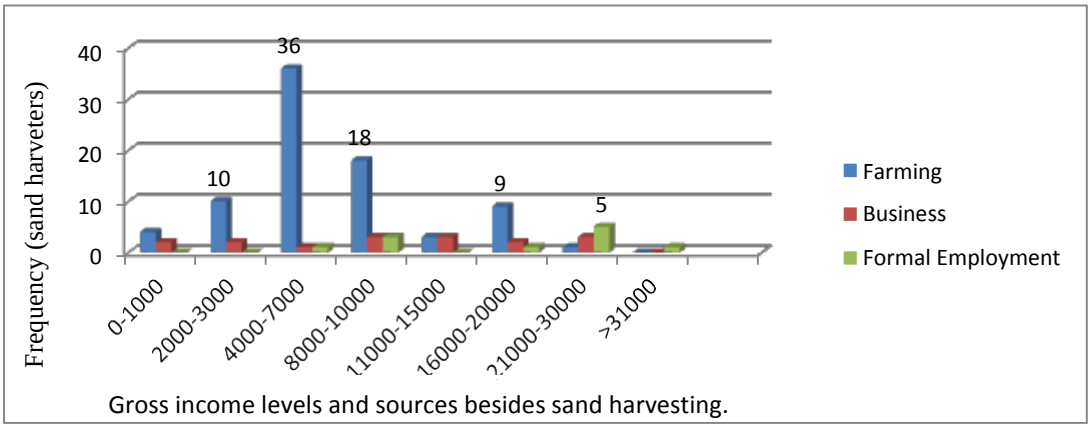

Figure 4.12 Income levels and sources besides sand harvesting

Further, Figure 4.12 shows the approximate range of income from the main sources besides sand harvesting identified by the respondents. The majority of the farmers that is, 36 earned between Kenyan shillings 4,000-7,000, followed by 18 earning between Kshs.11,000-15,000 with 9 earning between Kshs.16,000-20,000 and only 1 earning between Kshs.21,000-30,000.Most of the business people; 3 earning between Kshs.8,000-15,000 and Kshs.21,000-30,000 in each category respectively. Formal employment was the least popular category recording 5 earning between Kshs. 21,000-30,000 and 3 earning between Kshs. 8, 000-10,000.

The distribution of income among the three groups of sand harvesters varied. The sand harvesting (land owners) category, are those who own sand harvesting sites by the virtue of tributaries crossing their farms or whose land provide access to sand harvesting sites, loaders does the loading whereas transporters buys and ferry sand to outside market.

In reference to Figure 4.6 on page 53, it shows the income from sand harvesting for the sand harvesting categories for comparison with other sources. It revealed that 31 of the land owners earned between Kshs.4,000- 7,000, 12 earning Kshs.8,000-10,000 and 2 falling between Kshs.11,000-15,000. The majority of the loaders 30 earned between Kshs.8,000-10,000 and 14 between Kshs.11,000-15,000.Ontheother hand, 17 transporters earned Kshs.31,000 and above with only 9 earning between Kshs.21,000-30,000.

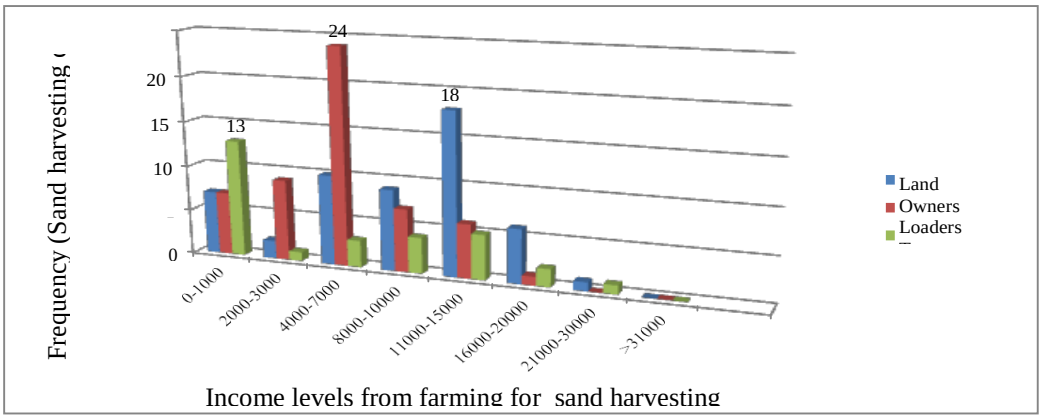

Figure 4.13 Income levels from farming for the Sand harvesting categories

Comparing sand harvesting and the other major sources of income, the findings showed that, land owners preferred farming as opposed to sand harvesting as they get higher income from the former than the latter, this is evident in Figure 4.13 where 18 respondents earn income in the range of Kshs.11000-15000 as opposed to 2 from harvesting in the same category.

However, most of the loaders cited sand harvesting to be better than farming where 30 loaders earned between Kshs. 8000-10000 compared to 12 land owners in the same category. Sand harvesting transporters category of respondents earned a very high income from sand harvesting than farming and business. This is evident in the Figure 4.6 (b) Where 17 respondents earned 31000 and above as compared to 0 farmers, 0 businessmen and 0 formally employed respondents.

Furthermore, in comparing the contribution of sand harvesting with the other major sources of income, the respondents were asked to give their satisfaction level individually at the family and community level on a Likert scale. Figure 4.14 and 4.15 shows the responses.

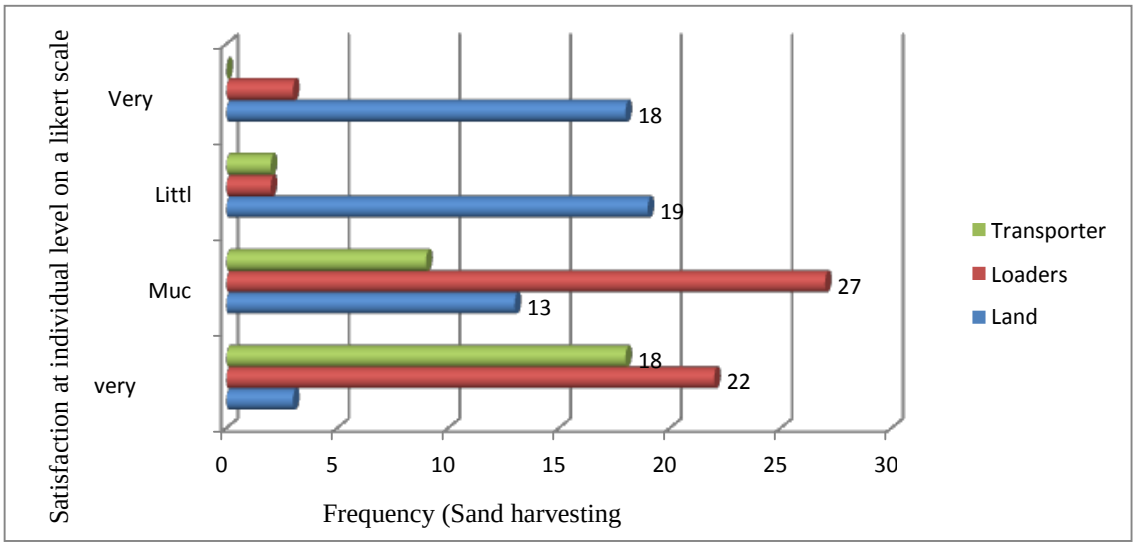

Figure 4.14: Sand Harvesting Categories and satisfaction level of respondents (individual).

At the individual level, 19 and 18 land owners' category of respondents affirmed, sand harvesting to have contributed little and very little respectively; 22 and 27 loaders ranked sand harvesting to have contributed very much and much respectively whereas 15 transporters reported very much over sand contribution.

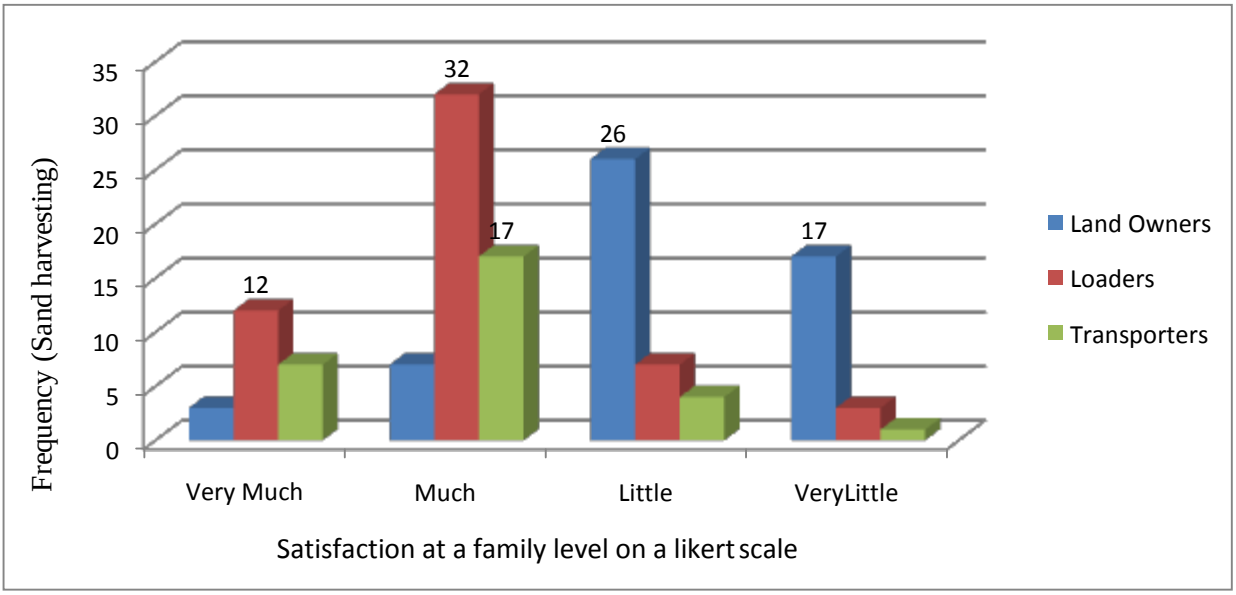

Figure 4.15: Sand Harvesting Categories and satisfaction level of respondents

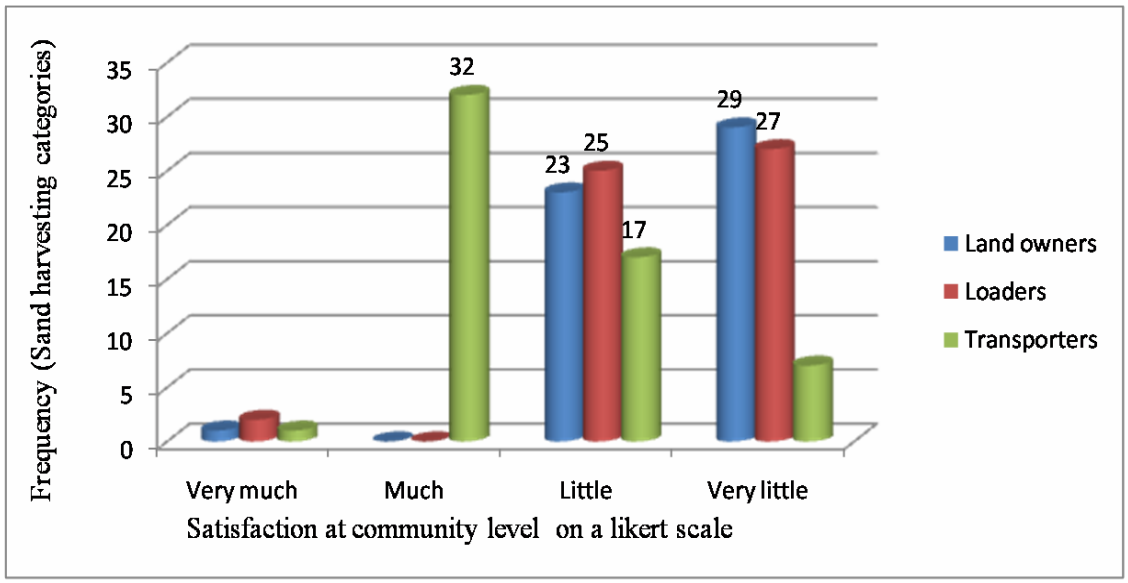

Figure 4.16 Sand Harvesting Categories and satisfaction level of respondents.

At the Family level, 26 sand harvesting land owners category, reported that the activity had contributed very little to their families, with 32 loaders and 17 transporters reporting sand harvesting to have contributed much to their families, However, 29 from the land owner category and 27 loaders held that sand harvesting had contributed very little to the community.

4.6 Existing policies on sand harvesting and their implications.

The study sought to know whether the sand harvesting policies and particularly the sand harvesting guidelines of 2007 were actually in operation in the study area and how it affects the sand harvesting activity if it exists or if it does not. The study based the assessment on the key considerations in the sand harvesting guideline as shown in figures 4.17, 4.18 and 4.19.

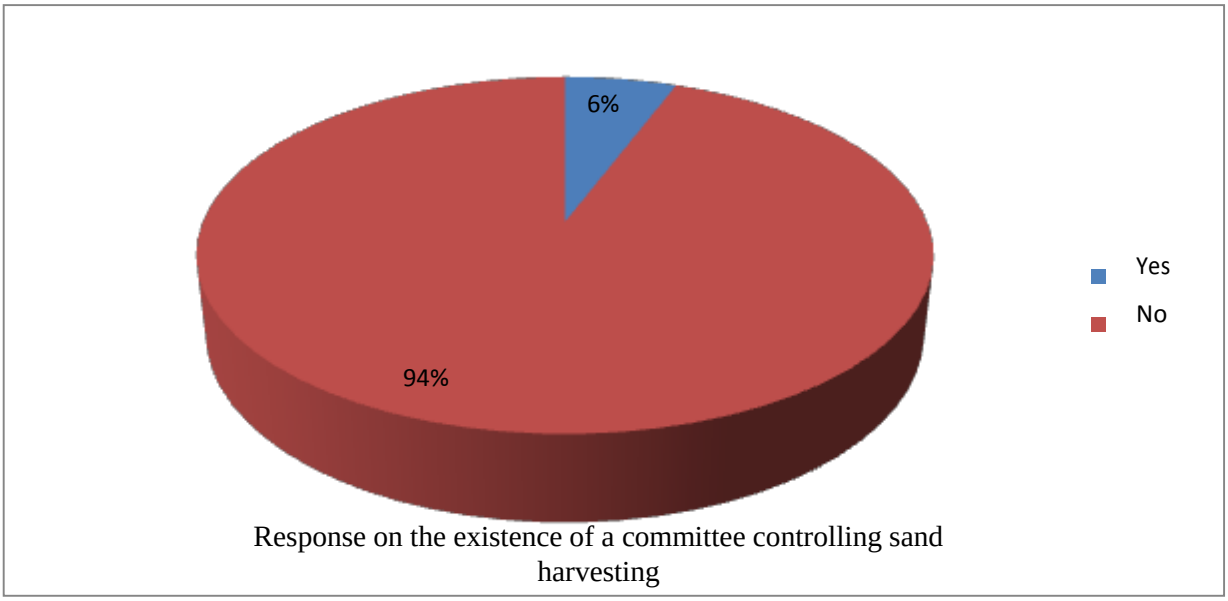

Figure 4.17 Responses on the existence of a formal committee to control sand harvesting.

The respondents were engaged on whether there existed a formal committee that controls the sand harvesting activity as required in the sand harvesting guidelines of 2007.A significant percentage standing at 94% were quick to deny the existence of such committee, with only a mere 6%,responding positively.

According to the sand harvesting guidelines (2007), technical sand harvesting committee ought to be formed in every County charged with sustainable sand harvesting within the county and any other function prescribed by the County Environmental Office. The findings showed the non-existence of such committee. The study further looked at the authority to harvest and transport sand in the area if it conforms with the guidelines and the responses were as shown in figure 4.17

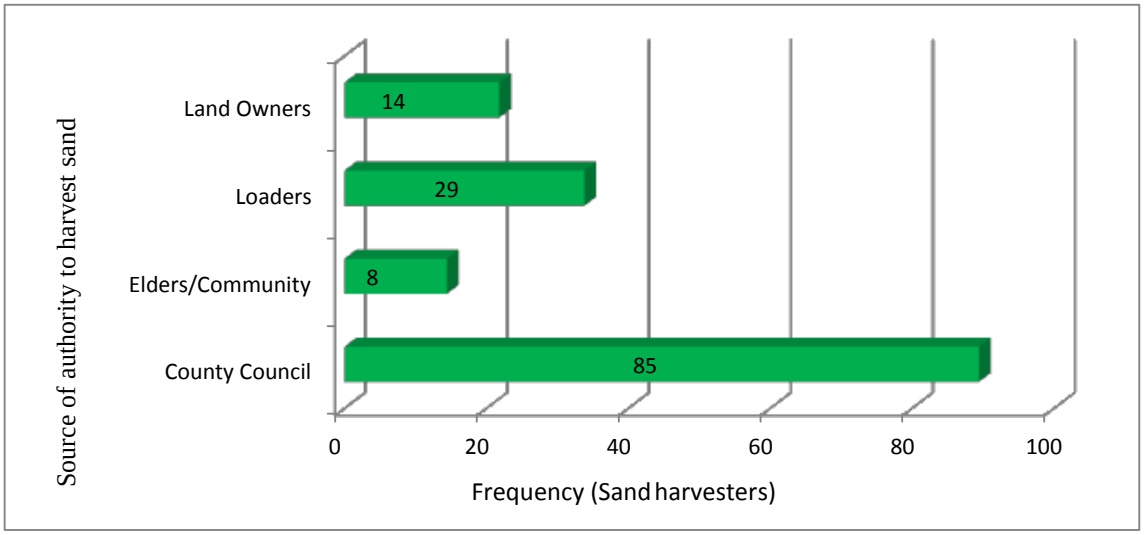

Figure 4:18 The source of authority to harvest and transport sand

An investigation on who gave authority to harvest sand was responded to and the responses showed that; 63% of the respondents said it was the County government with 21%,10% and 6% attributing the authority to loaders, elders/community and land owners respectively. Investigated on who gave the authority to harvest and transport sand specified by the guideline attracted varied responses. Some respondents said it was the County government while others said it was the community hence lack of clarity on the matter.

The divergent responses on the authority to harvest and transport sand are an indication of lack of awareness on the issue. To the respondents, County governments seem to have the authority to manage sand due to its active involvement in the collection of revenues at their check points. Some respondents said that no one is allowed to proceed with sand transportation unless revenue is paid to the county government. As per the Sand Harvesting Guidelines of (2007), the authority to harvest and transport sand is bestowed on the County environmental officer who issue approval permit to the dealers unless County formulates laws to allow coordinated control by the County and National

Environmental Management Authority. The study therefore, confirmed the lack of awareness on the management of sand harvesting and indicates the non application of the harvesting guidelines in the study area.

An investigation was also done to know if environmental impact assessment was being done before harvesting; whether the harvesting site have got an environmental management plan; also if part of the revenue from sand was being used to fund community projects.

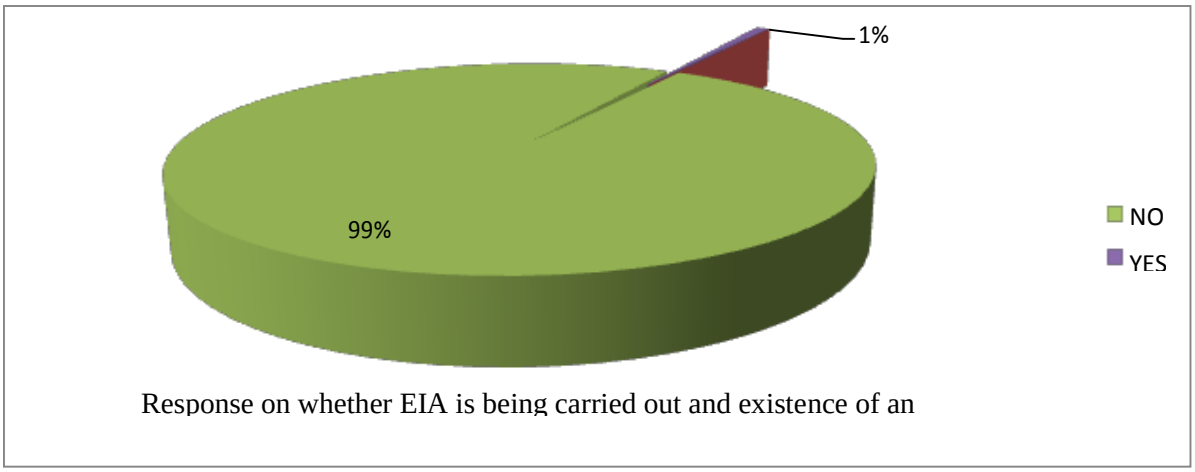

Figure 4:19 Responses on EIA done and existence of an EMP in harvesting sites

A significant 99% of the respondents did not agree on the existence of an environmental management plan in harvesting sites and the carrying out of an environmental impact assessment before sand harvesting is done. Similarly,87% of the respondents denied the fact that revenue from sand harvesting were being ploughed back to fund community projects with only 13% in agreement with this fact and the figure below illustrates this responses.

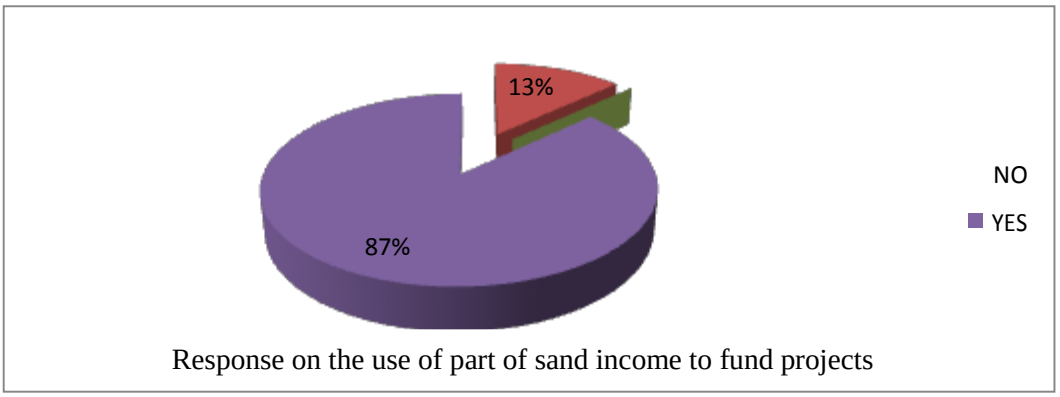

Figure 4:20 Response on the use of part of sand income to fund community projects.

In response to the part of revenue funding community projects, the respondents denied having revenue having been ploughed back and no project had been funded. They cited the worst state of the feeder roads and were not happy about the County government who collects huge sums of money and have neglected them. However, the County government officials claim to have funded early childhood education centers using the revenue from sand of which the community members were not aware and did not concur with.

As supported by the key informant interviews, the study generally, found out that the sand harvesting guideline was not in operation in the study area. Respondents, for instance when asked about the specifications on the depth of sand harvesting; carrying out of environmental impact assessment before harvesting and the use of designated access roads by the lorries; the response was that there was no depth specification, no environmental impact assessment done and no designated access roads.

The findings further showed that, sand harvesting was done both on the river bed and the river banks as oppose to the restriction by the National sand harvesting guideline of 2007 to be done only on the river beds. Also there was no rehabilitation and to document harvesting sites as required by the guidelines.

CHAPTER FIVE

DISCUSSIONS

5.1 Introduction

This chapter discusses the results of the study on the basis of the objectives and highlights areas with policy implications and gives suggestions.

5.2 Demographic Characteristics of the Sand Harvesters

Discussions on Various demographic characteristic of the respondents are presented in the sections that follow;

5.2.1 Age of the Sand harvesters

The results on the ages of sand harvesters are an indication that those engaged in sand harvesting were all adults. This observation is contrary to studies in other areas. Sand harvesting as per National Environmental Management Authority study report on the social impacts of sand harvesting revealed that it had resulted in increased rates of absenteeism and school dropout by minors in order to engage in the activity (NEMA, 2004). It further contradict with the findings of a study carried out in India which showed sand harvesting to have resulted in the proliferation of child labour due to the readily available cash associated with the activity (Sadasivan, 2003).

The study also implies that, most of those engaged in sand harvesting activity were youth for instance the majority of those participating as loaders were the youthful population full of energy. Therefore, sand harvesting activity has provided a sound alternative source of income to the significantly unemployed youth in the area. In support of this finding, a study from other areas and more notably from Togo held that the majority of those

engaged in sand and gravel harvesting activity were youth. Furthermore, sand and gravel harvesting in Togo had seen many youth gain employment from the sector. According to Togo National report of 2007, sand and gravel harvesting was ranked as one of the top sectors that have created employment to the youth in Togo (Ayenagbo, Kimatu, Gondwe, & Rongcheng, 2011).

There has been a rising unemployment rate in Kenya and such activity is of great help to the unemployed youth in the area. The rising youth unemployment has made the youth to adapt by engaging in opportunities that come up in their areas such as sand harvesting in Kerio Valley.

This is supported by research findings which acknowledge that livelihood strategies are generally adaptive over time, responding to both opportunities and changing constraints (Maseko, 2013).

The above results further maintain the views of Mbathi *et al*., (2000) and Mutisya (2006) in their research in Kenya. The findings by Mbathi asserted that, the booming construction industry in the recent times has led to the employment of thousands of people particularly the sand harvesting activity. Mutisya noted that sand harvesting had provided a source of income and employment opportunities.

5.2.2 Education level of sand harvesters

The study shows a high percentage (60%) of respondents having completed secondary education followed by primary (29%) education level.

The findings therefore, indicate that sand harvesting activity had no significant effect on education levels in terms of drop outs. The majority of those engaging in sand harvesting

having completed secondary education stood significantly at a higher percentage. The research by NEMA (2004) on social impacts of sand harvesting in other areas held a different view. In the NEMA report it was observed that, sand harvesting has recorded negative social and health problems including; high school dropout rates; rise in alcoholism and drugs and substance abuse.

5.2.3 Gender of sand harvesters

The results showed that most of those involved in sand harvesting were male whereas female recorded a smaller percentage. This pointed out that sand harvesting is more of a male activity. Those who participated in the activity were either transporters who dealt with sand trade or land owners particularly in female headed households.

However, the findings from observation showed that females engaged in activities that complimented sand harvesting for instance; preparing food for loaders and transporters near quarry sites. According to the national employment National Report (2007) in Togo, the same was reported where the harvesting of sand was dominated by male and women engaged in small enterprises associated with the harvesting activity in Togo (Ayenagbo *et al.*, 2011).

Furthermore, the study outcomes go against the results from a research conducted by Mutisya (2006), on the socioeconomic and environmental impacts of sand harvesting in semi arid areas of Kenya and a Report by NEMA (2004); which showed that sand harvesting activity had led to consequent issues including; prostitution, alcohol and drug abuse as such issues were not reported or observed in the research area.

5.3 Livelihood impacts of sand harvesting on the assets of local community using sustainable livelihood framework

This section discusses the findings of the impacts of sand harvesting on the major livelihood capitals/assets in the selected locations along Kerio river in Kerio Valley

Generally, the study showed that most of the respondents had acquired goats and sheep which are well adapted to the arid conditions of the study area even more than any other livestock. One of the respondent explained that as the drought worsens and the trees sheds leaves and seed pods hence, goats and sheep gets plenty of dry fallen leaves thus able to survive more than any other animal in the area during harsh dry spells. Therefore, Sand harvesting has had a great impact on the financial capital specifically in terms of cash flow; stock and savings in groups; A significant number (128 respondents) of respondents having bought sheep and goats (liquid stock) which are well adapted to the arid and semi arid lands.

This result concurs with that of Babbington (1999) that the access of one asset facilitates the acquisition of another as revealed by the acquisition of stock in terms of goats and sheep as a result of income from sand in the research area. Furthermore, it supports the conceptual framework which linked sand harvesting and assets that is; affecting and being affected by the different assets. In this case sand harvesting led to the acquisition of liquid stock in terms of goats and sheep which is a financial asset.

Financial asset as noted above in terms of income from sand harvesting is low but has tremendously enabled sand harvesters to acquire very important financial assets in form of goats/sheep, chicken, motorcycles and other livestock. The most notable being goats/sheep which are not only affordable, accommodated by the little income but also well adapted to the arid environment hence able to sustain livelihoods.

The findings support those by other researchers, a study for instance by Deller and Schreiber, (2012) confirmed that there has been more consistent evidence where sand harvesting has had a positive impact on employment and income growth rates. Another similar study noted that, Sand has contributed significantly to the economic development in areas where it is done; and has been realized through the creation of employment opportunities (NEMA, 2004).

From Key informants and Observations it showed that there were other spillover effects of sand harvesting activity to the economy of the respondents; the most notable ones are the dust pollution, soil compaction and land dereliction. Dust pollution has not only caused health problems to residents but also led to big losses to their crop production as explained by one of the watermelon farmer. The farmer cited having experienced losses as trucks passed near his watermelon crops during flowering stage. Dust trapped in the watermelon crops facilitates the diseases causing agents which attack the crop hence reducing crop production.

Soil compaction and land dereliction was also observed. Poor road network particularly the feeder roads coupled with the lack of designated access routes in some places forced Lorries to cross farmlands causing soil instability and compaction on the already cultivated farms. The situation was made worst by the creation of deep open pits which renders land unfit for agricultural production. This was also confirmed by the research findings by O'king (2012), that moving Lorries ferrying sand had led to soil erosion, interference with the soil stability and robs land that can be utilized for agricultural production in his research in the Kenyan coast.

Economic losses resulting from sand harvesting were evident in the study area as highlighted by the key informants. This further agrees with the outcome of a research

carried out in Narangi, north of Mumbai in India where farmers experienced the river water engulf their rice farms because of too much sand excavation and the nearby residents were on the brink of losing farmland and their livelihood (Sreebha *et al*., 2011). Also, a study in Tamil Nadu India showed that sand harvesting had led to the undercutting and collapse of riverbanks and the loss of adjacent land that could have been economically exploited for agricultural purposes (Padamala *et al*., 2008)

The research results are also in harmony with the works of Musah (2009) in Northern Ghana and the East Gonja District who noted that; sand harvesting has caused serious environmental impacts in Ghana and around the globe in the recent years ranging from loss of biodiversity; land degradation and loss of agricultural lands. In addition Pereira (2013) explained that unlawful harvesting of Sand and the poor governance enormously causes land dilapidation and endangers the rivers with extinction.

Conflicts between transporters and the farmers were also highlighted to by the key informants in the study area concerning the lack of designated access routes forcing the trucks to cross farm lands; hence clashing with farmers in the research area. The same was also observed by Musah (2009) in his research in Ghana that, sand harvesting had acted as routes of different kinds of conflicts.

The other activities associated with sand harvesting from the findings through observation were the mushrooming small enterprises. These enterprises were the establishment of make shift mini hotels on the roadsides and also near harvesting sites. Shopping centers had also benefited from expansion in accommodation facilities and hotels. Fruit vendors in shopping centers mainly by women were also noted. All these enterprises complimented sand harvesting activity by providing food to transporters and loaders.

The small businesses from observation and corroborated by key informants were mainly run by women hence boosting their economies. The results from a study in Togo described the same scenario were harvesting of sand is dominated by male while women engaged in small enterprises associated with the harvesting activity (Ayenagbo *et al.*, 2011).In the study area, the loaders and the drivers provided market for foodstuffs, fruits and charcoal ferried to the nearby towns for sale.

The rise of small enterprises generally improved the economy of the area where sand harvesting is carried out. In Togo, similarly sand harvesting had boosted the economies of many people. It was reported that Sand harvesting in Togo has played an important role in the boosting of local economy of Togo for many years (Ayenagbo *et al.*, 2011)

In many parts of Kenya, the activity of sand harvesting as in the research area is of great economic importance. As noted by Mwaura (2013), he observed that, harvesting of sand is one

of the alternative livelihood activities of the rural people and has become a source of livelihood for many rural communities in Machakos County. Nevertheless, Mwaura reported that unsustainable sand harvesting has in the past led to land degradation; loss of agricultural lands and biodiversity as well as increased poverty among people.

5.3.1 Impact on Natural Capital

A higher number of the respondents reported to have not been helped by sand harvesting to acquire any form of natural capital. The study pointed out that most of those who had acquired land if form of grazing, a plot or agricultural as a result of sand harvesting were generally the transporters who get a higher price in the outside marked and thus get a significant profit and extra cash to invest in natural capital/asset. A significant number of

respondents have neither been helped by the sand harvesting to acquire land. However a small number of respondents reported to have purchased a piece of land (plot) in a market center and a piece of land in town.

Natural capital which is land in different forms like; a piece of land (plot) in town; a piece of land (plot) in market centre; cultivated or grazing land helps in sustaining livelihoods as they can easily be sold to sort out any upcoming economic needs. The study revealed that sand harvesting had enabled only a few to purchase land in various forms and places at the expense of many engaged in the activity.

Key informants pointed out that the main reason for a few of the respondent having acquired natural capital in terms of land in different forms was attributed to; the lack of market connections; supportive institutions and inadequate groupings to boost their bargaining power. This is reflected in Babington's work on capitals and capabilities. According to Babington (1999), People's capacity to make a meaningful livelihood out of a resource to a great extent is influenced by the capabilities they possess as a result of their initial endowments of the different types of capital asset; For instance, people with significant endowments of land (natural capital) or financial resources (produced capital), or strong social networks (social capital) are in general better able to gain access to the institutions of the state and market and thus influence their subsequent effects on patterns of access.

In addition, the existence of various actors engaging in the process of sand harvesting from extraction, transportation up to the market leads to lack of uniformity in terms of payment at different level for the sand resource. The middlemen who transports sand to the market for the users are the ultimate group who get a much higher price and therefore, able to acquire natural capital in terms of land. In Machakos, this situation of

sand harvesting going through the stages of prospecting, extracting and transportation; while engaging a variety of stakeholders was observed (Mwaura, 2013).

5.3.2 Impact on Physical Capital

Most of the respondents held the view that sand harvesting has not facilitated the construction of physical assets with a high number of respondents not attributing the construction of physical assets to sand harvesting. Some were in agreement that it had built schools, others agreed on health centers and a few on cattle dips and no one citing road construction.

Further probe through key informants it revealed that the agreement on the building of schools, health centers and cattle dip by some of the community members is not by use of the income from sand harvesting but rather the ready availability of the sand material that has eased the cost of construction in the area. However, the County government official reported that sand harvesting revenue had been ploughed back to build early childhood development centers of which the residents were not aware of.

The benefits of Sand harvesting to the local infrastructure due to its availability is supported by research carried out by NEMA (2004). In the findings, NEMA (2004) observed that, sand harvesting has contributed significantly to the economic development in areas where it is done. This has been realized through creation of local supply of raw materials for the construction industry. The readily availability of sand in the study area has facilitated construction save for the feeder roads.

Observations showed that feeder roads were not in a good condition and there were lack of designated access roads which forced the trucks to cross farmlands hence conflicts with the farmers; destabilizing vegetation cover; compaction of soil in already cultivated

farms and loosening the soil paving way for the agents of erosion to prevail. The findings further deviate from Musah's (2009) research on the positive impacts of sand harvesting particularly in the road construction sector. In his research, Musah pointed out that sand harvesting has enhanced infrastructural development such as roads which is not the case in the study area as confirmed by key informants that the revenue from sand harvesting had not been used to enhance infrastructural development.

5.3.3 Impact on Social Capital.

A good number of the respondents had been triggered by sand harvesting to form social groupings that which are of significant importance in time of need the most common were; savings and loan and self help groups, however a higher number of the respondents preferred self savings. From the findings, the eligibility of a person to belong to a certain grouping was determined by the contribution he or she makes to it. They also highlighted the importance of the groupings in helping its members in times of need and also the members are able to borrow loans to educate their children, pay medical bills and even buy food the importance of social groupings was also noted by Mwasaa (2012) in his research on livelihoods.

The results from key informants showed that there were informal groups that existed mainly comprising of the members from different clans or just group of community members mainly comprised of the youth who came together with a common interest. The main aim of such groups was the control and protection of sand harvesting sites from outsiders.

The above result on groupings by the community members to protect harvesting sites concurs with the works of Doward *et al.*, (2001). According to Doward *et al.*, while most

of the assets are considered to be of benefit in terms of the household or its membership, some assets may be held in common with a broader user group. Therefore, assets can be considered at a number of levels from individuals to households, to groups and communities. Also, resource management solutions may be collective as well as aggregated but the centrality of the asset base to sustainable livelihoods is self-evident and does not invalidate the focus on individual household livelihood strategies (Doward *et al*., 2001).

5.3.4 Impact on Human Capital

The results revealed that, most of the respondents used income to buy food, followed by those who used money to pay for school fees for the children then housing and clothing. Portrayed clearly from the findings is the fact that, higher number of the respondents uses the income from sand to sort out the very basic needs. This result is supported by research outcomes in Togo which alluded to the fact that sand harvesting greatly benefited the community through generation of income and local revenue which is used in to meet the very basic needs of the family including; food; school fees for children and even entertainment (Ayenagbo *et al.*, 2011).Therefore, sand harvesting presents a viable livelihood option in the area given the arid conditions which renders farming unreliable.Health and safety issues were evident. Extra traffic due to the intensive nature of sand harvesting in the area has led to dust and noise pollution which is detrimental to the health of the residents. Furthermore, creation of deep open pits was also observed, where scooping of sand went as deep as 7-10 feet, causing instability and occasional collapse of the river bank.

Deep open pits, were observed in different harvesting sites especially those on the banks of small seasonal rivers and streams that forms the tributaries of the Kerio river. Some of the pits were also observed in the individual farms. These open pits are dangerous and had caused injury to people and animals. One of the respondents by the name Chemitei mention an incident that happened three years ago where the river bank crumpled burying one man who was fortunately rescued and rushed to the hospital. Figure 4.8 shows one deep open pit that collapsed on sand extractor at the river bank of Kerio river.

Health issues have been reported from studies in other areas too. In Wisconsin, sand harvesting has had quality of life issues and the threat of silicosis disease. Silicosis results from long term(chronic) or even shorter but intense exposure(acute) to high levels of inhalable dust that contains a significant proportion of silica (Akgun, 2006). Deller and Schreiber (2012) in their study contented that in spite of sand harvesting in many ways able to provide well paying jobs which results in low poverty levels; however, the study showed that the activity is associated with poorer overall health of the community.

Furthermore, results from key informant indicated that dust from sand harvesting has been the main source of air pollution. Also, noise pollution from the trucks is a nuisance to the human environment that is escalating at such an alarming rate and it is a major threat to the quality of human lives. Although noise is a significant environmental problem it is often difficult to quantify associated costs (Sadisvan, 2003).

5.4 Contributions of sand harvesting compared to other Livelihood options

The findings revealed that the most popular livelihood option in the study area besides sand harvesting was farming and comprised of cattle rearing, fruits and maize cultivation as mentioned above. Other livelihood options include; bee keeping, formal employment

and nonfarm trade. Agricultural sector and particularly rain fed has continued to dominate the main livelihood of the rural communities in Africa. As observed in the research area, many respondents relied on rainfall for the success of their crop farming. Past research attests to this finding. For example Muthui (2009) found that African rural livelihoods are largely derived from rain fed agriculture with 70% of the continent's population relying on agriculture. In Kenya research shows that over 80 percent of the population earns their living by engaging in agricultural activities or employed in agricultural sector (Mose, 1999).

Comparing the contribution of sand harvesting and these other livelihood options called for the division of sand harvesting community into three groups; Loaders, land owners and transporters all dealing with sand harvesting. Sand harvesting had contributed more than farming to the sand loaders most of them (30) earning a monthly income range of between Kshs.8,000-10,000 compared to 12 land owners in the same income range. Transporters too, benefited more from sand harvesting as oppose to other occupations they engaged in whereas; farming was still the better option for the land owners with the majority (31) recording an income range of between Kshs.11,000-15,000 from farming and (2) in the same range from sand harvesting respectively. on-farm trade was the lowest in terms of the contribution and formal employment was slightly higher than farming with sand trade being the highest paying with many respondents earning more than Kenyan shillings 31,000 and above.

Satisfaction level individually at the family and community level on a Likert scale was further used to compare the contribution of sand harvesting with the other major sources of income the respondents rated sand harvesting activity to have helped them individually and their families very much with loaders and transporters recording the

highest satisfaction level at an individual and family level.

The three categories generally recorded very little satisfaction of sand harvesting to the community. This is attributed to the fact that most of the respondents used the income from sand to buy the very basic needs like food and has helped them to survive. At individual and family level it is evident that the respondents had benefited significantly from sand harvesting making it an alternative source of income.

A research by Mwaura (2013) affirmed that sand harvesting on agricultural land is one of the alternative livelihood strategies for the rural people; he cited how sand harvesting has provided and alternative livelihood options for the community in Machakos County. In the research area, harvesting activity provides this opportunity to diversify using the strategy. Sand harvesting therefore, presents an alternative livelihood option owing to the unreliability of rainfall limiting other livelihood options particularly farming.

The results signify that sand is an important asset possessed by the people that need to be enhanced in order to make it more rewarding. According to Knutson (2006), underprivileged persons possess abilities and assets that can be used to assist them make a sustainable livelihood for themselves and their families. In this case, people in the study area have got limited livelihood options owing to the arid conditions that characterize the area hence; the endowment of such assets needs to be greatly developed. Despite the challenges surrounding sand harvesting, from the study it provides an opportunity for the harvesters to diversify their livelihood as noted by World Bank (2008), that Diversification of livelihoods has been put forward as one way of dealing with challenges to typical production patterns.

Sand harvesting presents an alternative livelihood option in Kerio Valley along Kerio river but its success as a livelihood strategy is fundamentally influenced by the

transforming structures. This view is also held by sustainable livelihood framework where livelihood strategies are fundamentally influenced by the vulnerability context and the transforming structures and, the livelihood outcomes which mean the final result of the livelihood efforts and that could result in improved wealth, living standards and status thus lessening vulnerability (Maseko, 2013).

5.5 Existing Policies on Sand Harvesting and their Implications.

There is an elaborate sand harvesting guideline that is governed by Section 42 (4) of the Environmental Management and Coordination Act, which mandates the Director General of the Kenya National Environment Management Authority to issue the National Sand Harvesting Guidelines.

First, the Technical Sand Harvesting Committee (TSHC), as per the guidelines should be formed in every District now sub-county with members carefully selected as specified by the guidelines. Their mandate is to be in charge of the management of the sand harvesting. Some of the main considerations captured in the sand harvesting guidelines are:

a) Sand dam(s)/ gabion(s) should be constructed in designated sand

harvesting sites; b) Lorries must use designated access roads only to sand

harvesting sites;

c) Designated sand harvesting sites ought to be rehabilitated appropriately by the Riparian Resource Management Association, County council and approved dealer under close monitoring and supervision by the Technical Sand Harvesting Committee in compliance with EMCA, 1999;

d) Sand harvesting or scooping is restricted to the riverbeds with no harvesting allowed on riverbanks to avoid widening of rivers;

e) It specifies the area of sand harvesting and the depth to which the harvesting will be done.

f) The requirements of an environmental impact assessment/environmental audit pursuant to the Environmental Management and Co-ordination Act No. 8 of 1999 have been fulfilled.

g) The respective Riparian Resource Management Associations, County Councils and approved sand dealers will plough back part of the revenue collected from harvesting activities to local community projects and environmental conservation.

A significant percentage denied the existence of a committee to control sand harvesting with only a few responding positively.

According to the Sand Harvesting guidelines of 2007, Technical sand harvesting committee ought to be formed in every County charged with sustainable sand harvesting within the county and any other function prescribed by the District/ County environmental office (NSHG, 2007). The findings showed the non existence of such committee.

The responses on who gave the authority to harvest and transport sand specified by the guideline attracted varied responses. Some respondents said it was the County government while others said it was the community hence lack of clarity on the matter.

The divergent responses on the authority to harvest and transport sand are an indication of lack awareness on the issue. To the respondents, County governments seem to have the authority to manage sand due to its active involvement in the collection of revenues at

their check points. Some respondents said that no one is allowed to proceed with sand transportation unless revenue is paid to the county government. As per the sand harvesting guidelines of (2007), the authority to harvest and transport sand is bestowed on the District/County environmental officer who issue approval permit to the dealers unless County formulates laws to allow coordinated control by the County and NEMA. The study therefore, confirms the lack of clarity on the management of sand harvesting and indicates the non-application of the harvesting guidelines in the study area.

Generally, the study found out that the sand harvesting guideline was not in operation in the study area. According to National sand harvesting guidelines of 2007, there must be the Allocation and transmission of at least 10% of the revenue collected to the Technical Sand Harvesting Committee. The Allocation of part of the revenue collected from sand dealers is meant for community projects and Ensuring rehabilitation of the sand harvested sites and other environmental damage associated with harvesting and transportation of sand within its area of operation (NSHG, 2007).

There is an elaborate sand harvesting guideline that is governed by Section 42 (4) of the Environmental Management and Coordination Act, which mandates the Director General of the Kenya National Environment Management Authority to issue the National Sand Harvesting Guidelines.

The study found out that, there is no implementation of both social the environmental considerations of sand harvesting guidelines in the study area. For instance, it was not clear who gives authority to harvest sand, there was no significant projects funded from sand revenue and no environmental impact assessment done before sand harvesting as spelt out in the guidelines.

The slow implementation of the National sand harvesting guidelines by NEMA and the formulation of the necessary legislative framework by the County government is attributed to the failure by the community to realize the full potential of sand harvesting as a livelihood option given the limited livelihood options in the study area owing to inadequate rainfall. This view is cemented by the works of Toner and Frank (2006) concerning the sustainability of livelihoods. According to Toner and Frank (2006) the formulation and implementation of the policies and regulations determine the level of benefits achieved in sustaining livelihoods. The sustainability of livelihoods cannot be guaranteed if institutional capacity necessary to design and implement policies and regulations in the interest of the people is lacking.

In totality, there is lack of coordination or link among the various assets in the community; for instance, human capital, social capital and physical capital. These explain the main reasons for having slow exploitation of the full potential of sand harvesting as exemplified by a number of factors: Poor access to the market makes it hard for the sand resource to fetch a good price which will in turn make sand harvesting have the necessary potential on the lives of the sand harvesters; only a few people with access to the market have reported good price for the resource.

The other issue of concern is the road network which are in poor state (specifically the feeder roads) or non existence making access to the resource impossible during rainy seasons hence affecting livelihoods especially for those solely dependent on the resource. The study observed that in some areas there are no designed roads and trucks are forced to cross farmlands to access sand which creates conflicts with the farmers. This confirms the argument by DFID (1999), that access to one capital might facilitate the access to other capital assets where, having access to good road network facilitates access to the

resource and vice versa. It consequently, follows that having good road network, a resources like sand, livelihood strategy like sand harvesting; good legislation and market network ensures sustainability. It also supported by sustainable livelihoods framework which links inputs (designated with the term 'capitals' or 'assets') and outputs (livelihood strategies); connected in turn to outcomes; which combine to ensure well-being and sustainability (Maseko, 2013).

There is also the inactiveness of legislations, policies and organizations that are supposed to control sand harvesting activity and ensure it benefits the community for instance the National environmental management authority and the County government. However, the County government is actively involved with the activity but its role is limited to the revenue collection, which the residents wonder why this revenue is not ploughed back for their benefit, more specifically to build their physical capital. This poor regulation of sand harvesting has been documented by other studies. In India Sand is considered as a 'minor mineral' its harvesting is controlled by State Governments. However, the Ministry of Environment and Forests lacks an efficient regulatory framework to control it. At one point the Supreme Court of India ordered the regulation of sand harvesting (Padamala *et al*., 2008).

Padamalal *et al*., (2008) further painted a picture on the environmental effects of river sand mining from the Pamba river and stressed the need for regulating the mining activity on an environment-friendly basis. Musah (2009) observed that, although sand harvesting cannot be completely stopped, the government and other stakeholders should develop new laws and policies which should aim at promoting sustainable harvesting by striking a balance between environmental conservation and business proceeds. Sand needs to be exploited to satisfy human demand but this requires efficient and effective resource

management to ensure economically and environmentally sustainable utilization. Mensah (2002), in the study outcomes suggested the establishment of pragmatic and explicit laws in a participatory manner in order to allow for enforcement at all levels. Harrison, Fidgett, Scott, MacFarlane, Mitchell, Eyre,& Weeks, (2005) puts forward A set of proposed planning guidelines for the management of river mining in developing countries taking the case of a few Jamaican rivers.

Generally, the findings supports the works of Padamala *et al*. (2008); Musah (2009); Mensah (2002); Harrison, et.al., (2005), that there is a need for the establishment of pragmatic and explicit laws in a participatory manner in order to allow for enforcement at all levels with an aim of ensuring sustainable sand harvesting in the long run. Moreover, the results also agrees with conceptual and DFID (1999) SLA framework and the works of Babington (1999) that structures (levels of government) and policies (laws and institution) have a great impact on the livelihoods and may either impact on them negatively or positively.

What comes out clearly from this research is the fact that there is a distinct disconnect between sand as an asset with other community assets which derails sand harvesting activity from reaching its full potential; For instance, the physical asset like the road network (especially feeder roads) to allow for accessibility, social asset like social networks (for instance, market networks) and formation of cooperatives to help market and negotiate better pay illustrates this disconnect. This agrees with the arguments of Babington on his capital and capabilities framework that; for a livelihood to be more meaningful, people ought to possess not only the assets but also the ways in they are able to develop/expand their assets by liaising with other actors through relations govern by logic, state, market and civil society (Babington,1999).

It is thus evident that the development of one asset aids the development of another asset (DFID, 1999). There are a myriad of opportunities of enhancing sand harvesting activity to reach its full potential as source of livelihood. Sand harvesting should be given a new perspective and be looked at as an important endowment to the community where it exists just by its mere existence and more importantly not considered in isolation but in connection with other assets like the physical, social and human capitals.

The relevant actors should for example develop the infrastructure; empower community members to form cooperatives to enhance (savings, loan borrowing and have a strong bargaining power) and connections with the outer markets in order to avoid exploitation by the middlemen. This will allow for the realization of the full potential of sand harvesting and for the community to able to challenge the structures under which living is made as Babington (1999) defined assets as "vehicles for instrumental action" (making a living), hermeneutic action (making living meaningful) and emancipator action (Challenging the structures under which one makes a living).

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter highlights key discussion points; makes conclusions and gives recommendations based on the findings.

6.2 Summary Of the findings

The results of the findings show that sand harvesters operate and earn in different levels, categorized as loaders, land owners and transporters. This level presents a great disparity in incomes from sand harvesting with transporters earning handsomely than any other group.

Despite, the low incomes from sand harvesting activity, there has been a significant impact on financial capital/asset, specifically the acquisition of stock particularly goats and sheep that are well adapted to the prevailing conditions of the area thus sustaining livelihoods and is vital for the sand harvesters.

Sand harvesting from the findings is more of a male activity as revealed by the result where male recorded 95% while female standing at 5%. However, from observation and key informants interviews results, females engaged in activities that complimented sand harvesting; for instance preparing food for loaders and transporters near quarry sites. Furthermore, there have been the mushrooming small enterprises like mini hotels, shops on the roadsides and also near harvesting sites. The small businesses mainly run by women provide foodstuffs, fruits and charcoal hence boosting their economies.

As per the key informant interviews and observations the other spillover effects of the sand harvesting activity to the economy of the respondents include; dust pollution, soil compaction and land dereliction. Dust pollution, has led to a reduction in their crop

production as dust trapped in the watermelon crops facilitates the diseases causing agents which attack the crop hence reducing crop production. Soil compaction and land dereliction due to poor road network particularly the feeder roads coupled with the lack of designated access routes in some places forced Lorries to cross farmlands causing soil instability and compaction on the already cultivated farms. The situation was worsening by the creation of deep open pits which renders land unfit for agricultural production.

Not many respondents agreed to the use of sand harvesting income to improve vital infrastructures like feeder roads. A few had formed social groupings with the help of income from sand and a good number mainly transporters had acquired natural capital particularly land as a result of sand harvesting.

Portrayed clearly from the findings is the fact that, higher number of the respondents uses the income from sand to sort out the very basic needs like food and therefore sand harvesting presents a viable livelihood option in the area given the arid conditions which renders farming unreliable. The full potential of sand harvesting to sustain livelihood is greatly curtailed by the poor development of other assets, more so physical, human and social assets. Poor road networks, lack strong social networks with the market and inadequate strong groupings like cooperatives to help market and negotiate for better price; inadequate skills on how to harvest better are classic examples of assets that challenge sand harvesting activity as a strong livelihood option.

Other processes, organizations and structures that govern and control sand harvesting have been either slow or rather dormant. The County government has failed to construct feeder roads to allow for easy access to the resource, despite collecting revenue from the activity. National environmental management authority either, has been slow in implementing policies and laws governing sand harvesting. Additionally, County

government has been slow in enacting laws to help manage sand harvesting activity in the research area. The results generally revealed that the development of other assets will in turn lead to the enhancement of sand harvesting activity to sustain livelihoods, these assets includes; physical (infrastructure development), social (formation of cooperatives and networking with the market) and human (empowerment with skills of how to harvest better).

Farming is the most popular livelihood option in the area basically, goat/sheep and rearing, maize and fruits farming, that notwithstanding the unreliability of rainfall calls for the diversification of livelihoods and sand harvesting provides an opportunity for diversification. Sand harvesting when compared to other livelihood strategies as per the results shows that, to the loaders and transporters it was ranked to be better than farming whereas land owners ranked farming as the most preferred livelihood strategy than sand harvesting. In addition, the majority of the respondents rated sand harvesting to have helped them and their families very much hence presents a feasible livelihood survival strategy.

In spite of sand harvesting having a number of environmental impacts like clearance of vegetation, crumpling of the river banks, destabilization of soil causing erosion and more significant dust pollution that affect flowering of sensitive crops like watermelon, on the positive side the dug up holes left are occasionally filled up during heavy rains. Sand as a resource therefore is able to replenish itself and is able to sustain livelihoods due to its capability to be harvested without endangering its resource base. Policies and laws existing on sand harvesting particularly the national harvesting guidelines of (2007) have not been implemented despite having the ability to change sand harvesting to be better for the sand harvesters. The body concerned, National environmental management authority needs to hasten its implementation and also key players like the County council

governments need to follow the guidelines and plough back revenue as recommended in the guidelines.

6.3 Conclusions

In conclusion, the full potential of sand harvesting is yet to be realized and it presents a viable livelihood option in the area. On the basis of the findings, the study recommends, the harnessing of the full potential of sand harvesting due to rainfall unreliability in the area and its ability to replenish itself.

6.4 Recommendations

Based on the findings of the study, this section suggest key areas for development practitioners and policy makers to ensure sustainable sand harvesting in order to benefit the community and provide a fundamental livelihood option.

6.4.1 Strengthening the control of sand harvesting

The study recommends that, disparities in sand incomes should be looked at. Policy makers and development practitioners ensure that there is stricter control of sand harvesting activity to ensure greater benefits to the residents by controlling Sand prices. This can be achieved by empowering of the sand harvesters to be organized in a strong cooperative to strongly negotiate and control sand prices and also the implementation of sand harvesting guidelines provided by the national environmental management authority. The County government should also enact laws in line with the national sand harvesting guidelines on how to manage sand harvesting activity in a sustainable way.

6.4.2 Increasing access to an appropriate combination of assets

The development of other assets is a must for the full potential for sand harvesting to be realized. This can be achieved through; ploughing back of revenue from sand harvesting

to fund infrastructure development or even creation of designated access roads to ease the transportation of the resource and avoid the destruction of the farms by the heavy trucks. The road networks should be repaired to avoid its deterioration due to the heavy trucks, which makes the transportation of sand and other farm produce like maize and fruits difficult leading to losses and inaccessibility these are all in accordance to the sand harvesting guidelines.

The other assets to be enhanced include; Market linkages; formation of a cooperative; revolving funds; capacity building; enactment of legislations at the County level and implementation of the existing policies and laws.

6.4.3 Supporting local institutions

Secondly, the existing groupings by the sand harvesters should be enhance and even trainings and capacity building on the formation of more cooperative societies that can provide an avenue for the harvesters to save income from sand resource and help them borrow loans or even create revolving funds to educate their children hence easing the burden of school fees given that the communities near Kerio have got limited livelihood options owing to the arid conditions in the area. Also, market linkages and information on the importance of sand resource to the community should be enhanced to ensure that the resource gets a wider market hence increased income and the betterment of the living standards of community in the sand harvesting areas.

6.4.4 Building on the strength of sand harvesting as a livelihood option

The study strongly recommends that, the development practitioners ought to look at sand resource as an important opportunity to take livelihoods of the community to the next level given that the resource is replenished every rainy season coupled by the fact that the other livelihood option especially farming is faced with rainfall unreliability and

therefore sand will always be in plenty and can help change the lives of the residents. This is evident from the research findings that despite the moderately low income from sand, a significant impact has been felt particularly with the acquisition of stocks like goats and sheep, well adapted to the area and thus sustain livelihoods. Sand is the best livelihood option in the area.

6.4.5 Creation of an enabling Environment in terms of Policies, Institution and processes

The study also recommends that structures and processes in this case (county government, non- governmental organizations, the National Environmental management Authority (NEMA) should fast track the implementation of the National sand harvesting guidelines in order to get the most benefit of the sand resource and for the improvement of the lives of sand harvesters.

The county government should take the initiative in drafting legislation on how sand harvesting ought to be managed. The county also must consult with the relevant environmental body, line ministry and base its draft on the national sand harvesting guidelines.

6.5Areas for further research

The finding of the study exposes the need for a solution in the sustainable management of sand harvesting. Sand harvesting is important as an alternative livelihood option given the unreliability of the rainfall and long spells of drought that affect farming which is the main livelihood in the area. Despite the existence of the sand harvesting guidelines, there was no implementation and the community members were not aware of the existence of such policy.

Research on the harmonization of existing policies and enactment of relevant sand harvesting laws by the county government. This will effectively allow easy implementation of policies and operationalization of sand harvesting laws at the grassroots.

The study also found out that there was a great disparity in the income from sand harvesting where the transporters benefited very much more than the land owners whose farms the sand is obtained. A study on the market value chain should be undertaken in order to determine the value of sand at all stages and help regulate the prices of sand as a resource.

Since the study area is a resource deficient and sand harvesting is a resource available in the area with a potential of taking the community to the next level in terms of income generation coupled with its capability to replenish itself, a study needs to be undertake on the possible ways of enhancing the potential of such resources in the resource deficient areas in order to get the most of it to benefit its custodians.

The study, further revealed that, there is a disconnect between the various assets which derailed the realization of the full potential of sand harvesting as a sustainable livelihood option. A study could be initiated and even a model developed on how the various assets can be linked to sand harvesting in order to realize the full potential of sand as a resource in sustaining livelihoods.

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APPENDICES

Appendix I: Questionnaires

Individual Questionnaire for Land owners/Loaders (Household Heads)

Introduction

Am/we are from University of Eldoret conducting research on Sand harvesting, and sincerely seek for your opinion. I/we kindly request you to answer the questions am/we are about to ask you and will appreciate any information you will provide.

Your answers are fully confidential and will be coded and recorded without

names. Thank you in advance for your participation and co-operation.

Yours truly,

Emmanuel Kiprotich Meli Researcher.

A) Respondent Particulars

1) Name of the respondent ……..

i) Name of your;

County…….Location……

Sub location…….Village…….**.....**

1) Gender?

(i) Male ( ) **(ii)** Female ( )

3) What is your age?**.....**

4) What is your marital Status?

(i) Married ( ) **(ii)** Single ( ) **(iii)** Separated ( )

5 a) What is your highest level of education?, (Tick appropriately)

(i) Primary ( ) **(ii)** Secondary ( ) **(iii)** Tertiary ( ) **(iv)** University ( )

v) No education ( ) **vi)** Adult education level ( )

(v) Any other (Specify)……

b) When did you finish your studies?……

6. What your main occupation? (Tick appropriately)

(i) Medical officer ( ) **ii)** Teacher ( ) **iii)** Farmer ( ) **iv)** Business ( )

v) Farmer and Business ( ) **vi)** Politician ( ) **vii)** Politician and farmer ( )

viii) Farmer and public servant ( ) **ix)** Public servant, Farmer and Business ( )

x) Others, specify……

7. i) Do you carry out sand harvesting?

Yes ( ) No ( )

ii) Do you own Sand harvesting site?

Yes ( ) No ( )

iii) How long has sand harvesting been taking place along Kerio River?.....

iv) How do you determine the ownership of sand harvesting sites?

v) Do you do sand harvesting as your main occupation?

Yes ( ) No ( )

vi) What is your other occupation?……

B) What is the socio-economic impact of Sand Harvesting on the local community along Kerio River?

8 i) Has sand harvesting enabled you to get/buy the following? Use the table below

{To buy land for example a plot in town, agricultural land, (Tick appropriately and give numbers)}

Natural capital (land in different forms as shown in the table below) **i)** Has sand harvesting enabled you to buy the following?					
Natural capital/assets	Yes	No	Acreages	Numbers	Value in Kshs. (Approximately
Agricultural land					
Grazing land					
A plot in a Market center					
A Plot in town					
Others specify					

ii) Has sand harvesting enabled you to buy or construct the following? Use the table below

{Assets like goats, motorbike, or even house as shown below,(Tick (√) appropriately and give numbers)}

Financial capital. (Assets like goats, motorbike, or even house as shown below)			
Financial capital	Yes	No	Numbers
Sheep and goats			
Iron sheets			
Water tank			
Bicycle or Motor cycle			
Cattle			
Chicken			
Car			
Other farm animals			

iii) Has sand harvesting enabled you to access the following?

{Enabled you to register in groups/Chamas (Tick (√)appropriately and give numbers)}.

Social capital Has sand harvesting enabled you to access the following?			Amount of saved per		
Types of social capital	Yes	No	Day	Week	Month
Cooperative society					
Savings and loan group					
Self help group					
Self Savings					
Others specify					

iv) Has sand harvesting contributed to your community in the following areas? **(Tick (√) appropriately and give numbers)**

Physical capitals/ Asset	YES/	NO	Numbers
Build Health services			
Build Schools			
Other projects (specify)			

v) How do you rate sand harvesting contribution to you, your family and the community? (Tick **(√)** appropriately).

	Yourself	Your family	Community
Very much			
Much			
Little			
Very little			

C) What is the contribution of Sand Harvesting compared to other livelihood options in the study area?

9 i) How much are you paid for sand harvesting?

Per lorry?.....

Per tonne?.....

ii) How much do you earn from your other occupation?.....

a) Occupation……

b) Amount per month……

iii) Compare Income from other sources to Sand Harvesting, (Tick **(√)** appropriately)

Income Sources	Yes or No	Monthly wages	Annual wages
Formal employment			
Sales from farm produce			

Sand harvesting			
Nonfarm trade			
Casual employment			
Support by relatives			
Apprenticeship			
Others specify			

10. What are the approximate uses of income from sand?

Approximate use of income from sand	
Item	approximate %/Rank
Food	
Housing	
Education	
Clothing	
Medicine	
Water	
Others specify	

j11) How do you rate Sand Harvesting and your other occupation in terms of their contribution to you, your family and the community welfare. (Tick **(**√**)** appropriately?)

	Sand Harvesting	Your other occupation (specify)……
Very much		
Much		
Little		
Very little		

C) What are the environmental impacts of Sand harvesting experienced in this area?.....
.....
.....

D) Existing policies on Sand Harvesting and their implications (Guided by the table below)

Question	**Answer**
Is there a body controlling sand harvesting? If yes, is it registered? What is the composition?	
Who determines the areas of sand harvesting? And Who determines the depth	

of the extraction?	
Are the sites rehabilitated After extraction?	
Is EIA(Environmental impact Assessment) done before sand harvesting?	
Does the designated sand harvesting site have an (Environmental mgt plan).	
Are the sand harvesting sites documented?	
Who gives the authority to remove and transport sand?	
Do dealers have approval documents?	
Do we have price guidelines for selling Sand? And who gives the guidelines?	
What is the buying price from the source to the market?	
is the seller issued with an official receipt and keeps records for periodic inspection?	
Are the sand dealers abiding by the guidelines?	
Are there designated access roads?	

Is there any revenue collected from the sand dealers? If yes how much per lorry?	
Who collects revenue from sand dealers?	
Does the revenue from sand dealers ploughed back to fund community projects? If yes give examples	
How deep is sand harvested?	
Is sand harvesting carried out in river beds or river banks?	
Is sand harvesting done concurrently with the rehabilitation of the sites previously harvested?	
How far are the sand collection site from the river banks,	
Is adequate sand retained in the river beds?	
How far is sand harvesting sites from any physical infrastructure like bridges, roads,	
Is the loading done in designated sites in controlled access roads	
Are there existences of sand gabion in the extraction sites?	

3.1 Questionnaire for Transporters

Name of the interviewer…… Date of Interview……

Questionnaire number…….

Am/we are from University of Eldoret conducting research on Sand harvesting, and sincerely seek for your opinion. I/we kindly request you to answer the questions am/we are about to ask you and will appreciate any information you will provide.

Your answers are completely confidential and will be coded and recorded without

names. Thank you in advance for your participation and co-operation.

Yours truly,

Emmanuel Kiprotich Meli
Researcher.

A) Respondent Particulars

1. Name of the respondent

…… **i)** Name of your;

County……Location…….. Sub

location……Village……

2. Gender?

(i) Male ( ) **(ii)** Female ( )

3 What is your age?.....

4. What is your marital Status?

(i) Married ( ) **(ii)** Single ( ) (**iii)** Separated ( )

5. a) What is your highest level of education?, (Tick **(**√) appropriately)

(i) Primary ( ) **(ii)** Secondary ( ) **(iii)** Tertiary ( ) **(iv)** University ( )

v) No education ( ) vi**)** Adult education level ( )

(vi) Any other (Specify) ……

b) When did you finish your studies?……

6. What your main occupation? (Tick appropriately)

(i) Medical officer ( ) **ii)** Teacher ( ) **iii)** Farmer ( ) **iv)** Business ( )

v) Farmer and Business ( ) **vi)** Politician ( ) **vii)** Politician and farmer ( )

viii) Farmer and public servant ( ) **ix)** Public servant, Farmer and Business ( )

x) Others, specify……

7. i) How long have you been doing sand Business?.....

ii) How do you determine the ownership of sand harvesting sites?.....

v) Do you do sand business as your main occupation?

Yes ( ) No ( )

vi) If No, which is your main occupation?.....

vii) What is your other occupation?……

B) What is the socio-economic impact of Sand Harvesting on the local community along Kerio River?

8 i) has sand harvesting enabled you to get/buy the following? (Guided by a table similar to the one on the questionnaire for households above)……

ii) Has sand harvesting enabled you to buy or construct the following? (Guided by a table similar to the one on the questionnaire for households above)

……...

iii) Has sand harvesting enabled you to access the following? (Guided by a table similar to the one on the questionnaire for households above)……

……

Has sand harvesting contributed to your community in the following areas? (Guided by a table similar to the one on the questionnaire for households above)…….

……

iv) How do you rate sand harvesting contribution to you, your family and the community? (Guided by a table similar to the one in the questionnaire for households above)……

……

C) What is the contribution of Sand Harvesting compared to other livelihood options in the study area?

9,i) How much do you pay for sand harvesting?

a) Per lorry to the owner of the harvesting site?**.....**or Per tonne?**.....**

b) Per lorry to the site extractors/loaders?**.....**or per tonne……

c) Cess per lorry…….or per tonne……

ii) How much do you earn from your other occupation?**.....**

a) Occupation……...

b) Amount per month……

iii) Compare Income from other sources to Sand harvesting, (Guided by a table similar to the one on the questionnaire for households above)……

10. What are the approximate uses of income from sand? (Guided by a table similar to the one on the questionnaire for households above)……

11) How do you rate Sand Harvesting and your other occupation in terms of their contribution to you, your family and the community welfare tick appropriately? (Guided by a table similar to the one on the questionnaire for households above)……

C) What are the environmental impacts of Sand harvesting experienced in this area?.....
.....

D) Existing policies on Sand Harvesting and their implications (Guided by a table similar to the one on the questionnaire for households above)……..**...**

Appendix II: Key Informant Interview Guideline

Name of the interviewer……

Date of Interview……

Questionnaire number……

The socio-economic and environmental impacts of sand harvesting along the Kerio River, in Elgeyo-Marakwet and Baringo Counties.

Once the subject is seated introduce the study and then invite them to share their opinions on the questions that you will ask them.

Am/we are from University of Eldoret conducting research on Sand harvesting, and sincerely seek for your opinion. I/we kindly request you to answer the questions am/we are about to ask you and will appreciate any information you will provide.

Your answers are completely confidential and will be coded and recorded without

names. Thank you in advance for your participation and co-operation.

I understand you are the……in the……

Please focus on Sand harvesting along Kerio river in all your responses, and feel free to clarify anything I bring up that's not clear.

Please help us understand: Value of sand, that is;

Payment per lorry?**.....**

Payment per tonne?**.....**

Payment for labour?**.....**

Payment for cess…….**.....**
Any other payments made……..

A) What are the socio-economic impacts of sand harvesting to the of the community Along Kerio river in the following areas;

B) What is the socio-economic impact of Sand Harvesting on the local community along Kerio River?

8 i) Has sand harvesting enabled community members to get/buy the following? (Guided by a table similar to the one on the questionnaire for households above)…….....

ii) Has sand harvesting enabled the community to buy or construct the following? (Guided by a table similar to the one on the questionnaire for households above)……

iii) Has sand harvesting enabled people to access the following? (Guided by a table similar to the one on the questionnaire for households above)……

iv) Has sand harvesting contributed to your community in the following areas? (Guided by a table similar to the one on the questionnaire for households above)……

V) How do you rate sand harvesting contribution to you, your family and the community? (Guided by a table similar to the one on the questionnaire for households above)……..

C) What is the contribution of Sand Harvesting compared to other livelihood options in the study area?

9 i) How much are the site owners paid for sand harvesting?

Per lorry?..... Per tonne?.....

iii) Compare Income from other sources to Sand Harvesting, (Guided by a table similar to the one on the questionnaire for households above)……

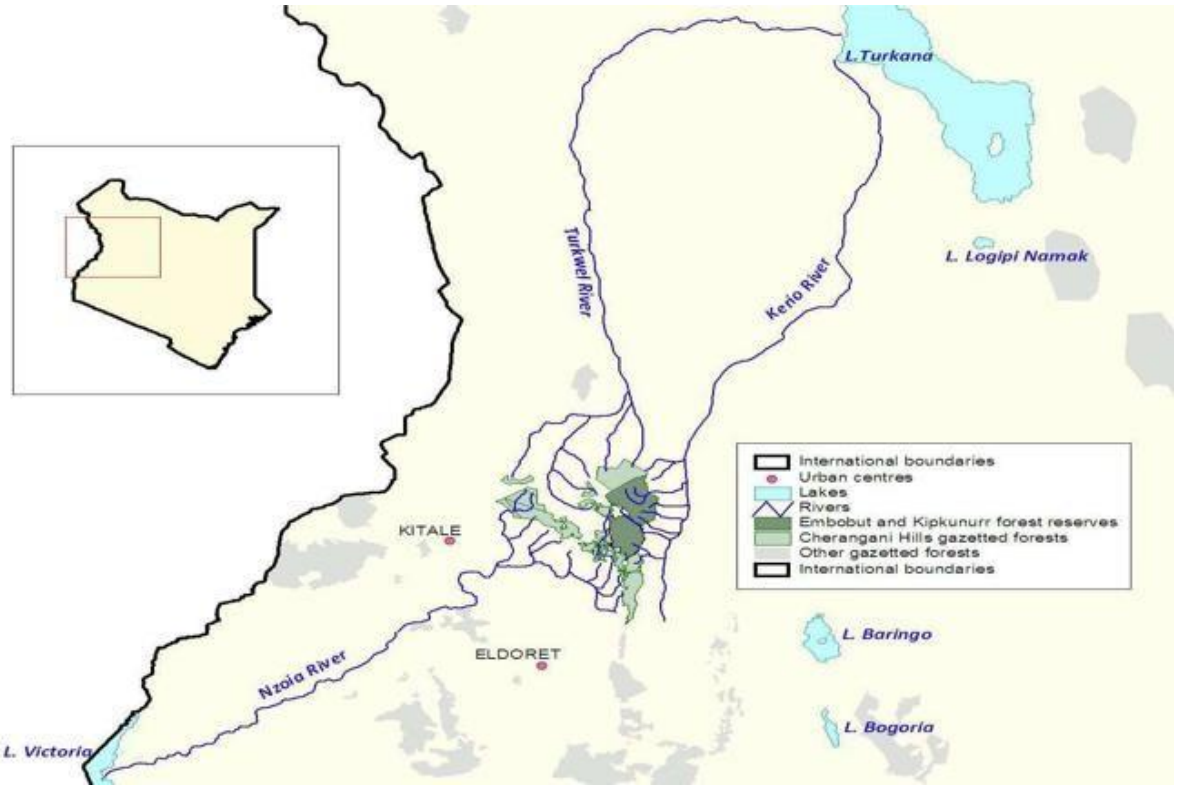
10) What are the approximate uses of income from sand? (Guided by a table similar to the one on the questionnaire for households above)……

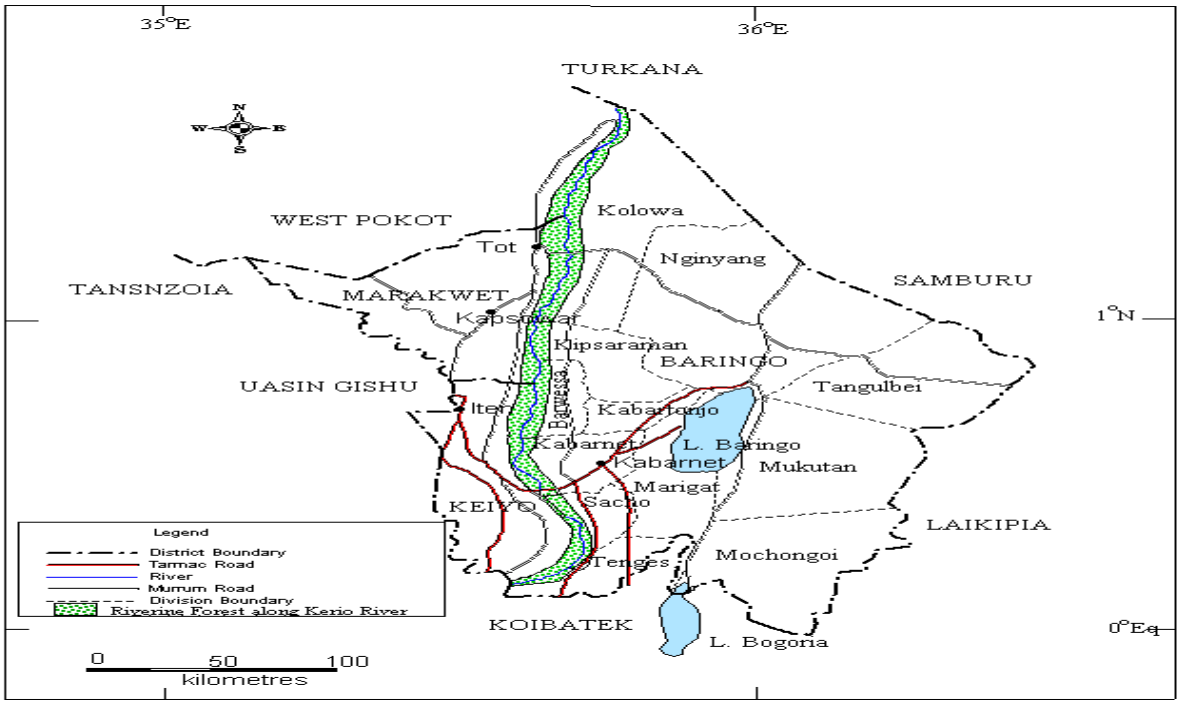
11) How do you rate Sand Harvesting and other occupations by the community in terms of their contribution to you, your family and the community welfare (Guided by a table similar to the one on the questionnaire for households above)……

C) Environmental impacts of Sand harvesting……

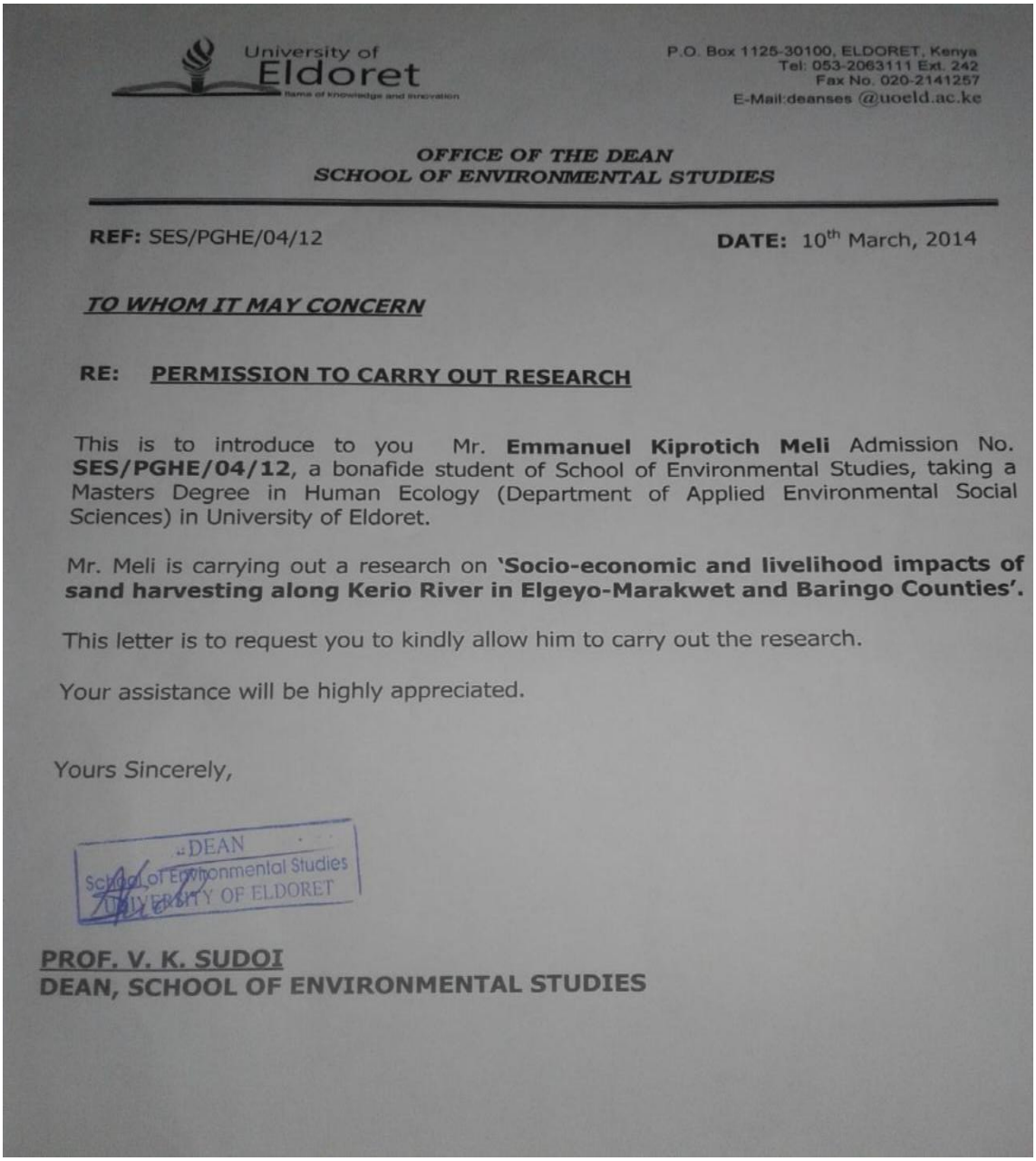
10) Existing policies on Sand Harvesting and their implications. (Guided by a table similar to the one on the questionnaire for households above)……

Appendix III: Map Showing Kerio River





Appendix IV: Permission to Carry Out Research



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OFFICE OF THE DEAN
SCHOOL OF ENVIRONMENTAL STUDIES

REF: SES/PGHE/04/12 **DATE:** 10th March, 2014

TO WHOM IT MAY CONCERN

RE: PERMISSION TO CARRY OUT RESEARCH

This is to introduce to you Mr. **Emmanuel Kiprotich Meli** Admission No. **SES/PGHE/04/12**, a bonafide student of School of Environmental Studies, taking a Masters Degree in Human Ecology (Department of Applied Environmental Social Sciences) in University of Eldoret.

Mr. Meli is carrying out a research on **'Socio-economic and livelihood impacts of sand harvesting along Kerio River in Elgeyo-Marakwet and Baringo Counties'.**

This letter is to request you to kindly allow him to carry out the research.

Your assistance will be highly appreciated.

Yours Sincerely,

DEAN
School of Environmental Studies
UNIVERSITY OF ELDORET

PROF. V. K. SUDOI
DEAN, SCHOOL OF ENVIRONMENTAL STUDIES

Appendix 5: Permit to Carry Out Research