Norwegian University
of Life Sciences

Master's Thesis 2019 60 ECTS
Faculty of Landscape and Society

Natural Gas Exploration and Extraction: Investigating the Resilience of Ecosystem Services and Implications for Local Livelihoods Songosongo Island, Tanzania

Garende Anthony Wema
International Environmental Studies

Natural Gas Exploration and extraction: Investigating the resilience of Ecosystem services and implications for local livelihoods Songosongo Island, Tanzania.

MSc Thesis

By

Garende Anthony Wema,

December 2019

Norwegian University of Life Sciences (NMBU)

Department of International environment and development Studies

The Department of International Environment and development studies, Noragric is the international gateway for the Norwegian University of Life Sciences (NMBU). Established in 1986, Noragric's contribution to international development lies in the interface between research, education (Bachelor, Master and PhD programme) and assignments.

The Noragric master's theses are the final theses submitted by students in order to fulfil the requirements under the Noragric Master programme "International Environment Studies", "International Development Studies" and "International Relations."

Email: wemagarende@gmail.com

Noragric

Department of International Environment and Development Studies

The Faculty of Landscape and Society

P.O. Box 5003

N-1432 Ås

Norway

Tel.: +47 67 23 00 00

Internet: https://www.nmbu.no/fakultet/landsam/institutt/noragric

Declaration

I, Garende Anthony Wema declare that this thesis is a result of my research investigations and findings, and that it has not been previously presented to any other academic institution for similar or any other degree award. Sources of information other than my own have been acknowledged and a reference list has been appended.

Garende Anthony Wema, December, 2019.

Signature…….

Dedication

I dedicate this work to my beloved Daddy the hero of my life, Mr. Wema Garende Ihundya. You played your role as a parent to sending me to school which was the foundation that has shaped me the way I am today. You fought the war without your partner beside you but you won it. I also want to dedicate this work to my beloved mom the late Tabu Warioba Kiberenge. You passed away and left me when I was still too young but now I am a full man, I wish you were alive today seeing your son achieving this academic level, but all in all R.I.P mom, if by God's will we shall see each other on that bright morning.

Acknowledgement

Many have played different roles that made me successfully accomplish this task. I cannot mention to fulfil their numbers but few to represent. Firstly, I would like to give thanks to **God** the almighty for his guidance and protections all the way in this lifelong journey. It has been ups and down but in all the situations you forsaken me not.

I sincerely send my gratitude to my supervisor ***Prof.* Pål Olav Vedeld** of the international Environmental and Development Studies (Noragric) Department, for his comments, guidance and support all the way from title formulation, proposal writing to thesis preparation. You were with me even in my hard time situations, that were indeed parenting characters. Thirdly I owe much gratitude to my beloved wife ***Suzan Garende*** for her tolerance, prayers, moral support and affection and for undertaking of my responsibilities to take care of our beloved daughter ***Erica,*** for the all period of time when I was away pursuing my studies in Norway. This MSc has been made possible by Norad/ EnPe programme whose sponsorship allowed me to study in Norway, but also to accomplish part of my studies in Tanzania. Thank you very much ***Norad/EnPe programme*** you made me come close to my destiny in education. I also send gratitude to **Anette Virtanen** my advisor and all the **P*rofessors, Doctors*** and all ***Workers in Noragric*** department, for their tireless hearts to facilitate learning. By you guys this has been made possible. Lastly but not least, I would like to acknowledge my all ***informants on Songosongo island*** Tanzania and the ***Songosongo community*** as a whole for the hospitality you showed to me, and your eagerly acceptance to cooperate with me in whatever circumstances could be. Thank you very much, Asanteni sana.

Abstract

Natural gas has become increasingly important energy source in the world, and its significances are expected to increase in many years to come. This is because the demand of the product continues rising while new sources of supply being discovered in many parts of the world**.** The discovery of Natural gas in Tanzania in 1970s and its subsequent production in 2000s had sparked high development and economic expectations in various sectors of the Tanzanian economy. Both the government and local people from where the discovery was made had positive expectations that the resource will take them from one point of the development ladder to another with more improvements. However, the exploration and extractions of the petroleum products may create both beneficial and detrimental changes in the predominant people's livelihood systems. Livelihood systems include the biodiversity and the environmental ecosystems that in most cases are harshly degraded with petroleum projects. This study examined the impacts of exploration and extraction of natural gas on Songosongo island Tanzania to livelihood systems. The principal objective was to examine how exploration and extraction of natural gas have impacted the livelihoods of people on the island. The livelihood activities on Songosongo island are gender differentiated as it is in many societies in Tanzania thus, the impacts to livelihood strategies cannot be generalized. The study revealed that while one gender category can be negatively impacted in some situations resulted from the gas project, it can be an opportunity and positive impacts to the opposite gender. Conceptual and theoretically the study drew heavily on concepts such as resilience and ecosystem service whereas the sustainable livelihood approach (SLA), was applied as a theory.

The study was conducted under qualitative paradigm thus qualitative research methods were employed in both data collection and analysis. The study sample included households performing diverse activities for a living such as fishing, seaweed farming, formal employment and casual labour in the gas plants and in government institutions like the Primary and Secondary schools, Dispensary and in executive government offices. The study findings illustrate that there are evident impacts of natural gas activities to livelihoods of local Songosongo community. The impacts are both positive and negative. In category the impacts are both beneficial and detrimental on social perspectives but viewed to be more detrimental on environmental side. The use of environmental resources on the island seemed to be unsustainable which is influenced by overpopulation resulted from an influx of new people coming to the island expecting to grasp good paying jobs at the gas plants which can uplift them in development. The study also revealed that overpopulation on the island is enhanced by an extremely high birth rate on the island.

List of Acronyms:

AGIP……. …… Azienda Generale Italiana Petroli (General Italian Oil Company)

AIDS……. .Acquired immunodeficiency Syndrome

ARVs…..Ant retrovirus

BCE……Before the Current Era

CARE……Cooperative for Assistance and Relief Everywhere

CCM…….....Chama cha Mapinduzi

CDC…..Center for Diesel Control

COSTECH…….....Commission of Science and Technology

CUF……. ……. ……...Civic United Front

DED……...District Executive Director

DFID…….....Department for International Development

EIA……. ……..Environmental Impacts Assessment

EIA……..…. ……..Energy Information Administration

ES……. ……. …….Ecosystem Services

FAO…….....Food and Agriculture Organization

FGDs……. …….Focus Group Discussions

GDP…..... …….Gross Domestic Product

GNP…….....Gross National Product

GoT…..... Government of Tanzania

HIV…….....Human Immunodeficiency virus

HWB…… ……Human Wellbeing

ICM……..... …….Integrated Coastal Management

IDS……. …..... …….Institute for Development Studies

IUCN…….International Union for Conservation of Nature

Km……Kilometers

MA……. ……Millennium ecosystem Assessment

MCA…..Member of Council Assembly

MW…..Megawatts

NEMC…….....National Environment Management Council

NGOs……..... …….,Non-governmental Organization

NMB……..National Microfinance Bank

NRGI……..Natural Resource Governance Institute

OPEC…….Organization of Petroleum Exporting Countries

OXFAM……Oxford Committee for Famine and Relief

PORALG…….President Office Regional Administration and Local government

SESs……. ….....Social-Ecological Systems

SL……. . ……..Sustainable Livelihood

SLA……. . ……...Sustainable Livelihood Approach

SLF……... ……Sustainable Livelihood Framework

SS-1….....SongoSongo-1

STDs……..Sexual transmitted diseases

TANESCO…….....Tanzania Electric Supply company Limited

TDFL….....Tanganyika Development Finance Company Limited

TEEB…..The Economics of Ecosystems and Biodiversity

TPDC…..Tanzania Petroleum Development Corporation

TVs…….. …….....Televisions

TZS…... …….....Tanzanian shillings

UN……. ……..United Nation

UNDP…… ……..United Nation Development Programme

UNEP……. ……United National Environmental Programme

USD……. ……...United State Dollar

VICOBA….....Village Community Bank

WCED……World Commission on Environment and Development

WEO…..Ward Executive Officers

WWF…..World Wildlife Fund

A list of figures

A list of tables

Table of Contents

CHAPTER ONE

CONTEXTUALIZING THE HISTORICAL BACKGROUND OF NATURAL GAS ACTIVITIES IN TANZANIA AND IMPORTANT KEY THEMES.

1.0 Introduction

This chapter provides highlights on the background to the study, setting a context for the study. The context portrays historical information about exploration and extraction of natural gas in Tanzania, the field background, theme and problems, it delineates both the cost and the beneficial sides of the field with respect to social and environmental concerns and the resource curse is put in context. The chapter also presents the statement of the problem, objectives of the study, research questions and the significance of the study.

1.1 The historical background of natural gas activities in Tanzania

Dating back to the 1950s, oil and natural gas became the main sources of primary energy for an increasing world population, the dominance kept growing and is still expected to continue for several more decades (Edwards, 1997 and Energy Information Administration [EIA] (2004), in Kharaka and Dorsey 2005*).* Energy is an essential commodity that powers the expanding global economy.

In Tanzania, the history of exploration for petroleum (Natural gas) dates back to the first gas discovery made at Songosongo Island in the 1970s. This was followed by further discoveries at Mnazi Bay, located in south-east Tanzania in the Ruvuma Basin, Mkuranga and Kiliwani North. All significant gas discoveries in Tanzania have been made on the coastal shores of the Indian Ocean (Kusekwa 2011). At present however, only two gas fields Songosongo and Mnazi Bay are in production. The Songas Gas-to Electricity project is among the largest industrial development sites along the coast of Tanzania, (McClanahan, Sheppard and Obura, 2000). Tanzania do expect to produce about 1 trillion cubic feet of natural gas from the Songosongo island concession and 2 trillion cubic feet from the Mnazi Bay area, (Kapinga and Thorns, 2013).

All of the country's natural gas production was previously consumed locally. There was only one 225km long pipeline connecting Songosongo island and the Tanzania's commercial capital Dar es Salaam. In order to meet the increasing demand for natural gas production at that present time and the coming years, a gas pipeline was constructed to transport natural gas from Mnazi Bay to Tanzania's commercial capital, Dar es Salaam. On September 2015, Tanzania Mnazi Bay Processing Plant successfully transmitted the first clean natural gas product to the export pipeline.

1.1.1 The benefit and cost sides of natural gas activities in context

Gas was discovered in Tanzania in 1974, but significant commercial production did not start until 2004 at the Songosongo island in the southern part the country (Jacob et al, 2012). The rising global interests in natural gas, has led to an enormous expansion in exploration and discovery activities including, in the last decade, also the Indian Ocean off the East African coast. One has achieved significant findings (Jacob et al 2012). While the exploration activities around these findings has been allocated to and dominated by international oil and gas firms, the development of the fields has also drawn the attention of the government of Tanzania (GoT) directly into the sector. These activities have started to generate (potential) large flows of revenue to the government. With GoT ambition to become a middle economy country by 2025, the natural gas sector therefore represents a hugely beneficial opportunity for Tanzania. If used efficiently and wisely a natural resource windfall can contribute to poverty reduction and help place the country on a successful and inclusive economic growth path becoming like other countries such as Norway whose economy heavily depends on hydrocarbon development projects, but where also most of funds have been invested and established for the future.

Hydrocarbon projects however, can also have significant negative environmental and social effects throughout their project life cycles (World Bank, 2013). If not well managed, in many global south countries' the petroleum discoveries and development turns into a resource curse rather than a blessing. From the early assessments to communication and oversight, effective development and environmental management is a critical aspect throughout the development and production chain if one wants to ensure good social and environmental performance. System resilience should be maintained when operating petroleum development projects to avoid undesirable regime shifts of the system. According to Folke et al, 2010, "Resilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same

function, structure and feedbacks, and therefore identity" shortly, we can term it as the capacity to change while maintaining the same identity.

It is eminent that the Western Indian Ocean is very rich in biological diversity. It ranges from coastal forests to coral reefs and it covers almost 20,000 known plant and animal species. Many of them are endemic to the region. Off-shore it hosts an estimated of not less than 10,000 marine species (World Bank, 2013). The Songosongo archipelago is famously known among Tanzanian fishermen as one of the best remaining fisheries areas off the Tanzanian coast for small scale artisanal fishing. It provides a very important livelihood element for a large number of coastal men. Fishers come to the area from as far away as Zanzibar and Mtwara (Darwall 1996). Nonetheless, economically, it also supports the world's largest wild prawn fishery and a major tuna industry as well as a significant tourism sector. Throughout the region, about 60 million people live along the coast of the Indian Ocean. Many among the coastal dwellers are directly dependent upon the aquatic resources in the region for their survival and livelihoods (World Bank, 2013). Southern Tanzania has been found to support a great diversity of marine habitats and a number of valuable fisheries upon which the coastal population are highly dependent (McClanahan et al, 2000). It is thus very important that the sustainability must be accounted for, in the extraction and use of resources from such areas to promote environmental resilience for the livelihoods of coastal dwellers.

1.1.2 The field background in context, theme and problems.

Tanzania's coastal zone is known for its rich and diverse coastal system ranging from coral reefs, mangroves, beaches, sea-grass beds and tidal marshes. These ecosystems serve as homes and nourishment for many important biological species and serves as buffers against storms and erosion. People living alongside coastal areas depend heavily on the coastal ecosystems for social, cultural and economic services ranging from fishing, tourism, mining and conservation activities. We can generally term the situation as providing livelihoods to coastal living people.

Despite the important services offered, the ecosystems are found within the same kind of environmental segments where these hydrocarbon projects and activities are operating. It is however, important to note that the petroleum industries in many cases operate in remotely situated ecosystems with rich biodiversity and where governments have limited capacity to protect the

environment or govern the people dwelling in that place (Kloff and Wicks 2004). Under such circumstances the expected blessings may turn into a resource curse

Though we have clear benefits that may be obtained from the petroleum sector, it can also carry major environmental impacts that may be regional or even global in scale. The petroleum industry has a significant influence on the total pollution of the environment through exploration and production operations, oil spillage, gas flaring and oil refining operations. Social impacts of operations, especially in remote communities, have also attracted attention (Olajire, 2014).
The impacts arose primarily from the improper disposal of some of the large volumes of saline water produced with oil and gas, from accidental hydrocarbon and produced-water releases, and from abandoned oil wells that were orphaned or not correctly plugged (Kharaka et al, 1995). Oil spillage and gas flaring remain major environmental challenges in the petroleum industry. The most significant environmental issues associated with the oil and gas industry operation include exploration survey, exploration drilling, development and production, hydraulic fracking, decommissioning and rehabilitation, refining, energy use and emissions to air (Olajire, 2014).

Exploration and production of petroleum have caused local detrimental impacts to soils, surface and groundwater, and ecosystems in most part of the world (Kreitler C.W 1993, and Kharaka Y.K, and Hanor J.S 2003). Pollution in the petroleum industry/sector is caused by gas flaring, above ground pipeline leakage. oil waste dumping and oil spills. From Olajire 2014, approximately 75% of the gas produced is flared annually causing considerable ecological and physical damage to other resources such as land/soil, water and vegetation. Gas flares, which in often times, natural gas projects are situated close to villages, produce soot which is deposited on building roofs of neighboring villages. Whenever it rains, the soot is washed off and the black ink-like water running from the roofs is believed to contain chemicals which can adversely affect the fertility of the soil. Gas pipelines have also caused irreparable damage to lands once used for agricultural purposes. The areas where oil is extracted most of the time bear the brunt of incidents emanate majorly from oil spillage, gas flaring and other minor sources such as drill cuttings, drilling mud and effluents. The effects are hazardous to the environment and its effects range from soil infertility to health risks which could eventually lead to loss of human life. While this may be true, hydrocarbons will remain essential to global economic development and prosperity for decades to come. In order to meet the rising energy demand, there is need to reconcile the goals of energy security and

environmental protection. That is why with such a rising demand, energy development along Tanzania's coast was fundamentally a part of the overall National energy strategy which was based on the ambition of the government of Tanzania (GoT) to move away from hydro-dependent power sources. The key opportunity to achieve that goal was by developing natural gas resources for energy generation. For some years, the GoT has been benefiting from the natural gas being drilled along its coast at Songosongo Island in Kilwa District, of Lindi region and a recent one at Mnazi Bay in Mtwara region for power generation (Jacob et al). These projects have created high expectations ranging as far as from the highest rank of government to the lowest of individual citizens.

GoT hopes for large and consistent revenues, multinational companies expect high returns on their large-scale investment they are obliged to make, while citizens expect and hope that their life standards will be improved, and local communities where these projects are operating hope to see relief from poverty**.** In Tanzania, with these two operating projects, one can expect gas development activities to involve a number of potential impacts on the southern Tanzania environment. The main impacts perceived in the upstream sector include damage caused by surveys and drilling, waste generation and ways to manage, reduce, dispose of and treat waste as well as the clean-up methods for sites (Kapinga and Thorns 2013).

There are many examples in the global south countries such as Angola, Mozambique and Nigeria in Niger delta, where by petroleum development activities biodiversity and ecosystems in coastal areas are sometimes harshly affected. The problems can often escalate into heavy socio-economic impacts for the people settled in coastal areas and that normally depend upon these resources for their livelihoods. Greenhouse gas emissions and climate change are other indirect impacts. The net effect at macro-level can be serious degradation of the planet's life-supporting system (Chapin et al, 2009).

1.1.3 Conceptualizing a resource curse theory in natural resource rich countries.

Resource curse is closely associated with the decision chain. For countries to benefit from resource wealth citizens and their governments must make a broad range of decisions. The decision chain in the extractive industry encompasses a set of decisions countries face along the way when trying to convert natural resources under the ground into better development above the ground (NRGI 2018). It illustrates the process of converting natural resources into long-term sustainable

development, from exploration and discovery to spending the revenues. In the approach it is very important to stress the key steps in ensuring that natural resource wealth transforms into citizen well-being.

The process begins with the decision of whether to extract and includes the questions of how to allocate rights to extract, how to generate revenues and other benefits, and how to manage the revenue from extraction. The Natural Resource Charter, of the NRGI, offers 12 steps (or precepts) of the guidelines along the decision chain at the national level. The precepts provide norms and good practices for how to optimize these decision-making processes and decisions to have the best chance to foster better development. According to NRGI 2018, Tanzania is one of the countries in Africa using the charter to evaluate their decision-making processes and learn where they can improve their governance, other countries are such as Nigeria and Sierra Leone, (NRGI 2018). Appendix 1 present the 12 charter precepts, with each precept covering key policy questions that should be applied in decision chain.

While there are many challenges unique to oil, mining and gas extraction, governments can make policy decisions under the charter guidelines to help avoid some of the negative consequences of extraction whereby also increasing the net benefits. Despite the guidelines being clear and have been adapted by some resource rich countries, it still has not been a dependable remedy for the so-called *resource curse* problem. Countries with non-renewable resource wealth have been facing both an opportunity and a challenge, when used well, these resources can create greater prosperity for the current and future generations, poorly used or squandered may lead to economic instability, social conflicts and lasting environmental damages. According to NRGI 2015, the term resource curse encompasses significant social, economic and political challenges that are unique to countries rich in oil gas and minerals (NRGI 2015).

The idea that large resource endowments are bad for the countries exploiting them is long established. It may seem to stems from what amounts to a strong puritan or spartan streak in human beings (Stevens, Kooroshy, and Lahn 2015). For some reasons or other too much of a good thing is considered not good. The attitude gain support from many literatures, but the most colorful probably being that of Jean Bodin, a sixteenth-century Philosopher, who argued that “Men of a fat and fertile soil are most commonly effeminate and cowards whereas……a barren country makes men careful, vigilant and industrious” (Jean Bodin, cited in Sachs and Warner 1997 p, 14).

From sixteenth-century and hundreds of years later, the thinking of Jean Bodin is still holding true when we see many oil, gas and mineral rich countries have failed to reach their full potential as a result of their natural resource wealth. Generally, they are also more authoritarian, more prone to conflict and less economically stable than countries without these resources.

The resource curse, also known as the paradox of plenty, refers to the paradox that countries with an abundance of natural resources (such as fossil fuels and certain minerals), tend to have less economic growth, less democracy, and worse development outcomes than countries with fewer natural resources. There are many theories and much academic debate about the reasons for, and exceptions to, these adverse outcomes. Most experts believe the resource curse is not universal or inevitable, but affects certain types of countries or regions under certain conditions (Wikipedia from https://en.wikipedia.org/wiki/Resource_curse*) accessed on 22 October 2019.*

One might expect to see better development outcomes after countries discover natural resources. In practice and by contrast resource rich countries tend to have higher rates of conflicts, and authoritarianism, while the most shocking is the lower rates of economic stability and the stagnant economy, compared to their non-resource rich neighbors. The long-standing idea of plenty being a bad thing was revived by the first oil price shock of 1973-74 when international prices of crude oil were quadrupled in three months' time with huge implications for the oil revenues of the OPEC countries (Paul et, al 2015). Studies have shown that there is a negative correlation between an abundance of natural resources and GDP performance. The alleged symptoms of the resource curse stipulated out by literatures includes the lower rate of economic growth, increased inequality of wealth, authoritarianism, increased conflict in society, degradation of the environment and human rights and poor decision making (Paul et, al 2015).

1.2 Statement of the problem and justification.

Natural gas has become an increasingly important energy source in the world, and its significances are expected to increase in many years to come. This is because the product demand continues rising while new sources of supply being discovered in many parts of the world (Jacob et al, 2012). For more than 10 years to date, Tanzania has been benefiting from natural gas being drilled at Songosongo Island in Kilwa District Lindi region and the more recent one at Mnazi bay in Mtwara region. Both Lindi and Mtwara regions are found in the southern part of Tanzania bordering the

Indian ocean. The natural gas extracted from these two regions are used to generate electrical power hence reducing the country's dependence on hydropower which have been facing many constraints brought about by water shortage to run the sector, as a result of uneven distribution and inadequate rainfall to fill up the hydropower dams. Apart from such a general advantage for the country as whole, petroleum extraction can also be associated with positive impacts in a form of employment opportunities, electricity supply, expansion of public services and energy security. People residing in areas where these projects runs can hope to change their livelihoods and perhaps poverty reduction is an expectation.

Despite the benefits that governments focus on from petroleum projects, which often counted at a national level, the inhabitants and the environment in place at the local level are always under high pressures. Biodiversity and ecosystems within coastal area are in some cases harshly affected and finally the problem escalate into substantial socio-economic impacts for the coastal settling communities and that depend on marine ecosystems for their livelihoods. Most of the current petroleum activities in Tanzania is situated offshore and also onshore in sensitive marine environments, critical for the survival of coastal communities and biodiversity.

To mention one Songosongo island in Kilwa district is an example. The large-scale discovery has increased the levels of industrial activities and infrastructure development along these coastal areas. Land has been paved for infrastructure development, which possibly implies cutting down of vegetation including mangroves and displacement of communities. The ecosystems, resources and the services it offers to support life within the area in particular are already under significant pressure and are being destroyed or degraded (World Bank, 2013). Hence, the potential impacts may be huge for coastal communities and to the national economy in Tanzania, which depends on coastal resources for a wide range of purposes (Miller et al, 2010). Thus, the issues raise some questions about, how sustainable such a natural gas development project could be, how it could sustainably be operated, and how socio-economic and ecological systems have adapted to the situation. This thesis sought to identify such knowledge gap which will help to scrutinize for the resilience of ecosystem services at Songosongo Island, and assessing the implications of the petroleum project to social livelihoods for these local communities.

1.3 Thesis statement and Research questions

The main statement of the study was to examine the impacts of natural gas activities (extraction of natural gas), on Songosongo island for the livelihoods of local people. This involve digging deep into impacts on the environmental perspectives as the environment itself is a component of the livelihood systems and the implications of the project for social-economic and wellbeing of the islanders.

1.3.1 The specific study objectives and research questions

a) To map ESS and analyze the effects of area industrialization on ecosystem.

1. What have been important environmental services for livelihoods support on the island?

2. What are costs caused by the natural gas activities on the island's ecosystem services?

3. How has the environmental governance system in Tanzania played its role to manage ecosystem resilience in Songosongo village?

b) To examine the major means of livelihoods on the island and the impacts of extraction onto them.

4. What are the livelihood strategies that men and women on Songosongo island are engaged in?

5. What are the contributions of extraction activities to the livelihoods of local Songosongo islanders?

c) To assess changes in livelihood condition for Songosongo communities with the effects to natural gas activities in the area.

6. How have the social-corporate responsibility (SCR) on the island supported the local people's livelihoods?

7. What are the livelihoods social- economic outcomes of the extraction's activities on local Songosongo inhabitants?

1.4 Significance of the study

Many of the petroleum projects all over the world, often only focus on the substantial amount of revenues that could be created from the course of activities. Though environmental and social concerns have been advocated more frequently by environmental agencies and social activists, we also see good environmental and social policies to ensure sustainability. However, these issues have often not been given priority when it comes to run the operations of these petroleum projects. There has been vivid environmental degradation with effects on the subsequent ecosystem services in many such petroleum projects which finally limit the capacity of nature to support livelihoods through offering services from ecosystems important for the survival, particularly for the communities in the vicinity. The communities in areas of petroleum projects do not only suffer from the indirect consequence of failure of an environment to support their lives but there are also direct, physical, and sometimes brutal with violent cases have been reported.

With petroleum projects land for agriculture, for resident and residential homes of many people in different places are reported to be lost. Relocation and marginalization of people are always the case and critical problems to where these activities are undertaking. This study has adopted a holistic approach in studying the impacts of petroleum extraction activities on Songosongo island to the environment of the island through an analysis on important ecosystem services. On the other hand, social impacts are also common in this project. Findings of the study may help inform policy makers, program and project planners in Tanzania, who address environmental and social issues in the petroleum sector. Thus, one should be able to come up with appropriate measures for intervention in the petroleum sector and building a more sustainable, running approach of petroleum projects in the country.

1.5 Organization of the thesis chapters

This thesis is organized into seven chapters. Chapter one comprises the general introduction to the research and the background information of the extractive industry in Tanzania. It contains the problem statement, objectives of the study, the research questions and the significance of the study as seen. The chapter also give highlights of contextual information on the so called a "r*esource curse"* as an important concept expressing what often happen to resource rich countries of the Global south.

Chapter two explore the theoretical underpinnings and conceptual frameworks used in the study. It comprises of theories, concepts and frameworks. The theories of sustainable livelihood, the concepts of resilience and ecosystem services are all elaborated in this chapter to show their link to the study.

Chapter three portrays the research methodology. Description of the study area including the home district location in Tanzania, demography, social and economic activities of people in the area, presentation of the techniques and methods used in production of the data, the status and the roles of the researcher are elaborated including the insider outsider perspectives. Research ethics, validity and reliability of data and challenges and limitations are also discussed.

Chapter four and five focuses on results and findings by objectives. It expands on important ecosystem services in Songosongo, major livelihood activities engaged in by Songosongo community, impacts of the industrialization to ecosystem services and changes in livelihood outcomes in light of theories, concepts and frameworks used.

Chapter six sum up the study findings and give conclusion of the study.

CHAPTER TWO

CONCEPTUAL FRAMEWORKS AND THEORETICAL PERSPECTIVES OF THE STUDY.

2.0 Introduction

This chapter discusses theories, frameworks and important concepts embedded in this study. Theoretical and conceptual framework explains the course of actions of a research and grounds it firmly in theoretical constructs. The aim of the frameworks is to make research findings more expressive or meaningful, and acceptable to the theoretical constructs in the research field and ensure generalizability. A theoretical framework according to Grant and Osanloo (2014), "is a blue print or guide for a research". It is a framework based on existing theory in a field of enquiry that is related and reflects the hypothesis of the study (Adom, Hussein and Joe 2018).

Theoretical frameworks provide structures in showing how a researcher defines his or her study in terms of philosophy, epistemology, methodology and analytical orientations (Adom et, al 2018). A conceptual framework on the other hand is a structure in which the researcher believes can best explain the progression of the phenomenon to be studied (Camp 2001). It links with the concepts, empirical research and important theories used in promoting and systemizing the knowledge embraced by the researcher (Peshkin 1993). It is the researcher's explanation of how a research problem would be explored. In this chapter the concepts of Resilience and Ecosystem services and the theory of sustainable livelihoods with its subsequent framework are presented and discussed in details and their applicability to the study is clarified.

2.1 Resilience as a central concept

Resilience is a central concept for the overall themes of this study. Thus, it is necessary to present the contextual conceptualization of the term, in order for readers to perceive the intended meaning for the study. Resilience coalesce other themes in this study such as ecosystem services and livelihoods to meet the main thesis objective. One of the study objectives is to assess the ecosystem services. The general status quo of the Songosongo ecosystem has been determined in favour of resilience concepts as tool.

Ecosystems and the social systems that use and depend up on them are tightly linked, it is the feedback loops between them that can determine their overall dynamics as an interdependent

social-ecological system (Folke et al 2010). System resilience is about people and nature as interdependent systems i.e. social-ecological systems. This is real for local communities and their surrounding ecosystems, but with the high acceleration of human activities on the Earth, it makes a global scale issue that has complicated the chance or even becoming irrational to continue separating the ecological and social while trying to explain them independently even for analytical purposes (Folke et al, 2010). Humanity may also be affecting the frequency, duration, intensity and distribution of different kinds of disturbances in the ecosystem.

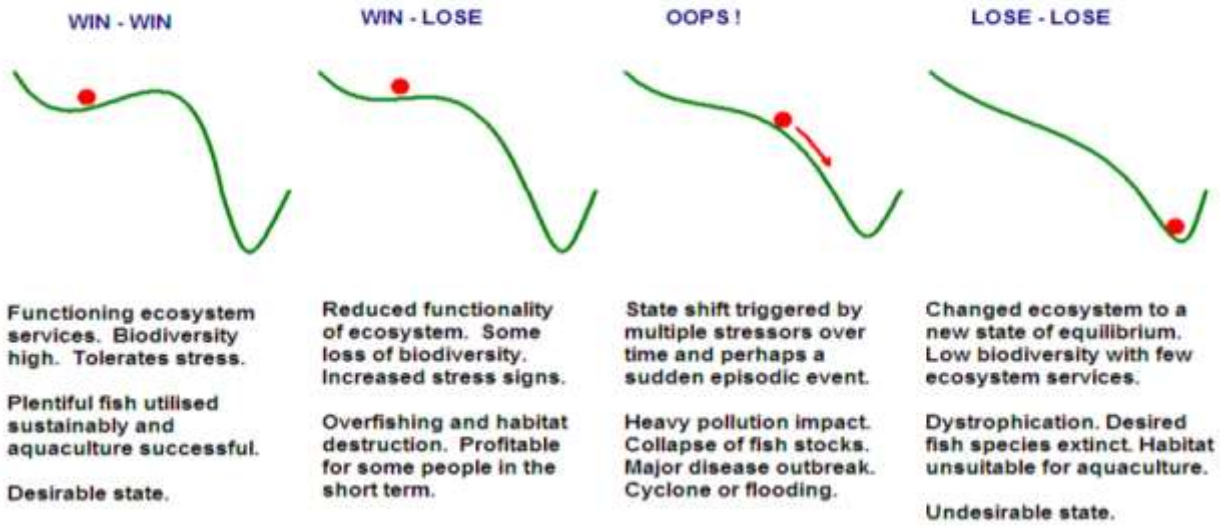
In the field of ecology and society one of the most famous papers was written to elucidate the relationships among the three concepts, resilience, adaptability and transformability (Walker et al, 2004 in Folke et al, 2010). In that paper resilience was defined as "*the capacity of a system to absorb disturbance and reorganize while undergoing changes so as to still retain essentially the same functions, structures, identity and feedbacks"* (Walker et al, 2004 p, 4 in Folke et al, 2010). Despite the fact that many literatures have defined the term differently and that has rendered it into either way of contextual understanding and meaning, the above will still remain as an operational meaning of resilience concept for the purpose of this study.

Much confusions emerged about the use of the term resilience, since the publication of the paper following discussions around many literatures. Due to these confusions Folke et al 2010, strived to develop a theoretical framework that could help understand what drives social-ecological systems (SESs) centered around the idea of resilience. The framework was termed resilience thinking in which the three core elements of resilience thinking resilience, adaptability and transformability were rephrased. In fact, the concept of resilience in ecology was originally coined by C. S. (Buzz) Holling (1973), who published a seminal paper in the Annual Review of Ecology and Systematic on the relationship between resilience and stability (Walker, Andries, Kinzig & Ryan 2006). Holling introduced resilience as a concept that could help to understand the capacity of the ecosystems with alternative attractors to persist in the original state subject to perturbations, as also analyzed in Folke (2006). In this study it is intended to use the term to assess the capacity of the ecosystem in Songosongo island, to persist providing services to the society like before the perturbation. The perturbation in focus at Songosongo is an establishment of Natural gas plants and overall activities of gas extractions.

Resilience for social-ecological systems is related to the amount of change the system can undergo and still retain the same controls on functions, structure or still be in the same desirable state within the same dome of attractions. Management can either build or destroy it depending on how the social-ecological system organizes itself on responding to the management actions. External conditions to ecosystems such as climate, inputs of nutrients or toxic substances, groundwater reduction, habitat fragmentation, loss of species diversity often change gradually and even linearly over time (Scheffer et al, 2001). Some ecosystem states may respond in a smooth, continuous way to such trend of changes, while others may be quite inert over a certain range of conditions, responding more strongly when condition attain to a certain critical level (Scheffer et al 2001). This critical level is what is called a threshold. The implication of this is that for a certain environmental condition the ecosystem has two alternative stable states separated in-between by an unstable equilibrium marking the border between the basins of attraction of the states.

Figure 1 from Bryceson (2017), provide a sketch illustration of the phenomena.

Figure 1: The loss of system Resilience and shift of Ecosystem states



Source; Bryceson (2017), adopted from Scheffer et al, (2001)

The resilience concept provides a theoretical framework for looking at relationships between ecosystems and society from a comprehensive, multi-dimensional perspective (Holling, 1973; Folke, 2006). It has been grown its importance since it was firstly coined in ecology, as a concept for understanding, managing, and governing complex linked systems of people and nature (Folke et al. 2004). Having its conceptual roots in ecology, resilience employs a systems approach to examine feedbacks to different perturbations including, for example, gradual climatic changes or anthropogenic induced disturbance events, such as fires or clear-cuts. These disturbances and their subsequent effects rarely have linear directions, system dynamics are significantly more complex because "periods of gradual change and periods of rapid transition coexist and complement one another" (Folke, 2006, p. 258,).

Knowing resilience and its relationship to changes in ecosystem states we may also consider how different various other scholars have documented and use the concept in depth to unveil interdependencies of social-ecological systems. The resilience has a broad utility, "the term and the concepts around it have impressive resonance and the traction for current thinking and policy on global change, development and environment (Brown, 2016). Pimm (1991) consider resilience to be a measure of how fast a system returns to an equilibrium state after a disturbance, whilst, Holling (1973) put it as a measure of how far the system could be perturbed without shifting to a different state regime. The former, i.e. return time, is what currently known as engineering resilience (Holling 1996). From Vatn (2015 p.166)," Chapin et al 2009, considered resilience as the capacity of the system to absorb a spectrum of shocks and perturbations and still retain and further develop the same fundamental structure, functioning and feedbacks". Fraser et al, (1999) stamped it as the ability to overcome adversity and be successful in spite of exposure to high risk. Despite some differences among scholars, numerous discussions of resilience in the literature also revealed a striking agreement about the nature of resilience, (Roberta R. Greene PhD, Colleen Galambos D.S.W & Youjung Lee D.S.W 2004).

That being the case, the researcher needs to share commonly held definitions with readers so that they did not attribute their own meaning to the concept (Strauss & Corbin, 1990).

The resilience concept and ideas appear to have had a parallel evolution in fields such as psychology (Deveson 2003) or mental health (Walsh 2003) as cited in (Walker et al 2006). Over the last decade, however, much work has been done to expand and test the applicability of these concepts to fields that are linked to ecology (Walker et al 2006).

One of the first was the edited volume by Berkes and Folke (1998), which explored traditional and current management in linked social-ecological systems (Walker et al 2006).

The work was expanded by the Resilience Network, a transient research group that managed to produce four edited volumes, each of which explored different interdisciplinary connections (Walkers et al 2006). Gunderson and Pritchard (2002) focused on ecological state changes resulting from human actions in a variety of ecosystems. Berkes et al. (2003) documented how humans across a wide range of cultural settings have adapted to ecosystem changes in ways that influence the resilience of the combined social-ecological system (Walkers et al 2006). Dasgupta and Mäler (2004) explored the economic implications of state changes in ecosystems, and Gunderson and Holling (2002) attempted to develop a theoretical synthesis based on preliminary investigations into linked systems (Walkers et al 2006).

According to Vatn 2015, resilience has some attributes common with concept of robustness. While robustness means the maintenance of the system`s performance, resilience focuses on the capacity of the system to change and adapt, and still remaining within its critical thresholds (Vatn 2015). "*A threshold is the level of a state variable of a system that if surpassed or beyond it makes the system flip"* (Vatn 2015 p,167). A threshold marks the limit of human's engagement with nature in the linked social-ecological systems. Development up until the threshold will typically not result in changes that could allow that system to still return to its previous state after the perturbation (Vatn 2015). We may see the parable of a rubber band and make the relation to the resilience of an interlinked social-ecological system.

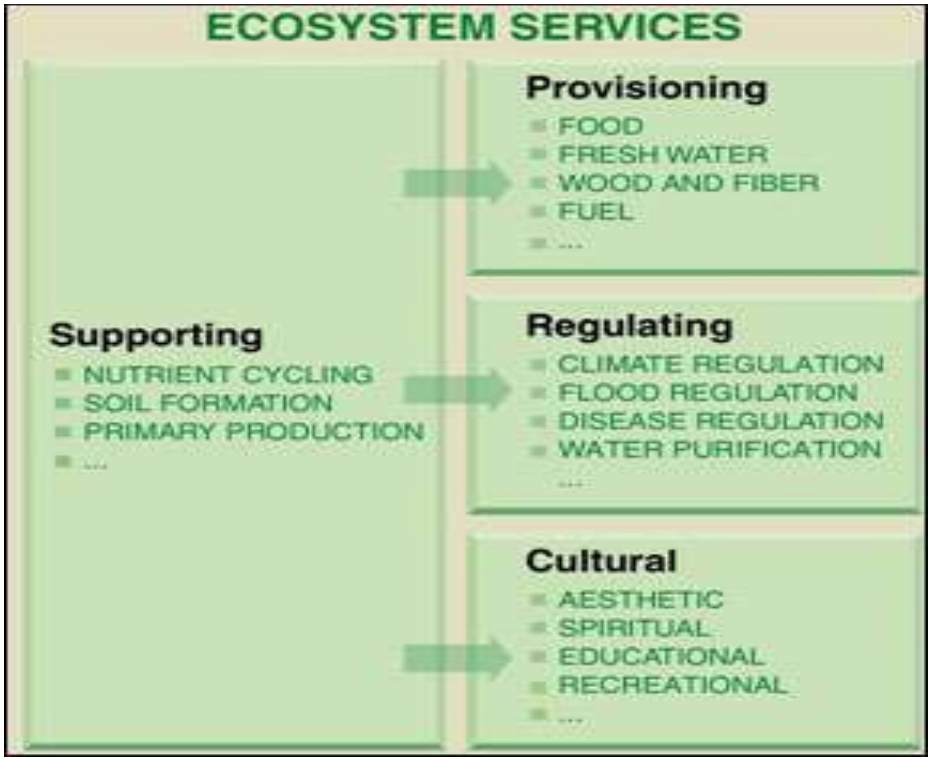
"That one may stretch the rubber band far without anything happening to its structure, stop stretching it and it returns to its original length, but stretching it beyond a certain point which is its threshold or tipping point it breaks and can never retain its original shape. Beyond the threshold, abrupt changes may happen" (Vatn 2015).

The parable holds true also for the social-ecological interlinked systems. Human engagement with nature may go long time with unseen symptoms to this SES's functions and structure, showing that there is loss of resilience jointly with gradual change of resilience state granted that, system threshold has not surpassed yet. Surpassing the tipping point cause an abrupt change, triggering collapsing of the system completely, a typical example for this can be changes from green landscape to a full desert.

2. 2 Contextualizing the Concept of Ecosystem services (ES), and Human well- being (HWB)

Human beings are totally dependent on nature. Health, prosperity and security are wholly connected to the planet's natural systems which are what we call ecosystems. Historically, back in 1970s the concept of ecosystem services emerged, and in the following decades the concept gained more recognition. However, the idea that natural systems support human wellbeing is much older, (Johnson 2018). Further, as early as 400 BCE, Pilato was able to document the relationships between deforestation and water supply, (ibid.). Knowing this the Millennium ecosystem assessment (MA), in their document, addresses that healthy ecosystems will provide us with food, fresh water, clean air and a stable climate. It will also protect from diseases and disasters and finally allow us to make choices about our way of life (MA 2005). Ecosystems are major components of a more overall biodiversity concept (TEEB 2010), and from MA (2005), ecosystem was identified as a dynamic complex of plant, animal, and microorganism communities and the non-living environment interacting as a functional unit (MA 2005). Human beings are an integral part of the ecosystem. Human well-being, progress and prosperity are essentially dependent up on improvement of the earth's ecosystems management to ensure their conservation and maintaining their sustainable use. But while the demands for ecosystem services are highly growing, it is at the same time that the capability of many ecosystems are diminishing it is thus, hard to meet these demands (MA 2003). As noted by TEEB, ecosystem services are *"Conceptualizations of the useful things ecosystems do for people directly and indirectly, whereby it should be realized that properties of ecological systems that people regard as useful may change with time even if the ecological system itself remains in relatively constant state"* (TEEB 2010). And MA (2005) defined ES as the benefits people obtain from ecosystems either directly or indirectly. MA grouped ES into four major categories. Figure 2 show these four categories and give subsequent examples for each of the categories.

Figure 2: The Ecosystem Services categories according to MA



Source: MA 2005

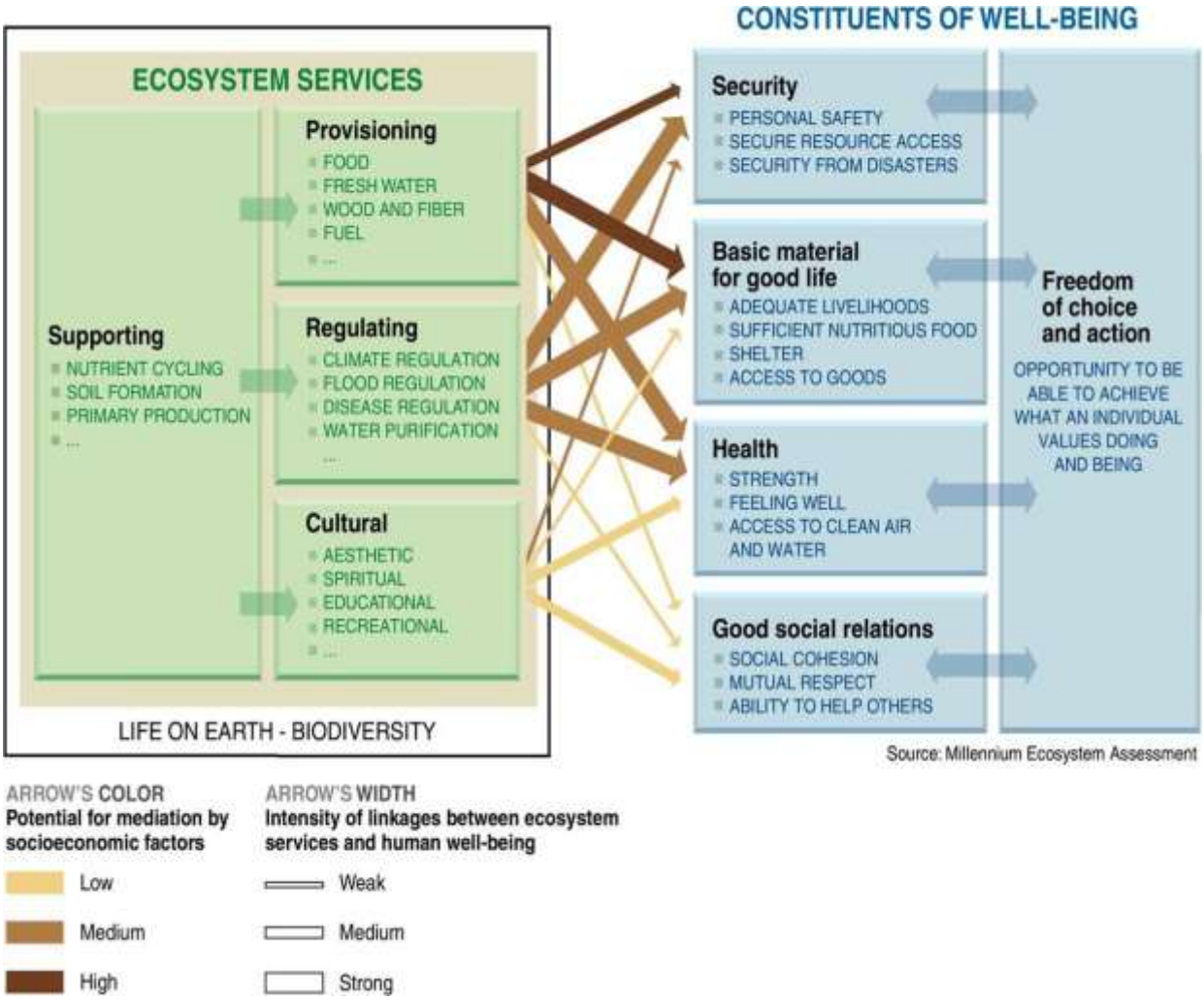
Ecosystem services include products such as food, fuel, and fiber; regulating services such as climate regulation and disease control; and nonmaterial benefits such as spiritual or aesthetic benefits.

It is also vital to note that a vivid and explicit connection between ecosystem functions and human well-being exists. While the unfair impact of ecosystem degradation on the poor can be acknowledged, it is clear that even the wealthy may also feel the consequences. Ecosystem degradation always cause more suffering to rural populations and more directly than urban populations and has its most direct and severe impacts to the poor classes. The wealthy have more control and access to a bigger share of the ecosystem services, with the capacity to consume those services at a higher per capita rate, and they are buffered from changes in ecosystem services availability through their ability to purchase scarce ecosystem services or substitutes (MA 2005). Taking an example, that even though a number of marine fisheries have been depleted in the past century, the supply of fish to wealthy consumers has not been thrown into confusion since fishing

fleets have been able to shift to previously under exploited stocks. By contrast, poor people often lack access to alternate services. This increases their vulnerability to ecosystem changes that may result in famines, droughts, floods and other calamities against their livelihood. They often live in areas exceptionally sensitive to environmental threats, lacking financial and institutional abilities that could moderate the impacts of these dangers. Degradation of coastal fishery resources, in coastal areas like Songosongo island as for this case, leads to declines in protein consumed by the local community since fishers may not have access to alternate sources of fish and community members may not have enough income to purchase fish. Thus, degradation affects their very survival.

The framework in Figure 3 depicts the strength of the linkages between categories of ecosystem services and the human well-being components that are encountered in common. It also indicates the extent to which it is possible for the socioeconomic factors to mediate the linkage. When it is possible to purchase a substitute for a degraded ecosystem service that indicates there is high potential for mediation, (MA 2005).

Figure 3: The linkage between ES and human wellbeing,



Humanity always depend up on services provided by the biosphere and its ecosystems. Nevertheless, the biosphere itself is the product of life on earth. The composition of the atmosphere and soil, the cycling of elements through air and waterways, and many other ecological assets are all the result of living processes and all are maintained and replenished by living ecosystems (TEEB 2010). The human species, while buffered against environmental immediacies by culture and technology, is ultimately fully dependent on the flow of ecosystem services, (MA 2005). Changes in these services bring some effects to human well-being in differing ways. Importance of ESS to mankind and lives of other living kinds make it a key phenomenon to assess in Songosongo owing to the fact that the area is hosting the Natural Gas extraction activities for more

than ten years now. The ESS assessment at Songosongo will contribute to unveil the status-quo of the environmental resources in the area.

2.3 The theory of sustainable livelihood.

The concept of sustainable livelihoods constitutes the basis of different sustainable livelihood approaches (SLA) and it has been adapted by different development agencies such as the British Department for International Development (DFID), (Serrat 2017). It presents a way of thinking about the objectives, scopes and priorities for development activities. The concept is an attempt to go beyond conventional definitions and approaches to poverty eradication, that had been found to be too narrow as they focused only on certain aspects or manifestations of poverty, like low income, while ignoring other vital aspects of poverty such as vulnerability and social exclusion (Krantz 2001). With SLA it is now well accepted that more attention must be paid to the various factors and processes which in one way or another either constrain or enhance poor people's ability to make a living in an economically, ecologically and socially sustainable manner (ibid.).

The idea of sustainable livelihood dates back when was first introduced by the Brundtland report of the World Commission on Environment and Development (WCED), known by the name "*Our common future"* in 1987 (ibid.). The report acknowledged the concept of basic needs of the poor from the use of economic indicators such GDP and GNP instead. By this, introduced concepts that later were conceptualized as livelihood and sustainable livelihood, whilst putting sustainable development on the development agenda for many nations. Sustainable livelihood thinking is inspired by the work of Robert Chambers in 1980s and has been further developed by Chambers, Conway and others in the 1990s (DFID 2000). And the 1992 United Nations Conference on Environment and Development expanded the concept advocating for the achievement of the sustainable livelihood as a broad goal for poverty eradication (Krantz 2001). To understand the term livelihood, let us look on the thoughts of Chambers and Conway (1992) who defined it as *"a means of gaining a living"* (Chambers and Conway 1992 p'5). The livelihood concept perceives the world from the point of view of individuals, households and social groups who are trying to make a living in volatile conditions and with limited assets (Serrat 2017).

Sustainable development as defined by the commission is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The definition contains within it two important concepts: the concept of '*needs'*, in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of *limitations* imposed by the state of technology and social organization on the environment's ability to meet present and future needs” (WCED, 1987, p 43). Looking at the Songosongo case study, the findings is trying to disclose how resource extraction embraces the two concepts “*need of the present*, and the *limit approach* for the future generations.

From the very beginning of livelihood research in the early 1990ies, different variants of the Sustainable Livelihoods Approach have been introduced. CARE, Oxfam, UNDP and DFID in particular are international organizations that highlighted distinct aspects of the approach and sometimes change the focus and design to suit their priorities. More research on sustainable Livelihoods as a concept was widely attributed to Robert Chambers (Chambers and Conway 1992). Solesbury (2003) points out that Chambers and Conway presented sustainable livelihood as a linking of the three extant concepts of capability, equity and sustainability, all constitutes the basics for the sustainable livelihood approach (SLA). In the late 1990s, the British Department for International Development (DFID) integrated the approach in its program for development cooperation (Solesbury 2003). The DFID approach is based on livelihood analysis which includes institutional and political issues. This approach was much useful in Allison and Ellis (2001), where it was used to understand the strategies used by artisanal fisher folk to tackle the fluctuating fisheries resources. To understand the complexities of different livelihood strategies in Songosongo the model by Allison and Ellis was applied in this study.

2.3.1 The contextual definition of the SLA

There are many discussions around the term sustainable livelihood. Most of these discussions has put the focus on rural areas and situations where people make a living from some kind of primary self-managed production. The sustainable livelihood approach improves the understanding of the livelihoods of the poor, organizes the factors that constrain or enhance livelihood opportunities and shows how they relate and help to plan development activities and assess the contribution that existing activities have made to sustaining livelihoods (Serrat 2008). Different authors have different definition on the term livelihood. Putting into operations the SL concept and approach by

the Institute for Development Studies (IDS) and the British Department for International Development (DFID) led the proponent Ian Scoones from IDS in 1998 to propose a modified definition of SL stated as *"A livelihood comprises the capabilities, assets, (including both material and social resources) and activities required as a means of living. A livelihood is sustainable when it can cope with, and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base"* (Scoones 1998 as quoted in Dugbazah 2012 p,105). Of various components of the sustainable livelihood approach, the most controversial aspect is the portfolio of assets and asset access from which people make their living. Assets includes both tangible assets and resources and intangible one such as claims and access, hence any definition of livelihood sustainability the authors argued for, has to include the ability to avoid or to withstand and recover from stress and shocks (Krantz 2001). The definition by Scoones above was a modification from the earlier one by Chambers and Conway (1992), which state that "*A livelihood comprises of the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term".*(Chambers and Conway 1992 p, 7). With regards to the definitions, a livelihood must possess the element of sustainability and must be able to recover from stress, shocks and/or perturbation. Thus, it is resilient to external shocks and stresses, it is not dependent upon external support, and it is able to maintain the long-term productivity of natural resources and when it does not undermine the livelihood options of others. The new definition by Scoones however, does not include the requirement that for livelihood to be considered sustainable they should also contribute to other livelihoods.

Though they have been many studies on livelihood concept and hence many definitions have been portrayed to suit specific phenomena under observation, this has actually limited, or provided boundaries of the assessment. This study chose to draw heavily on Ellis's definition. From Ellis (2000), a livelihood comprises of assets (which could be natural, physical, human, financial and social), the activities and access to these (mediated by institutions and relations) that together determine the living gained by the individual or household. In most studies the household is provided as a scope, and the household's activities therefore constitute the total activities defining the ability of the household to secure a particular livelihood. "A household combines all people

that share the same hearth for cooking" (Chambers and Conway 1992 p, 6). "This human group seeks to mobilize resources and opportunities and to combine these into a livelihood strategy which is a mix of productive and reproductive activities, income, labor and asset pooling" (Grown and Sebstad 1989 as quoted in Rakodi 2002 p, 7).

The Sustainable Livelihood Approach is a clear people-centered approach. Thus, people rather than the resources they use is the priority concern. It seeks to identify the most pressing constraints faced by people regardless of where these occur (i.e. which sector, geographical space) as well as to understand how to tackle the challenges these people are faced with. It also seeks to understand the variable capabilities of people to cope in times of intense danger such as droughts, climatic and seasonal changes. In this study for instance, sustainable livelihoods look at the ability of Songosongo inhabitants to use their different assets they possess including the natural assets (i.e. Ecosystem services), to maintain their productivity in the advent of natural gas activities in their area as a disturbance (Conway, 1985, in Allison and Ellis, 2001).

SLA gives three important insights into the poverty discussion as pointed out by Krantz (2001). The first is that while economic growth may be essential for poverty reduction there is no automatic relationship between the two since it all depends on the capabilities of the poor to take advantage of expanding economic opportunities. Poverty as conceived by the poor themselves is not just a question of the low income, but also includes other dimensions such as bad health, illiteracy, lack of social services as well as a state of vulnerability and feelings of powerlessness. Finally, the poor themselves often know their situation and needs best, and they must therefore be involved in the design of policies and projects intended to improve their lot. To bring together all the components of SLA, different models have been proposed by different authors and International institutions to constitute all the components in a single a framework hence a name Sustainable livelihood framework (SLF).

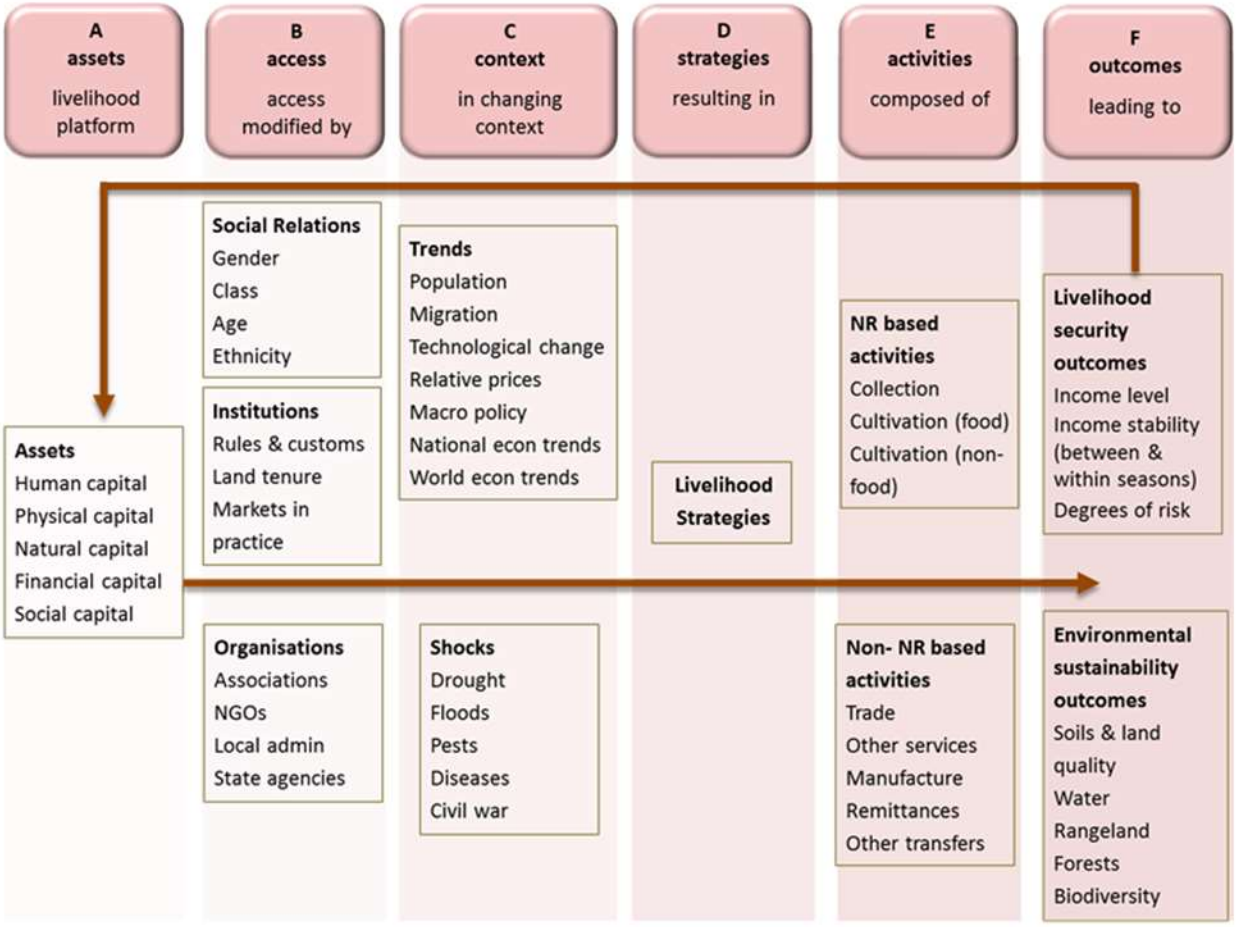
2.3.2 The Sustainable Livelihood Framework

The sustainable livelihoods approach has been simplified into forms of a framework by different authors and organization to brings together the main components that are thought to act in accordance with the livelihood's definition. One of the most widely used livelihoods frameworks in development arena is the one by the British Department for International Development (DFID).

The SL framework is a tool for development work that highlights how to understand, analyse and describe the main factors that affect the livelihoods of the poor (DFID 2000). Pedersen and Petersen (2010) point out that the framework describe what development dedicated for poverty reduction should focus on, to create sustainable livelihood for the poor.

These assets are owned, controlled, claimed, or in other ways accessed by the household (Swift 1989, cited in Allison and Ellis, 2001). It is very important to note that assets are not limited only to cash, savings, or other material things, but also intangible and non-material aspects such as health, their knowledge and skills, their friends and family (Rakodi 2002). As mentioned earlier, the livelihood approach is a people centered approach i.e. it concerned first and foremost with people. Thus, an accurate and realistic understanding of people's strength (here we call them assets and capital), is vital to analyse how they endeavour to convert their assets into positive livelihood outcomes (Bezemer and Lerman 2002, in Eneyew and Bekele 2013). To meet the self-defined livelihood goals people, need a range of assets or capital. These capitals are in categories of human, social, financial, physical, and natural capital, and hence they can be affected by external factors referred to as vulnerability context, comprising trends and shocks that are beyond the household control (Allison and Ellis 2001). The SL framework has been illustrated with different models according to authors to make it easier to understand the different components and their relatedness (Pedersen and Petersen 2010). However, this study has adopted the one by Ellis (2000).

Figure 4; The sustainable livelihood framework, (from Ellis 2000 p,30)



Source: Ellis 2000.

2.3.2.1 Human capital

In the context of SL framework DFID (2000), point out that, human capital represents the skills, knowledge, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives. Human capital is essential in order to use the other kinds of capitals that exist (Pedersen and Petersen 2010). The quality and quantity of human capital in a household constitute direct effects to the economic situation of the human group. According to (Serrat, 2008), human capital includes the issues of labour market, education and health.

As stated in Allison and Ellis (2001), this form of capital is the most important asset possessed by people living in rural communities. The efficiency of human capital is increased when investing in training and education. Similarly, it can be influenced by one's skills acquired through work experience. Free from illness and other health challenges, increases the effectiveness to work (Ellis, 2000). Some factors such as death, birth and migration seem to affect human capital as well. Environmental and health issues related to the extraction of natural resources have been also affecting human capital. For instance, a UNEP report published in (2009), points out that both environmental pollution and conflicts caused by the production of raw materials raise the health risks of the local population (UNEP 2009).

Lack of human capital in the form of skills and education is seen to affect the ability to secure a livelihood more directly in urban labor markets than in rural areas (Rakodi 2002). As pointed out by Basedau (2005), the petroleum industry employs mainly high-skilled workers to operate activities such as the running of the off-shore oil platforms and on-shore infrastructure, such as pipelines and refineries, while local people has often nurtured exaggerated expectations of employment opportunities. These hopes however are likely not fulfilled, and eventually could lead to conflicts between communities and petroleum (i.e. oil and gas) companies. The only opportunity to be employed temporarily as an unskilled person can be only during the preliminary stage of the project development like the construction phase (Waskow and Welch, 2005). Fishermen, peasants and other unskilled local people do not have such high requisite skills. Hence the high job expectations may therefore likely not be met.

2.3.2.2 Physical capital

Physical capital describes the basic infrastructure and producer goods that are needed to support the livelihoods that people seek (Pedersen and Petersen 2010). This includes among many, depending on the core livelihood activities in locality secure homes and buildings, adequate water supply and sanitation, clean, affordable energy and access to information. It is obvious that the costs of housing in oil and gas producing countries or regions often develop analogous to the price increase of goods and other services. The provisions from different infrastructures are more often overstretched and become more expensive as the demand for it continuously goes up. Such a pressure is transmitted to local land which in turn affects the prices of goods and services particularly that of housing, and house owners according to Rud and Aragon (2013), begin to

demand more than they usually would charge irrespective of the consumer's origin or income. Accommodation services such as hotels lodging and guest houses also stretch up with the advent of an oil and gas discovery due to the influx of people (Boohene and Peprah, 2011).

2.3.2.3 Financial capital

Financial capital is the financial resources that people can use to achieve the livelihoods that they are striving for (Pedersen and Petersen 2010). It could be in the form of savings, credit, wages, proceeds from work and living costs. While the ability to generate *financial capital* depends on wages or proceeds of work and living costs in a household's success in developing a livelihood strategy, it is probably the most versatile among the five, as it can easily be changed into other types of capital or it can be used for direct achievement of livelihood outcomes (e.g. purchasing of different aid materials necessary for livelihood activities). Petroleum industry (natural gas production inclusive) is often accompanied by the influx of high-skilled foreign workers who easily cause an increase in demand for some goods and services. High demand eventually causes the prices to rise. In contrast to these increments, income sources often remain unchanged limiting the ability of local populations with no links to the oil sector to pay for goods and services that were previously affordable, (Waskow and Welch, 2005).

2.3.2.4 Social capital

Pedersen and Petersen (2010) define social capital as the social resources that people can get help from, in order to achieve their livelihoods. This could be through networking, membership of formalized groups or mere trust between people that make them help each other. Social capital emphasizes the importance of social interactions, structures social institutions to individuals and households. It consists of all social and community networks as well as effects of migration of people from one point to another getting new social networks. In SLA context, the term stand for all social resources upon which people draw in seeking their livelihood outcomes, such as networks and connectedness that increase people's trust and ability to cooperate or membership in more formalized groups and their systems of rules, norms and sanctions. It is believed that the influx of foreign workers into the petroleum producing regions always have consequences. In some cases, for instance the social fabric within communities could be shaken through resentment among those who do not have jobs and the few that do (Bourdieu and Wacquant 1992, in Palloni et al., 2001).

It is further argued that "the men who get jobs on a drilling site often abandon the traditional work and ways of life" (ibid.,) which in turn become a motive for tension within the local community. It is not only the security threats that could be imposed by this influx of people in areas hosting petroleum activities. The increase of housing and living costs can also trigger movements out of the community which finally can destroy and undermine existing social networks. Obviously, the access and amount of social capital is determined also through birth, age, gender or kinship and may even differ within a household. Petroleum activities such as an exploration of natural gas in an area can result into either in-migration or out-migration, which can either strengthen or destroy existing social networks.

2.3.2.5 Natural capital

Natural capital is to be understood in a very broad manner since it both covers tangible factors like natural resources such as trees and land etc., and more intangible products such as atmosphere and biodiversity. It consists of natural resource stocks such as soil, water, air, genetic resources and environmental services like hydrological cycle, and pollution sinks. From Kollmair and Gamper (2012), the term natural capital stands for the natural resource stocks from which resource flows and services (such as land, water, forests, air quality, erosion protection, biodiversity degree and rate of change) useful for livelihoods are derived. Natural capital is the ecosystem services which is offered by the ecosystem for livelihoods. In a livelihood context natural capital is particularly important for people (especially in rural areas) who derive to a large extent or even their whole livelihoods from natural resources.

Within the Sustainable Livelihood Framework, it exists a particularly strong relationship between natural capital and the vulnerability context, and many of the devastating shocks for livelihoods are natural processes that destroy natural capital (e.g. fires, floods, drowning, drought etc.). The development of petroleum products (oil and gas) involve a number of steps to its production stage that serves as a potential threat to the environment which ultimately cease the ability of nature to offer the ecosystem services. For example, gas and oil structures that are stationed in breeding grounds for fish or other ocean animals can disrupt breeding patterns and affect populations (Waskow and Welch, 2005). The bright lights associated with the oil rigs for example that are stationed in ocean also attract most of the fish into 'no go' zones where fishermen are banned from

fishing (Badgley, 2011). The consequences these potential risks will have on environment and livelihood strategies in Songosongo will be discussed later in this study.

2.3.2.6 The vulnerability context

There has always been a struggle of people and households to secure their livelihoods and assets however their efforts and struggle are strongly influenced also by the context within which they desire them. The SL framework emphasizes the concept of vulnerability. Chambers, (1989), define vulnerability as being powerless, uncertain, and being exposed to risks, shocks and stress. The vulnerability context describes the external environment that people live in, it includes critical trends such as technological trends or population trends. Also shocks such as natural disasters or economic inflation and seasonality referring to the way prices, employment opportunities and production might shift with seasons. All of these factors will affect the assets that people have or can access and thereby the sustainability of their livelihoods, (Pedersen and Petersen 2010). Serrat (2008) highlights the most important vulnerabilities are such as diseases, deaths, floods, storms, droughts, famines, and changes in prices of goods and services and new technology.

In the context of livelihoods, the poor are at the mercy of external shocks, stresses and crises more than any other part of the society. Once hit by an external event, they are often lack the means to recover. Fishing families as part of the Songosongo society, Allison and Ellis (2001), insist that, they are no less prone than other rural dwellers to adverse events (shocks) and trends, with natural fluctuations in fish stocks being especially critical for them. These shocks may also include changes in the weather, illness or death of a family member, the drowning of a fisherman, the destruction of a fishing boat or fishing nets and a reduction in the level of fish stocks. The death of a family member for instance can be a great shock especially if that person was a breadwinner.

Another shock can result from the demarcation and prevention of fishermen from fishing around 'no go' zones which leads to dispossession of fishing grounds (Benjaminsen and Bryceson, 2012). Chamber and Conway (1992) describe vulnerability in two different angles of thinking "the external" as the stresses and shocks to which a livelihood is subject; and "the internal" which is the ability or capacity to cope (Chambers and Conway 1992, p, 10). There are a variety of coping strategies or events often employed to deal with the shocks which includes: stint, hoard, protect, deplete, diversify, claim and move (ibid.). Shocks, trends and seasonality's could have either long

term or short-term effects, and may have impacts on coastal economies. In the short term, investors usually invest in the region. Job opportunities will be opened for some local people. Through Corporate Social Responsibility projects, the oil and gas companies and government institutions will embark on development plans such as the building of new schools or refurbishing old ones, provision of potable drinking water and the construction of road networks (E and P Forum/UNEP, 1997). But in the long term, if not well managed, oil and gas can result in tensions between the local people, oil and gas companies and the government which could finally lead to the loss of livelihoods. The study therefore examines the vulnerabilities of men and women in their livelihood strategies and their coping mechanisms during time of such circumstances.

2.3.2.7 Livelihood Strategies and Outcomes

DFID (2000) describe livelihood strategies as a range and combination of activities and choices undertaken by people in order to achieve their livelihood goals. The livelihood goals here are what we call the livelihood outcomes (Serrat 2008). These activities are natural resource-based activities and non-natural resource-based activities (Ellis 2000). According to Serrat (2008), decision on livelihood strategies invoke natural resource-based activities, non-natural resource and off-farm activities. The natural resource-based activities may include for instance gathering of firewood, cultivation and harvesting of food crops such as rice and corn, and livestock rearing (Ellis 2000). Non-natural resource-based activities for example may include petty trade, handcraft etc.

Potential livelihood outcomes are therefore referring to more income, increased well-being. Reduced vulnerability, improved food security and recovered human dignity (Serrat 2008). One crucial point to note is that projects and programs, while favouring some, can disadvantage other, this is one of problems of development among many. The Songosongo community has diverse livelihood strategies to meet their livelihood goals, these activities are different between people and households due to economic level, and they may even differ within a household (Ellis 2000), as affected by gender differentiation. Due to the diverse livelihood activities people are engaged in, they also engage in various coping strategies in order to survive in time of shocks and stress.

2.3.2.8 Policies and Institutions

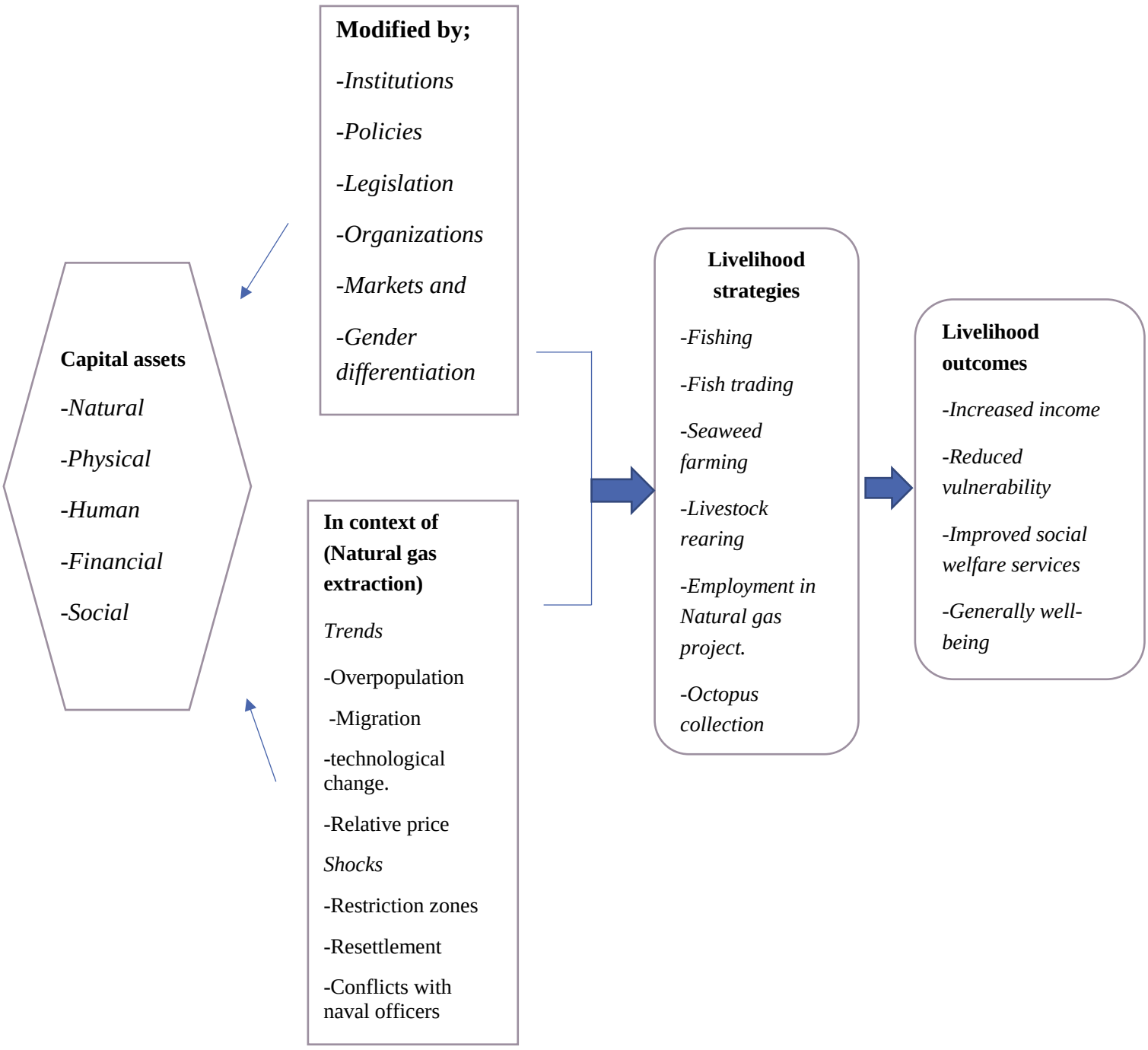
Livelihood strategies and outcomes are not just dependent on access to capital assets or constrained by the vulnerability context, they are also transformed by the environment structures and processes (Serrat 2017). These transforming structures and processes shape livelihoods. According to FAO (2013), transforming structures and processes are the institutions (formal and informal), organizations, policies and legislation which determine access to the five kinds of capital, terms of exchange between the different types of capital and the economic and other returns from livelihood strategies and diversification patterns.

Structures encompasses all public and private organizations that establish and implement policies and legislation, deliver services, purchase, trade and perform all kinds of other functions affecting livelihoods (Serrat 2008). Structures may be formal or informal, local, national or international. The lack of well working structures is often important obstacle to sustainability on development projects. Processes on the other hand are the laws, regulations, policies, operational arrangements, agreements, societal norms, and practices that in turn determine the way in which structures operates (Serrat 2017). Lacking appropriate institutions and processes in which policies can be implemented, lead to that policy-determining structures are ineffective (Serrat 2008). North (1990), portrays institutions as the formal rules, conventions, and informal codes of behaviour that comprise constraints on human interaction. Processes are vital in many aspects of livelihoods including provision of incentives that enhance people to make better choices, grant or deny access to assets, enabling people transform one type of assets into another through markets, and the influence on interpersonal relations (Serrat 2008).

2.3.3 Application of the theory to the study

Looking at Songosongo case study as my focal point, the sustainable livelihood framework portrays Songosongo community to comprise people who have access to certain capital assets. These capital assets are natural, physical, financial, human and social capital. But in the prevailing transforming structures and processes which including institutions, organizations and social relations, may influence this access leading to an adoption of different of livelihood strategies and outcomes. See figure 6, below the modified livelihood framework for the current Songosongo scenario.

Figure 5: A modified Livelihood framework for Songosongo scenario.



Source; Author's construct, (modified from Ellis 2000),

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGICAL CONSIDERATION OF THE STUDY.

3.0 Introduction

Research is meant to discover answers to research questions. It is an organized and systematic way of finding answers to research questions. Through this organized and systematic process, different stages have to be passed through by a researcher. This includes conceptualization of the problem, field visiting and gathering of data and finalization by the write-up. The fieldwork was conducted in a one-month time starting mid-August to mid-September 2018. This chapter discusses the research approach or design, the techniques used in producing data for answering the research questions. It is contented with highlights about location, social, economic and the demographic aspects of the study area. The research approach, data collection techniques, ethics, challenges and limitations are all included in this chapter.

3.1 Describing the Methodology in research

Silverman (2006), define the term methodology as all the choices a researcher can make about relevant models, case studies, data gathering and all forms of data analysis, in planning and actually in conducting a research. To answer research questions in social research, a researcher has to decide the type of techniques to use for data gathering and analysis, depending on nature of the research to be carried out. The decision a researcher make on what type of methods or techniques he/she will opt to systematically answer the research questions is what we call a research methodology. Such methods include qualitative, quantitative or both in combination which is referred to as mixed methods. The data collection methods are either be qualitative or quantitative (Bhattarcherjee 2012). This study has chosen to use qualitative approach. Qualitatively, the research takes place in the natural setting, and the researcher often visits the site of the participants to conduct a research (Rallis 1998). This is crucial to enable the researcher to develop a level of details about individuals and the place, and be involved in actual experiences of the participants (ibid.). For researchers who are really interested in understanding of how people make sense of their real world, and what experiences they have in that world, the qualitative approach is

recommendable (Merriam 2009). Walsham (1993) points out that the basis of qualitative paradigm is on interpretivism with an argument that, human actors socially construct knowledge of reality and so do also researchers. In contrast to a more positivist assumption there is no objective reality to be discovered by a researcher and that can be replicated by others. The interpretivism is based on the idea that efforts in qualitative research must focus on disclosing multiple realities and not searching for one objective reality. Methods such as group interviews, in-depth interviews, participant observation and focus discussion groups (FDGs) can be part of a qualitative research approach. Smaller sample sizes can be used to provide important information which cannot even be met when a large sample is in favour in quantitative research (Bryman 2012). Quantitative approach on the other hand involve explanations of the phenomena through the use of mathematically based techniques through data collection and analysis of the numerical data obtained (Aliaga and Gunderson 2005). Its paradigm is often rooted on positivism or realism. Positivist assumption hold an argument that the main purpose of research is to disclose reality. Positivists often argue that there is only one truth, an objective reality that exist independent of human perception (ibid.). Quantitative approaches involve large sample sizes, and testing of theories or hypothesis by experimenting in the laboratories and through survey research, (Bryman 2012).

3.2 The study research design

A qualitative research approach was an option opted for this study which actually suited the study objectives. Denzin and Lincoln point out the reason why it is beneficial to use a qualitative approach in complex naturalistic settings. "*Qualitative research is situated activity that locates the observer in the world. It consists of a set of interpretive material practices that make the world visible. These practices transform the world. This means that qualitative research study things in their natural settings attempting to make sense of or interpret phenomena in terms of the meanings people bring to them"* (Denzin and Lincoln 2005 p, 32). Qualitative research is concerned with offering specialized techniques for obtaining in-depth responses about what people think and experience. For people to understand better, you need to provide them with information in a manner which they usually experience (Lincoln and Guba 1985 in Shenton A.K, 2004). Qualitative data has an ability to more fully describe phenomena under the study. This is important for the both researcher's and the reader's perspective. Research in qualitative approaches are typically

rich in detail and insights into participants experiences of their world and they are epistemologically in harmony with the reader's experience (Stake 1978). Qualitative research by its own nature is subjective and exploratory, rooted in its basic principles of openness, research as communication, reflexivity of objects as well as flexibility (Denzin and Lincoln 2000). This enable researchers to gain insight into attitudes, beliefs, motives and behavior of the target population, thereby gain better understanding of the underlying processes. I strongly preferred qualitative approach after the realization of limited information about Songosongo livelihoods and the activities on the island, apart from extraction of natural gas which has gained more attention in different media. The approach is an ideal choice for this study because data obtained will add on reader's deeper understanding of issues (Tewksbury 2009), about Songosongo livelihoods whereas filling that reader's knowledge gap. I used five main qualitative methods for data collection in the field. This includes, participant observation, unstructured interviews, semi-structured interviews, group interviews and interviews with key informants. These methods were able to generate primary data. By primary data I mean comprises all data generated in the field through different data collection techniques. Secondary data were also generated from various sources including online materials and documented sources which are relevant.

3.3 Describing the target area of the study

The reason why Songosongo was chosen as the study area was on the basis of the fact that the island which is about 42.6 Km^2 is harbouring one of the largest petroleum projects along the East African coastline, while in a conjugate way a residential area for more than 6000 people. The area is in Kilwa district, Lindi region in the southern part of Tanzania mainland.

3.3.1 Historical background of Kilwa District

Administratively, Songosongo is a ward in Kilwa district in Lindi region, with five other districts. The other are Lindi Rural, Ruangwa, Nachingwea, Liwale and Lindi Urban which is the headquarters of Lindi region. The district is found 296km from the Tanzania's commercial capital Dar-es Salaam. It borders to the Indian ocean in the East, while the West is Liwale District. In the northern part there is Rufiji District of the Coast region and the south is Lindi Rural disrict. The district is divided into three important parts in the history of Tanzania. Kilwa kisiwani, (the word *Kisiwani* is a Swahili word means *island)* is the oldest area and is an Island. The place was a

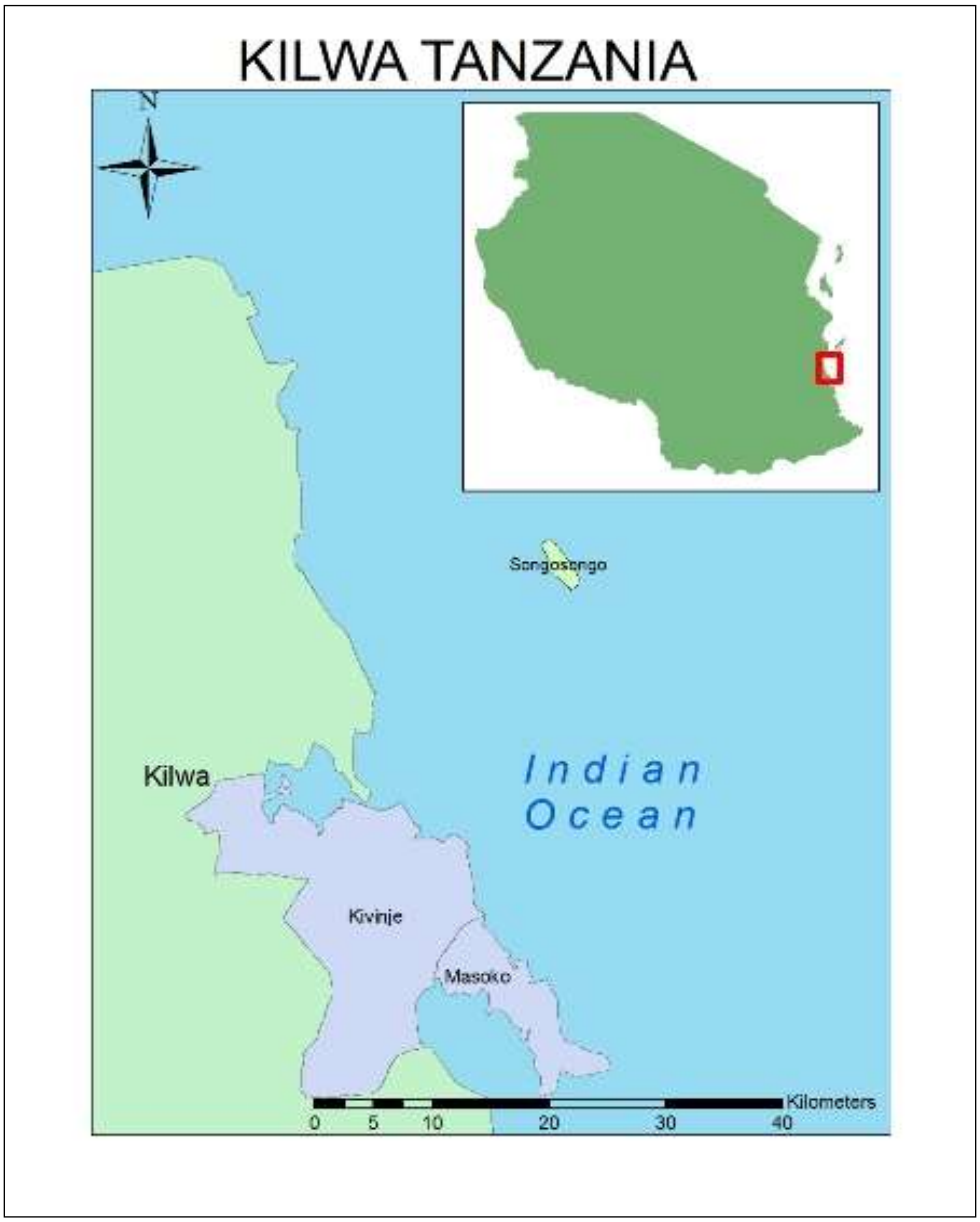
commercial hub in the period of early contact between the East African, the Middle East and the Far east areas. It is a famous place in east Africa since the 14th end up to the 19th centuries. The second part is Kilwa kivinje. According to Mesaki (2005), during the colonial era, the German in the 19th century built a fort named *Fort Jesus* at Kilwa Kivinje to get control of all other areas of southern Tanzania. And the third one is Kilwa Masoko, the word *Masoko* is a Swahili word as well, which means *markets.* The place was named Kilwa Masoko because was one of the slave markets during the era of slave trade in East Africa. By now Kilwa masoko is the headquarters of the district.

The historical connections with people from various places of the world has been the main cause of the current inter-generational impacts on religion and ethnicity. The Islam and Arab cultures still thrive in the district and almost 90 percent of the people in Kilwa are Muslim (WWF 2005). The Islamic culture has led to increasing polygamous marriages, since it does allow a man be married to up to four wives at a time. Though polygamous marriages are limited to those who can afford them (Holy Quran chapter 4), because in Islamic norms husbands are required to provide equally for all the wives they have. In Kilwa district Songosongo most men who marry more than one wife more often than not are unable to provide for their wives and children. This has increasingly simulated an independent income-earning spirit in women married in polygamous marriages.

Kilwa Ditrict has an abundance of marine fisheries and other resources including natural gas. The bays of Rukira, Songosongo archipelago, Rushingi and Kiswere are the important fishing grounds, while Kivinje and Somanga are known to be the largest fish-landing stations (Mesaki 2005). The WWF (2005), recognize Kilwa as the only area of Tanzania's territorial waters in which fisher-folk can still catch large fish like bream, grouper, parrot fish, snapper, rabbit fish, emperor fish, sharks and rays by using shark net with a 5 to 6-inch mesh (WWF 2005). However, Kilwa is still one of the poorest parts of Tanzania, thus the level of dependency on natural resources is high and little possibility exists that the integrated coastal management (ICM) can be successful without alternative livelihood strategies. Seaweed farming is an alternative livelihood activity in the district which rank Kilwa among the best producers of seaweed in Tanzania. Especially the cottonii species fetch a high price in the market (Songosongo ward office 2018). This alternative livelihood strategy however is underrated by men and considered as female activity in a household. These

invisibility of women's socio-economic contributions in Kilwa district, Songosongo is an example and has been persistent and become more prominent, because fishing is seen the most important activity for the native local people and is mostly referred to as male's domain (ibid.). Thus, other activities done by women to sustain the households in the village are often not considered in several development planning policies and programmes.

Figure 6: Map of Kilwa District and position of Songosongo island



Source: Besta 2010

3.3.2 Livelihood activities in the District

There are 190,744 people in Kilwa District, whereas 6,608 found in Songosongo. People in Kilwa depend entirely on agriculture for their existence, (WWF 2005). It contributes more than 80 percent of the District Gross Domestic Product (GDP), while employing more than 70 percent of the total labour force (ibid.). Famous crops farmed includes sorghum, paddy, maize (corn), cassava, sesame and cashew. Agriculture is operated under small scale techniques which use traditional technologies as well. The majority of women involve in subsistence agriculture; thus, food production is often inefficient to support their families throughout the year. Fishing is also important and the major livelihood activities in the District, and a majority of men and women are engaged in fisheries related activities such as fish processing, frying and trading, and fishing itself. The WWF (2005) confers that almost 100 percent of the animal protein required by people along the coastline come from fish. In fisheries activities, women dominate more in inshore activities and shallow waters fishing whereas men are dominant in offshore fishing.

WWF (2005), and Mesaki (2005), both recognize Rukira, Songosongo archipelago, Rushingi, and Kiswere bays as the richest fishing grounds, while Kivinje and Somanga as the largest fish landing stations. Other alternative livelihood strategies in Kilwa which I also managed to see some during my fieldwork includes livestock rearing, coconut farming, timber production, carving, carpentry, seaweed farming, and salt making, (Mesaki 2005).

3.3.3 The Songosongo Island

The geographical focus of this study is Songosongo Island which is located at 8º 30’S and 39º 30’E. According to Mesaki 2005, the area is part of the Songosongo archipelago, which consists of Songosongo Island itself and other parts of an archipelago includes the Fanjovi, Nyuni, Ukuza and Simaya islets. It is about 25 km northeast of Kilwa Kivinje and approximately 160 km from Dar es Salaam (Songas 2001). The geographical location of Songosongo Island enables it to win both status of a village and a ward at the same time. Administratively Songosongo is thus both village and also a ward in Pwani division. The village is divided into three main parts, the North west of the village is Funguni, the North east is Pembeni and the central part is called Kisuni. All the gas fields and plants are located in *Funguni*, offices for ward and village executive officers, dispensary and the primary school are all located at the central part of the Island, *Kisuni*, whereas

the secondary school is located at *Pembeni*. Politically, Songosongo as village is reigned by a village chairperson from the *Civic United Front* (**CUF**) a political party. At the ward level is represented in the District assembly by a Member of Council Assembly (MCA), or Ward Councilor, from the ruling party, *Chama cha Mapinduzi* (**CCM**).

The largest part of the island soil is covered by coral rag, which make crop cultivation difficult, the only crop you can see in the island is coconut trees having a dual purpose as a crop and as a shadow tree. The failure to cultivate, and no harvesting of any crop make the island population fully dependent on people in other areas in the mainland for all the requirements of food items. It was a supprise for me to see vegetables such as Chinese cabbage, tomatoes, onions and amaranths to mention few, including different types of fruits, all ordered outside the island, which are Kivinje, Somanga, Masoko and other nearby areas in the mainland. This make these fetch a high price in Songosongo. The only food material the island is capable to produce for its population is fish protein and coconuts.

Statistics from the ward executive office (2018), shows that Songosongo island has 725 households, 221 are female headed and 504 are male headed households. The total population of the islanders is 6608 where 1237 are abled male, 1624 are abled female. There are about 3573 children. The island population also constitutes 99 elders (older aged group) and 81disabled. This was however, another case of shock when I came to notice that the number of children is above half of the total population. To me this signify a lack of knowledge on family planning and birth control. I was also told that the population of natives is a mixture of different ethnic groups including Makonde, Mwera, Matumbi and Yao, as they all migrated from different places of Kilwa district to establish their residential place on the island. Despite the above there is no common dialects spoken, as it always be in many villages in Tanzania, In Songosongo Swahili is their mother tongue and the first language to speak.

Turning back to the environmental resources, the Songosongo archipelago and its associated reefs are rich in biodiversity, which also serves as home to endangered species such as sea turtles which are found to nest there (Darwall 1996). Diverse types of fish and other aquatic creatures of economic importance are abundantly available. These organisms include species of finfish, lobster, and sea cucumber, cephalopods like octopus, squid and cuttlefish (WWF 2005). The Pumbavu islet (also known as Dabali juu by local) and Funguni areas are good breeding and nesting sites for

turtles, (Darwall 1996). The Songosongo gas field holding an estimated reserve of approximately one trillion cubic feet of gas is an inclusion of the Songosongo archipelago (Songas 2002). The gas field is located onshore and offshore of the Songosongo island. It is about 15km from the Tanzania mainland and 200km south of the Tanzania's commercial capital Dar es Salaam (ibid.).

The project serves two onshore and three offshore natural gas wells on the island. The gas from the wells are piped to a plant on the island. The discovery well, Songo Songo-1 (SS-1), was drilled in l974 by AGIP. Appraisal wells were drilled in 1978, 1981 and 1982. "The gas processing plant and pipelines were built and are owned by Songas Ltd, a local joint venture company formed by power company CDC Globleq (itself formed by CDC Group), TANESCO, TPDC and TDFL. CDC Globleq has the controlling interest in the plants in Dar es Salaam project, and the gas plant and wells are operated on its behalf by Pan African Energy Tanzania Ltd, a local subsidiary of Orca Exploration Group Inc". (Off shore Technology, http://www.offshore-technology.com/projects/songosongo/). Construction of the pipeline network was completed in May 2004 and the first gas reached Dar es Salaam in July 2004, so the project started commercial operation in July 2004. Natural gas from both onshore and offshore wells is piped to the processing facilities which are situated on Songosongo island to be processed. Then through a 25km submarine pipeline the processed gas is transported to the mainland coast.

From the mainland coast a 200km pipeline transport the gas to Ubungo, Dar es Salaam where it is used as a feedstock in the generation of electricity for the national grid. A proportion of the gas is also supplied to other industrial users through sales.

Figure 7: Aerial Image of Songosongo Island, people settlement and gas plants location.

(Source; Google image, 12. 9. 2019)

The island is divided into two distinct parts, one part is inhabited while the other is not, the uninhabited is the host of Natural gas activities. In this part of the island the gas plants, airstrip and the gas wells are located (see figure 7). The inhabited northern part of the island is sandy, while the southern part is rocky and not inhibited. The northeast and northwest are mainly inhabited. The northeast is Pembeni and it is a favorable ground for collecting octopus and farming seaweed, whereas the northwest is part of Funguni which is inhabited and also contains the Songosongo gas plant owned by Songas company.

3.4 The outsider-insider status

The principal task of producing data in a new research area to researchers, is how researchers will be able to position themselves in order to gain access to information. The consequences of the failure to position and fit in the researched population will affect not only the general research work but the quality of the research findings and results as well. The outsider and insider status of a researcher plays a crucial role to an access to the required information by a research study. Mullings (1999), confers, outsiders are not related to the group they are studying in any way, and they have little knowledge of them. During the fieldwork on Songosongo island I always presented myself as a student researcher, hence my major expected role was to ask questions to them. Being a student researcher, this gave me an outsider status.

The outsider status provided me a room to introduce myself that I am here to learn because I know nothing about your livelihoods. This actually become my guiding principle throughout my fieldwork activities. The outsider position was quite true on my side. For instance, despite being a Tanzanian pursuing my studies in a Norwegian university I had never been to the southern part of Tanzania (Songosongo inclusive). Thus, I was not part of their culture, norms and customs and ways of their livelihoods. I had little knowledge about marine fishing, seaweed farming and perhaps little information about the extraction of natural gas on the island, and what interaction they had with the community. This status as an outsider was crucial and beneficial in the sense that many but not all informants were willing to provide and explain to their last point all the information, I searched from them.

A researcher needs personal qualities such as an open, enquiring mind, and to be a good listener, sensitive, flexible and adaptive to contrary findings (Robson 2002). And s/he need to interpret information rather than just recording them. At a different level of the research one needs to recognize the influence s/he hold on the research process, which raises the issues of reflexibility, (ibid.). Being an outsider, however, could also limit access to information. Some of the research targets perceived me as a threat, opportunity, and a nuisance. During fieldwork some of the officials from Songas saw me as an outsider and restricting my access to information, regardless of having consented previously, including my status as a student researcher. The simple answer to me was "*nothing is hidden about Songas, all the information you need can be found online, you just visit Google*". However, few granted me interviews, after explaining the importance of the interviews and that the data I need are only for study purpose. With all the permit documents and identities I had in hand, allowing me to conduct a research on the island, one of my research targets still showed not trusting me at all, saying, "*you can still be a spy who has been sent to spy on us and after a few days we shall see the consequences of your work"*.

My position as student researcher from a western University makes me an outsider which increased lack of trustworthy to me for some informants. However, my positionality as a young Tanzanian man, conducting a research in a research setting on Songosongo island in Tanzania, and holding some commonalities with the researched like gender, religion, and language gave me the status of an insider in another way. My ability to communicate with my researched informants in the common language of Swahili enabled me gaining their trustworthy in some extent, despite being a student researcher from western University. Under the argument of Olesen (2000), that the extent to which I can call myself an insider needs further qualification because of the hidden assumption that insider knowledge is unified, stable and unchanged (Olesen 2000). By this therefore I cannot consider myself as full insider, but partial.

3.5 The participants sampling

Selection of participants was both purposively and randomly conducted. The selection of participants for the, participant observation, group interviews and key informants' interviews were purposively selected while structured and un-structured interviews conducted informants were randomly sampled. Sampling allows a researcher to infer information about population with no investigation to every individual within a population.

Sampling involve gathering of information about a relatively small portion of a large group or population aiming at making inferential generalization about the group in totality, (Rice 2010). The strong reason why purposive sampling was part of this research is embedded in the fact that informants with rich information on the given issue the researcher is interested with should be selected (Creswell 2003). This is successful when a so-called theoretical closure is attained.

Theoretical closure is when the researcher undergoes exhaustion of the information and no longer gets new information from his /her respondents, (Grazer and Straus 1967). Through consultation of knowledgeable individuals about the differences in social, economic activities, age, and marital status in the village targeted households, groups and key informants were identified and later visited for conversation or participation in what they are doing. Key informants in the village were purposively sampled by virtue of the professional role, positions and experiences they are holding in the community. In this case therefore, the Ward Councilor, The Village chairperson, Ward executive officer (WEO), The Headmaster Songosongo secondary school, the clinical officer in-charge for Songosongo Dispensary, The Songas relational and community development officer, and some influential village elders, were all identified first, previously consented and interviewed at last. This diversification of informants was considered, aimed at avoiding bias.

3.6 Gender and demographic aspects of informants

Kothari (2004), confers sample size as the number of items selected from a population to constitute a sample. My sample size consisted of 79 informants. From this, Government officials were five, local leaders (village and ward) were three, one Songas official, one Pan African staff, three influential village elders and 66 villagers (members of Songosongo community). Out of 66 villagers 25 were interviewed in groups. Table 1 below illustrate the number of informants in categories and their gender appearance in the research.

Table 1; Gender and demographic characteristics of research informants;

Category	Number	Gender	
		Male	Female
Government officials	5	5	---
Local leaders	3	3	---
Songas officials	1	---	1
Pan African staff members	1	1	---
Village elders	3	3	---
Villagers	41	21	20
Group 1 Interview	9	9	---
Group 2 Interview	16	---	16
TOTAL	**79**	**42**	**37**

Source: Field data 2018;

The respondent's percentage by gender constituted 53% male and 47% female. Male informants make a total number of 42, whereas female respondents were about 37 in total. Many official informants that were actually selected by virtue of the position they held in different institutions were male. Thus, had influence on lower percentage of female respondents.

3.7 Research methods

Data collection was organized in what Bryman (1998), and Creswell (2003) termed a triangulation approach. It is an approach whereby a researcher applies different data collection methods in gathering information. It is the most common way in which the integration of qualitative and quantitative research can be conceptualized to extent that some researchers treat integration and triangulation as essentially synonymous, (Schrest and Sidan 1995). However, triangulation in this study does not mean an inclusion of quantitative data collection approaches. The main qualitative approach used in the study was interviews. It is thus, triangulation on the basis that different

interview approaches supplemented by participant observation were used to gather the relevant information of the study. Unstructured and semi-structured interviews were mainly preferred as the most appropriate qualitative methods for gathering qualitative data with an essence to receive data-rich accounts from informants about the situation and their personal opinions on the issues pertinent to the research objectives. Methods used to collect data therefore includes participants observation, unstructured interviews, semi-structured interviews, group interview and key informants' interviews.

3.7.1 Participant observation

Participant observation is a community immerse in and learn based approach. It involves staying in the community, interacting and sharing with people of what they are doing and experiencing for a period of time and hence get insights about them (Clifford and Valentine 2010). The researcher will get to note important hints relevant to research questions, while participating in their daily life experiences using the research equipment with him/her, such as camera and field notebooks. I used participant observation as an effective way of empirically observing the gaps between the stated and actual behaviour, (Bryman 2008).

Although I am an agriculturalist by professional, I was new and essentially blind for in the field of seaweed farming. I participated in various activities regarding seaweed farming. Since seaweed farming is carried out in the sea, I took time to visit farmers in their sites and get involved in the planting, harvesting, and in the drying process at their homes. These gave me the opportunity for informal interviews and to discuss some aspects seemed relevant to research questions with participants in different settings. Seaweed farming is considered as female livelihood activity in Songosongo. My informants for in this angle therefore were in a large extent women.

Knowing that it is ethically immoral to some societies in Tanzania, and that a man to have conversation with woman without having consulted her husband first could bring quarrels, I sought for informed consent previously at their homes that I will visit them in their seaweed farms. I also took with me the street leaders (called *mwenyekiti wa kitongoji*) to the seaweed farms. Every time I visited women in their seaweed farms in the sea, I took with me *mwenyekiti wa kitongoji* of the side I was visiting. This was important to increase trustworthy to me by the husbands of the women I was visiting.

I also visited business men and women on the island by participating in markets and spending time at shops areas observing transactions and different items prices. I involved in water fetching program and arrangement set by the village leaders at the water points donated by Songas, and visiting the landing beaches for fish traders. The fact that I was introduced in the village as a Tanzanian studying abroad, I was invited to many events including one ceremony for dowry giving and several streets developmental meetings. All these gave me more insights into the perspectives of the islander's livelihoods.

Figure 8: **Participating in planting (photo 1&2) and harvesting (photo 3) of seaweed, at Songosongo island Tanzania (2018.)**

Source: Field data Songosongo island

3.7.2 Group interviews

Group interviews is based on an interaction within a group and as crew that join to create common meaning (Bryman 2008). It involves a small group of people discussing issues brought on the discussion table by a researcher (Hay 2010). It usually considers the homogeneity of respondents, people with some similar characteristics to form an interview group, (Clifford and Valentine 2010). I used group interviews to elicit information in a manner that allowed me as a researcher to reveal salient issues about natural extraction, and what is the salient of this process for the livelihoods of the islanders (Morgan 1997). This enabled to understanding an existing gap between what people say and what they actually doing (Lankshear, 1993).

I was however very keen, to not allow the influence of one or few respondents to dominate the session which could led to a biased output. I organized two group interviews based on gender and age, one group was for male youth, (young men), who according to the discussion all were artisanal fishers. Selecting groups for interviews was crucial, based on the assumption that informants sometimes are more open when discussing local experiences and perceptions in groups rather than being interviewed in one to one manner (Creswell 2003). I selected this group of young men with the essence to get their opinions and perceptions about the natural gas project, and how they think the project is important for their current and future livelihoods. Sampling of the group members was carried out randomly, and the total number of fifteenth respondents were invited but only nine appeared on the interviews meeting.

Figure 9: Listening to one of the respondents (not seen on the photo) during one of the group meetings Songosongo island Tanzania 2018

Source:Field data.

The second group I focused on, are women. This didn't consider the age of respondents but only gender. Women in Tanzania are responsible for almost all the domestic chores and thus they sometimes are overwhelmed by these home chores especially when important home resources such as water and energy are not sufficiently available. I opted to talk to this group as well, to get to know how they perceive an extraction of natural gas on the island has impacted their livelihoods as mothers and expected mothers. In contrary to the latter group, the number of invitees were twelve, but the attendance was sixteenth, some invitees were not attended but there are also some who attended the interview meeting taking with them their friends. Few hints from bundles of information I gathered, the group was generally thankful to Songas and PanAfrican Energy Tanzania for the provision of water in the village. "*Though water still does not suffice the requirements, but something small is better than nothing"* one of the respondents argued.

They also argued on the disadvantaged side of the project, and another respondent mentioned about restricted zones.

"*We are now prohibited not to collect firewood or coming near to the gas plants, places where were previously free and non-restricted and in fact are places where we use to get firewood since then"* argued another woman.

3.7.3 Unstructured interviews

Unstructured interviews were used in both of the above research methods. The participant observations and group interviews were all carried out using unstructured interview guide. Bryman (2008) stresses during unstructured interviews, questions might be asked by a researcher and the participants are left to respond freely on the issues under research. This type of interviews is considered synonymous in characteristics to conversations. In reality of the environmental aspect in which participants observations were carried out such as in the sea for seaweed farmers, around market areas and in the landing beaches, unstructured interview was a suited approach. In similar ways interviews in the two group meetings were characterized by a dialogue, hence I was more interested in letting my respondents freely express their opinions and perceptions on the issues of natural gas extraction and livelihoods on the island, rather than keeping them strictly bound with a structured interview guide.

3.7.4 Semi-structured interviews

I used semi-structured interviews as a qualitative method to seek information from the sampled households and also from various key informants. Interviewing by semi-structured interview guide was based according to Mason (2002), on the assumption that social phenomena can possibly be examined by asking people to talk and gathering knowledge by listening to, and interpreting what they say and how they say it. This was the main research technique I applied in this study as it allows in-depth exploration of different social actors' perspectives and positions (ibid). Longhurst (2010) added on that an excellent way of gathering information is through talking to people. It usually likely to open in a manner which is conversational, while offering chances to participants to explore issues they are interested with.

I used semi-structured interviews method to collect information from the households sampled and from all key informants with the fact that the approach allows for flexibility to probe for answers, follow up of original questions and pursue new lines of questions (Denscombe 2007). Digital audio recorder was used during key informants' interviews which took place either in their offices or homes. Audio recorder was also used during group interview meetings. This enable events being observed in their natural settings, as I wasn't focusing too much on writing. I interviewed 41 households and 13 Key informants. Key informants interviewed include government officials, Village and Ward political leaders, influential elders in the village, Songas and Panafrican energy Tanzania officials were all interviewed. All interviews were conducted in the language of Swahili, since all the respondents and almost every islander could speak the language fluently.

Figure 10: Conducting an interview to a woman, during households' visitation Songosongo island (Tanzania 2018)

Source: Field data

3.8 Ethical issues, and Research limitations

According to Bryman (2012), the ethical issues are usually rooted around four basic corners of the research which are lack of informed consent, harm to participants, privacy invasion and if there are issues of deception involved. I can declare, that the ethical aspect of research in this study was successfully met. Before the start of the fieldwork, a formal permit for conducting a research on the island was obtained and authorities granted it. In Tanzania the authority legally responsible to issue such permits is COSTECH. Through the University of Dodoma, I was granted a permit to conduct a research. As emphasized in Clifford and Valentine (2010), an ethical researcher helps to maintain public interest and prevents suspicion from among his/her informants.

With regards to the issues of informed consent, these went well as I sought consent for every informant whom I thought can participate in the study. Before I started my interviews or any talk about my research the first thing, I did was an introductory of myself as a Tanzanian studying in Norway, followed by showing up of the permit and other necessary documents to them.

These were done to win informants willingness and making them feel free to participate. Explaining about what a research is all about to my informants was important to prevent deception. So, I explained to my informants as much as possible about the research process which enabled an establishment of some level of trust. I also gave explanations about the purpose of my research and its relevance; this is because some informants wanted to know how relevance my research is before they agree granting me an interview. Informants were informed that the interviews were voluntary, and not an obligatory, and that they are free to withdraw from the interview any time they feel to do so. In some interviews to my key informants, I used digital audio recorder, so I sought the consent of my informants before the audio recorder was switched on. I also played the recorded audios for any informant wanted to listen to it afterwards. In additional to that all the photographs presented as part of data in this study were all taken with the informant's consent. Confidentiality has been maintained to keep the privacy of all informants. This ensured that informants were unidentifiable.

Apart from ethical considerations, I also encountered several limitations throughout the research process. The first limitation I encountered was fund as a key resource that aided my transport to the researched area, funds which were issued by the Dodoma university, an issuance came late of time which attributed the fieldwork to proceed late out of the proposed scheduled time. Another

key limitation was the accessibility of the island. Regarding that it is an Island (Songosongo) is only accessible through the use of a locally made boat and by air. Although there is an airstrip, the flights to Songosongo island are mainly for Songas officials and visitors who travel to and from Dar es Salaam and it is hard to get a scheduled passengers flights to the island.

The alternative was to take a bus from Dar es Salaam to Kilwa Kivinje, and then take a local boat to Songosongo island. There is only one boat trip from Songosongo to Kilwa Kivinje and back to Songosongo every day, thus missing it out one would have to wait another day schedule. It was not the issue of transport that I encountered as limiting the research process, on the island accommodation was another limitation. Lack of good accommodation, executive lodges and restaurants on the island was the cause of failure of my supervisor to make a visit and join me during the fieldwork as it had been agreed between parties. Although this brought no effects to the data and generally the research in anyhow, it was limiting as it costed me to pay for one islander young woman (*Ms. Yusta Mwakarebela*), to prepare me food every day, for the whole days I spent on the island including breakfast, lunch and dinner which was actually very expensive and thus increased the research budget.

CHAPTER FOUR

EXTRACTION, PROCESSING AND TRANSPORTATING OF THE NATURAL GAS AND THE IMPACTS TO ECOSYSTEM SERVICES ON THE ISLAND

4.0 Introduction

This chapter presents and analyses the research findings. The findings are generally focused on the impacts brought about by the extraction of natural gas to the island natural environment. The chapter addresses the requirements of research question **(1**), **(2)** and **(3)** comprised in objective **(a).** It highlights important ecosystem services and its alteration over time with the natural gas activities. The chapter is generally focused on environmental issues, disclosing existing relationships between ecosystem services and the natural gas activities undertaken on the island and how this relationship is part of the livelihoods of the islanders. The other 2 objectives will be addressed in chapter 5.

4.1 Ecosystem services making livelihoods on Songosongo island

Ellis (2000), stated that livelihoods comprise of assets which including 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 or outcomes gained by the individual or household, (Ellis 2000 and Scoones 1998). Relying on Ellis (2000). This study defines livelihoods as the strategies and/or various ways in totality through which individuals or households gain their, means of survival and/or a living in the environment they are located. Means of survival encompasses all the assets as per Ellis (2000), are natural, physical, financial, and social capital which the access to them is determined by institutions and social relations within community.

It is however important to note, that strategies or means of gaining livelihoods are usually dynamic and they can be both natural resource or non-natural resource based (Allison and Ellis 2001). The means of securing livelihoods, whether they are natural resource or non-natural resource based, are directly connected to the environment in which an individual or a household is located. As stressed by the Millennium Ecosystem Assessment (MA), humanity depends on the biosphere and its ecosystems. The environmental connection to the livelihoods is strongly embedded in the

benefits that humanity gain from ecosystem for livelihoods (MA 2005) regardless of if it is direct or indirect.

The benefits from ecosystem are generally termed Ecosystem services. IUCN define Ecosystem services as *"the benefits people derive from ecosystems".* Besides provisioning services or goods like food and other raw materials, plants, animals fungi and microorganisms provides essential regulating services such as pollination of crops, prevention of soil erosion and water purification, and vast arrays of cultural services like recreation and a sense of place, (https://www.iucn.org/commissions/commission-ecosystem-management/our-work/cems-thematic-groups/ecosystem-services). Theories around relationships between nature and the social systems dates back in history and has been documented for a long time. For example, back in 18th and 19th centuries economists recognized the value provided by land and other natural resources as assets for production. Man, and Nature (1864) by George P Marsh is recognized as one of the founding works of the U.S conservation movement and was among the beginners in writing to formally address the relationships between natural and social systems. Marsh argued that an extensive degradation of natural systems by human actions would diminish human welfare, see (Johnson 2018 in https://www.britannica.com/science/ecosystem-services. The United nations (UN) Millennium, ecosystem assessment, confers the term as the outputs, conditions or processes of natural systems that directly or indirectly benefits or enhance social welfare, (ibid.). Ecosystem services can benefits people in various ways either directly or as inputs into the production of other goods and services. Bees pollinates crops, enhancing food production and is considered an ecosystem service, another indirect benefit can be the attenuation of flooding in residential areas that wetlands and the riparian buffers can offer.

With its small sized area of only 42.6 km^2, the Songosongo island is supporting a population of more than 6000 people, undertaking various human livelihood activities. This provides an appropriate and small sized setting to study the social-ecological, (livelihood-ecosystem's) interdependence outcomes, knowing that government, private institutions and the islanders themselves rely to a large extent on marine and non-marine resources. The UN millennium ecosystem assessment (2005) evaluated the consequences of ecosystem change and the conclusion was that "human have degraded the ability of Earth's ecosystems to support social welfare" (MA 2005). Though the natural gas itself is an ecosystem service (provisioning) all the processes and

activities to manipulate the potentials around it for the benefits of humanity have also triggered degradation of other potential services from the ecosystem on Songosongo island.

4. 2 What are perceived livelihood ecosystem services on Songosongo island?

This section portrays a range of ecosystem services that Songosongo men and women, identified as important for their livelihoods, currently and for years to come. In describing the benefits of the local island's environment, islanders spent most of the time talking of goods they could gather to either sell, use at homes or beneficial to them at their natural settings. They similarly, also discussed broader and intangible environment services such as regulating, supporting and cultural services.

4. 2.1 Ecosystem services

Many respondents commonly mentioned fish and firewood, as provisioning service from ecosystem, honey from forest bees, fodder, medicinal herbs, fruits and building materials such as building poles and roofing thatch grass, were all listed as important for islanders' livelihoods. Fresh water extracted from Panga kiza caverns was only source of fresh water for the islanders for many years, being extracted from there by hand. However, the Songas and PanAfrican energy Tanzania have provided processed tape water through water points (local calling them Viosks), in the village supplementing that from Panga kiza caverns. The caverns were the only source of fresh water for the islanders until 2016, when desalinated water was officially inaugurated to catter for the shortage problems in the village.

Another environmental service was the site for seaweed farming as provisioning services, seaweed farmers agree that the opportunity to farm seaweed as a livelihood strategy is because the environment is conducive and favorable. Discussions with respondents were also about several regulating and supporting services that links other benefits to successful livelihood strategies and an improved quality of life in the village. These included the local climate regulation by the village semi-forest part of the island that in turn bring favorable moisture through transpiration. However, the semi forested area talked about by the islanders is located in area where the natural gas plants currently are located.

Relationships between control of the wind speed coming off the ocean and trees was another important aspect of nature acknowledged as well. Other interviewees mentioned how nature plays a miraculous role of conserving and purifying water at Panga kiza caverns as supporting services, though an island is surrounded by salt waters in whatever direction one could face. This is actually fresh water in the midst of salt waters. Elders respondents really acknowledged this service, that Panga kiza had been the net source of life and life supporting machine on the island for many years to date, believing life on the island would be impossible in the absence of this water source. This was just to put more emphasis to the point mentioned earlier that processed water provided by Songas and PanAfrican energy Tanzania are there to supplement and reducing the load on the Panga kiza source, thereby reducing the village water shortage problem.

Not forgetting the vital role of nature to offers some species of plants with medicinal advantages to people favouring health for better livelihoods was as well acknowledged by the islanders. Culturally environmental role to bring pleasant environment for leisure, happiness and enjoying mind to mankind were in few cases addressed by respondents pointing to good beaches and the nearly small islands offering recreational sites for people to rejoice in nice oceanic winds and for swimming. Panga kiza caverns seemed to be a multipurpose area in function. It was mentioned as a sacred area where elders used to meet the island gods, for sacrifice, offerings and praying in times of calamities, in the belief that something bad had been or is being done on the island. Thus, gods are angry, and needed sacrifice and offerings to rectify the situation.

As indicated in Table 2, respondents identified bundles of various ES highlighted in the paragraphs above. According to MA categorization, all the identified ES are tabulated. From the respondents' views and perceptions some ES are currently not available at all or inaccessible, and some are less available than demanded with all the blame to the environmental deterioration on the island which accelerate in favors of natural gas extraction activities. Zonal restrictions and overpopulation due to in-migration of people on the island seeking for job in the natural gas plants were mentioned to be the potential causes of the inaccessibility and shortage of some of the ESS that were previously accessible or available in suffice.

Table 2: Summarized ecosystem services identified by Islanders and the accessibility perceptions of the islanders to these ES Songosongo Tanzania 2018

ES, Category	Name of ES	*Current accessibility*		
		Accessible	*Hardly accessible*	*Inaccessible*
Provisioning Services	-Food (fish in their kind, coconut production)		●	
	-Wood (firewood, charcoal, building poles)		●	
	-Building materials (thatch and limestone soil as roofing material and painting respectively)		●	
	-Water (fresh water, for drinking and domestic use)		●	
	-Medicinal herbs		●	
	-Livestock fodder		●	
	-Honey (from bees)			●
	-Site for seaweed farming	●		
Regulating Services	-Local climate regulation (rain, humidity and temperature control).		●	
	-Conserving water supply		●	
	-Biodiversity maintenance (including, rare spp of plants and animals)		●	
	-Air balancing, (O_2 release and CO_2 removal)		●	
	-Wind buffers (sub-forest part of the island)			●
	-Erosion control		●	
	-Water purification		●	
Supporting Services	-Pollination	●		
	-Nutrients cycling (creating a favorable soil for coconut production)		●	

Cultural Services	-Recreational sites			•
	-Sacred caves for gods worship sites			•
	-Pleasant environment for leisure		•	
	-Educational site (place for exploring new knowledge)	•		

Source: Field data adopted from MA (2005) and TEEB (2010)

Accessible, hardly accessible and inaccessible, though inappropriate to encompass all categories of ES, are categories used to show whether the Islanders are still enjoying the potential from a particular ES to the maximum of it *(accessible). If* only the fittest afford to use it the ES is *hardly accessible* and if the potential from ES is completely diminished on the island and cannot be reached by the islanders, *(inaccessible).*

4.3 The alteration of ES, costing people's livelihoods and wellbeing

Trade-offs between ES are commonplace. Any action to modify an ecosystem by altering one ES generally result in changes of other ESs as well (MA 2005). This can be explained by putting an example of the actions to increase food production which often involve one or more of these, increased water use, degraded water quality, reduced biodiversity, forest cover reduction, declining of forest products and release of greenhouse gases, (ibid.). On Songosongo island the case is to alter the explored natural gas which is deep under the ocean to beneficial usable forms for lives of mankind. This does involve modifying the island ecosystems. The modification of the island ecosystems to obtain the usable form of natural gas has led to alterations or deterioration of other various ecosystem services ranging from material to non-material things.

With a wide range of activities undertaken on the island, islanders in both settlement sides of Pembeni and Funguni perceive the island's environment and its associated benefits in diverse ways. Perceptions and opinions stressed out during interviews were basically embedded in habits of respondents driving them to use a particular environmental services and what type of service a respondent is benefiting from. So, it is crucial that people engaged in varied occupations had different perceptions on the benefits from the environment. This is similar to people using environmental products by habitual influences, for example few respondents addressed that they

like going to collect octopus not for money or any other genuine purpose but because they enjoy doing it for leisure. For others however octopi collection is a livelihood strategy.

Thabit Kombo Khamis is a watch guard in one the companies on the island said "*I like spending some time on the island beaches as my hobby for leisure and to have peace of mind and I do this every day after work"*. They also argued on how and what ecosystem services they benefitted from and an emerging change to the particular ecosystem services. Though respondents did not have unanimous meaning of what specifically, qualified as an ecosystem service, they do agree that there is a wide range of materials and services from the environment that have been beneficial for livelihood of mankind as described and tabulated in section 4.2.1 above. The islanders also perceive and agrees that the island's environment and its subsequent beneficial materials and services are changing over time and that the changes are predominantly negative. These changes in ecosystem services has direct impacts on lives of islanders as discussed by respondents.

4.3.1 Declining of fisheries products

Artisanal fishers and fish vendors talked about declining fish catch, compared to before the gas extraction on the island. Fishermen further complained about the zonal restrictions, that areas in the sea where they are now restricted in fishing are areas of high fish catch. The fish vendors on the other side were unhappy about this because it is the only activity they depend on for their livelihoods.

"*This shortage has caused only the giant in business to buy fish from fishermen offering unbeatable price for we small fish traders to compete" a woman fish trader at Dabali juu landing beach argued.*

The shortage is not only affecting artisanal fishers and fish vendors, "*consumption of fish protein at our homes has been in one way or another hampered as well, by this catch decline" argued another respondent in Songosongo local market.* Fish shortage is attributed by an increasingly in-migration of people to the island which increased the fish demand, within an environment of declining stocks. Late in 1990s to the beginning of 2000s there were only few fish traders who transported fish to the nearby small towns and centers on the mainland like Kilwa kivinje and Kilwa masoko hence only a small portion of the landed fish on the island's beaches were

transported out of the island with a big portion remaining which easen the availability for local consumption.

In 2005 the extraction, processing and the transport of natural gas commenced on the island. This came conjointly with a high influx of people from various mainland parts, and the fish prices in Songosongo villages went up due to the increased demand. The demand went up as fish were required to feed many people in camps of different companies established on the island as a result of the extraction activities.

The District Fishery Officer disagreed with the reasons for the declining of fish given by the islanders. For him the fish catch decline on Songosongo island is to large extent caused by the illegal fishing which does not applying sustainability principles. To mention a few, fishing methods, the use of illegal fishing gears, such as drag nets, dynamites fishing, and using fish net with small mesh size, all together have posed a serious problem in the fisheries along the Tanzania coast, as they destroy important habitats for fish and marine ecosystems in general. He also mentioned the long-term trend of overharvested fishery resources along the coast of Tanzania as an overall driver of fish scarcity.

4.3.2 The loss of recreational sites and resettlement

Recreational sites such as Funjovi islet as an example, was an important leisure area for local people and a resting place for fishermen it is now privatized and a foreign hotelier is running a tourist hotel, and all local people inhabiting the place before were resettled to either Pembeni or Funguni and no compensation was paid to resettled families. Complaints on the lack of compensation were also addressed by the village chairperson during interviews arguing that his family was victimized to lose the family land that were used for different livelihood activities also related to the gas plants.

From our talk he said "*my father was forced to agree and receive compensation set by the agreement between the natural gas processing company (Songas), and the government without having to listen to the arguments from the land owner side. In fact, my father didn't want to completely sell land and the coconut trees on it to the gas company but he preferred leasing on contracted basis. Also, if the project phased out, the family should have the land back again. But this was completely ignored while the compensation the family received was too small compared*

to the size of the occupied piece of land and the number of coconut trees grown on it". This contested piece of land is currently an accommodation camp site for Songas and PanArican energy workers and for Songas sub-office in the village. The Songas main offices are found/located in Dar es Salaam.

4.3.3 Pollution and loss of sites for seaweed farming

Key seaweed farmers poignantly stated that seaweed farming on the island is an important livelihood strategy. For years to date women on the island farm seaweed and use it as an income earning activity. Seaweed farming help to fulfill household's essential needs like food and shelter for female-headed households, and for male-headed the income supplements the family income. However, seaweed farming in recent years has encountered a pre-harvesting rot (die-off) of the seaweed which leads to decreased harvests. Seaweed farmers blame the extraction activities considering it as the potential polluter of their production sites in the shallow inter-tidal areas where it used to grow well.

"*Previously we experienced no such a pre-harvest rotting of seaweed, the problem started to emerge around 2012 almost eight years after the natural gas extraction, processing and transportation activities were put into operation. The duration I think is enough for the directed chemicals and rejected materials from the plants to ocean to show or reveal the polluting effects" said Zainab Kombo Hassan 40 years old seaweed farmer on Songosongo island.*

Msuya and Porter (2014) stressed that the main causes would be the species sensitivity to fluctuations in environmental parameters leading to die-off attributed to stress. Rapid variation in environmental parameters in the seaweed farms, fouling, surface run-offs, epiphytisim, use of the same cultivars for many years and cultivating in the same area for an extended period of time have also been suggested as causes of seaweed die-off in Tanzania and elsewhere (Msuya et al 2014). Farming seaweed near the gas field and around the side of where the gas plants are located, is strictly illegal, and farmers now compete for the sites for establishing their seaweed farms, in other side of the island.

4.3.4 Scarcity of animal fodder and the collapsing of gardening

The alteration of ES was also evident in the local animal rearing on the island, where the animal keepers experience a fodder crisis. Livestock keepers on the island state that they have been automatically forced to practice free range systems in their livestock management. Cattle and goats in addition of poultry are the common livestock available on Songosongo island. Due to fodder shortage on the island, animals are left to move free here and there seeking for grass and vegetations to graze and browse respectively. The roaming animals will return to their respective homes for water.

Scarcity of fodder is leading to poor animal conditions and hence poor quality of the animal products. As a result of the free range practiced on the island, the gardening which was a livelihood strategy, for most women as has collapsed due to the free animal movement. The collapsing of gardening created a scarcity of vegetables and fruits which are important components in people's diets. Currently, all vegetables and fruits available in Songosongo markets are imported from mainland, implying extremely high cost for local islanders.

4.3.5 Decreased forest products

The availability of forest materials such as building poles, fuel wood medicinal herbs and honey from forest bees are all constrained in access. Forest-honey, and many plant species that were previously used as traditional medicine for diseases curation are diminishing. Fuel wood which still a dependable source of homes cooking energy is diminishing and scarcely available on the island. Like for water, women in Songosongo village spent much of their time seeking for firewood as a source of cooking energy and heat in their houses. An eminent cause of this is an increased number of people triggered by high population growth and birth rate and the in-migration of people hoping for jobs in the gas plants. There are also a majority of people who live in the village involved in fishing activities. All the cooking on the island and houses heating depend on either firewood or charcoal. Both firewood and charcoal are found in the small uninhabited part of the island consisting of natural and spacy forest. However, this small forest seems to be currently depleted with an excessive cut down of trees and other vegetations. This reduce the vegetation cover making the land bare which increases the susceptibility of the land to be easily eroded. Apart from the exploitation for building material, firewood, and charcoal making to secure cooking

and heating energy at homes, reduced vegetation cover at Songosongo was also influenced by land clearing by the Songas during the early stages of the natural gas project establishment, for the underground pipeline which is the carrier of extracted and processed natural gas to Dar es Salaam.

Figure 11: A land clearing in Songosongo island Tanzania 2018

Source: Field data

Though electric power has been supplied in most houses on the island the electric power is not used for cooking. Most of the households with power connection in their houses, use it for lighting. They also use power to run small electronic devices with low power consumption such as TVs, Radio and for recharging their phone batteries. Some complained saying although they can afford buying electric cooking accessories and others having them already in their houses, the power supplied in their houses is of low voltage ones to run the kitchen devices. Being supplied and used in free of charge terms, the suppliers have set power consumption limit to local users, prevents power to be used for other electric accessories in houses.

4. 3.6 Air pollution and reduced nutrients cycling affecting coconut production

There was also an attribution of the nutrient cycling as ecosystem service with poor harvests of coconuts in recent years. Coconut planters and cultivators do believe that frequently air pollution from unknown particles from the gas plants which often cover the whole island is directly affecting the lives of living beings, human being inclusive, but effects is more intense on the coconut trees may be because of the height factor so that the coconut tree receive more direct of pollutants. As a result of this there are few fruits per tree and many palms do not produce coconuts at all. The situation was previously not observed in the area.

4.3.7 Loss of sacred groves and traditional beliefs

Panga kiza caverns offering both supporting (water conservation and purification) and cultural (as sacred and holy place) services. There are many foreigners of the area that come from different cultural perspectives, traditions and belief on the island. These local groves are no longer sacred as it was previously. This has in one sense diminished its cultural services to inhabitants who considered the places holy. Turning to supporting services the caverns also conserves and purifies water. It is the one and only site on the island where people can extract naturally made fresh water for home consumption. There are negative changes to this service which actually is difficult to directly link to extraction disturbances it is observed water coloration with unpleasant odour from two of the caverns among the four this water was unsafe. The time I was there only two caverns were serving the islanders in joint with processed water in the water viosks available in the village. This issue is further discussed below.

4.3.8 Songosongo an education site for research

The consequential changes in ES where the extraction activities are seen the major disturbance has influenced most ES changes to the negative. This is contrary to educational service (a cultural ES) on the island. Education services has been identified to undergo a positive change over time since the start of the natural gas activities on the island. According to informants there are many researchers and student researchers visiting Songosongo for research purposes. Many are trying to explore new knowledge about Songosongo, since the start of natural gas activities in the area. Local people perceptions on this however, is that there have been no livelihoods benefits from the

many scholarly researches conducted on the island. Nevertheless, the island has been highly promoted to the outside world making it famously known. This is a reason people in the outside world imagine high development attainment at Songosongo as opposed to reality argued WEO Songosongo (2018).

4.4 The role of governance and the capacity to manage ecosystem resilience

Governance is seen as "steering" and there is an element of authority being involved (Vatn 2015). Agrawal and Lemos (2006) confers Environmental governance as a set of regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes. In Tanzania, the National Environment Management Council (NEMC) sits under the Vice President's Office is and the highest national entity responsible for all issues regarding environmental governance in the country. The main role of this entity is to provide advice on all matters pertaining to environmental conservation and management.

The NEMC is the leading technical advisory, coordinating and regulatory agency responsible for the protection of the environmental and sustainable use of the natural resources in Tanzania. It is responsible for consultation, collaboration and partnership arrangements with other entities concerned with environmental matters and the public at large, and for facilitating and promoting such measures as necessary to help achieve an important quality of lives for Tanzanians through a clean and undegraded environment. NEMC has been mandated both authority and all the regulatory processes and mechanisms to influence environment actions and outcomes it is thus a hub for environmental governance in Tanzania.

However, the study findings unveiled that NEMC lacks a system channel to coordinate and monitor of environmental issues at local administrative levels like Songosongo village. The United Nation Environmental Programme (UNEP), concur and states that Environmental governance should comprise the rules, practices, policies organizations and institutions that shape how humans interacts with the environment (UNEP 2009). Governance is thus more than Government (Agrawal and Lemos 2006). Although natural resources and environment departments do exist at district level, there is no working harmony between NEMC and these departments. The District Departments of Natural Resource and Environment perform their environmental and natural resource related roles independently but under the District Executive Directors (DEDs).

While NEMC sits in the Vice President's office in the Environment Department, District authorities are in the President's office, Regional administrative and Local governments (PORALG). These are two different offices differing in ministry budgetary priorities and working systems. Good environmental governance needs to take into account the roles of all actors that impact on the environment. This involve the government, NGO's the private sector and the civil society. Cooperation is critical towards achieving an effective governance that could aid a move towards a more sustainable future (UNEP 2009) and maintaining the system resilience.

4.5 Conclusion

To sum up, this chapter discusses that the natural exploration, extraction, processing and transporting activities on the island have conjointly affected the environmental aspects of the island. Generally, the chapter covered the first research objective (objective **a**), carrying the three research questions 1, 2, and 3. The focus has been on the environmental benefits (ecosystem services), which help in making people's livelihoods and human wellbeing. The impacts of extraction activities to these ecosystem services and the related costs people incurs in their livelihoods and wellbeing were also argued for in the chapter. Similarly, the chapter has highlighted on the environmental governance issues. The environmental governance system in Tanzania and the roles played by this entity to maintain system resilience.

CHAPTER FIVE

EXTRACTING NATURAL GAS, PROCESSING AND TRANSPORTATING AND IMPACTS ON LIVELIHOODS OF LOCAL SONGOSONGO ISLANDERS.

5.0 Introduction

This chapter present and analyses the research findings on livelihoods based on research objective **(b**) and **(c)** and their subsequent research questions. The analyses of the findings in this chapter is mainly focused on the impacted social and economic aspect influencing people's livelihoods by the natural gas exploration, extraction and processing carried on the Songosongo island. Thus, in light of the sustainable livelihood approach theory and research questions, the discussions expand from highlighting important livelihood strategies for male and female on the island. The gender influence on livelihood activities, the contributions of natural gas extraction to local livelihoods, the corporate social responsibilities (CSR), supporting livelihoods and the economic outcomes of people livelihood activities**.**

5.1 The livelihood activities for Songosongo islanders

Songosongo island is in a rural setting, hosting one of the largest petroleum projects along the East African coast. Like other rural households in the country, the 6600 people in Songosongo combines a diverse set of income generating and social activities in constructing a portfolio of livelihood activities to meet and possibly to enhance their livelihood outcomes (Zhang J, Yi S, Paudel B, Khatiwada R. J, Khatiwada P.S and Deng W, 2017). About two-thirds of the world's poor people is residing the rural areas in low-income countries. They basically depend on subsistence farming and other natural resources for their livelihoods (Zhang J, et al, 2017). People are often poor and deprived with a minimum standard of life due to low farming productivity and limited accessibility to non-farm income sources which increases their vulnerability to poverty. While poverty is a multi-dimensional issue, the relationship between assets holdings activities and economic outcomes generate a household's livelihood strategy and outcomes.

This section portrays a range of activities that Songosongo islanders undertake to ensure income stability for livelihood. The geographical setting of the island was found to have great influence on the nature of the livelihood activities on this island. Generally, households put more efforts in

both marine and land-based activities to generate income, households' efforts are on exploiting both land and marine resources for a living, either in combined or in specific activities. However, a large proportion of households in the village assume a combination of more than a single livelihood activity for income generation. Table 3 describes a diverse of livelihood activities and outcomes identified during my fieldwork on the island.

Table 3; Summarized livelihood activities undertaken for a living on Songosongo island Tanzania 2018.

A livelihood activity	*Nature of the livelihood activity*		**Gender**	
	Land based	*Marine based*	*Male*	*Female*
Fishing		✓	❖	
Seaweed farming		✓		❖
Formal and informal employment	•		❖	❖
Practicing agriculture on mainland	•		❖	❖
Gardening	•			❖
Fetching water for sale	•		❖	
Transporting people and goods in and out of the island	•	✓	❖	
Octopus collection		✓		❖
Keeping livestock and poultry	•		❖	❖
Food-selling (informal restaurants)	•			❖
Shops trading	•		❖	❖
Groceries	•		❖	❖
Carpentry	•		❖	

Building and repair fishing vessels		✓	❖	
Selling fried fish		✓		❖
Guest-house trading (room renting)	•		❖	
Barbershops	•		❖	
Tailoring	•			❖
Mobile phone financial services	•		❖	❖
Collecting of shells		✓		❖
Fish processing and transporting		✓	❖	❖
Importing cloths and shoes for sale	•			❖
Importing of vegetables and fruits from the mainland	•		❖	❖
Remittances	•		❖	❖

Source; Field data Songosongo island 2018

Livelihood on Songosongo island entirely depend on a range of livelihood strategies and social activities (see Table 3 above). These livelihood strategies are basically marine or land operated activities as influenced by the geographical positioning of the island. Major marine based strategies are such as fishing, octopus' collection, and seaweed farming while the major land operated livelihood strategies include farming on the mainland, livestock rearing, formal employment and small scaled businesses of their kinds on the island. Both marine and land-based livelihood strategies are in some households used in combination to raise households' incomes. For instance, it is possible of finding a household here with the father is an artisanal fisher, mother a seaweed farmer and their children both living together engaging in other income generating activities like small scale businesses.

5.1.1 Land operated livelihood strategies

Livestock keeping on the island is practiced by a small proportion of households and the animals kept play an important role as a savings and an income security sold as the last option at the time an immediate income is required in the household. Animals kept are cattle goats and chicken. Cattle and goats are often owned by men whereas chicken are mostly owned by women. Cattle and goats can be sold when household is in need of an immediate income, chickens are purposely for directly consumption especially when fish availability is running scarce. Chicken can also be sold to resolve small financial issues.

Some households were found practicing agricultural activities through having farms on the mainland side and crops such as cassava, cashew trees, rice, millet and vegetables are grown. Households practicing farming on the mainland side are often those who migrated to the island in recent years from the mainland, and thus they would have access to land for agriculture that they used to own prior to their migration to the island. These are also people who have access to land resource on a rent basis to land owners on the mainland. Islanders women are used to marine way of life such as octopi collection, fish processing and selling, shell collection and seaweed farming, and find it difficult to manage on-land farming like on the mainland.

Gardening were once a livelihood activity mostly for women and they used to grow mainly vegetables such as Chinese cabbage, cucumber, amaranths and okra to mention few, which they used to intercrop with maize (corn) crop. Gardening depended entirely on rains with supplemented irrigation using water from the panga kiza caverns. However, the time I was there gardening was no longer operated on the island. When I asked about the abandonment the response was because of animals are moved freely, grazing everywhere on the island. They used to control problems from livestock destroying their crops by fencing their gardens using makuti. *Makuti* are the coconut leaves. As a result of degraded environment on the island fodder shortage to livestock increased and cattle and goats which are in a free free-range system started to destroying the makuti fence and graze on their plants. This silently killed gardening on the island.

Songosongo is water locked land inhabitants on the island depend on imported materials from the mainland found more than 20km away. All food and groceries come from mainland markets to the island market for sale. There are a number of households both in Funguni and Pembeni, owning small grocery shops while others are running guest houses, and bar businesses. In both residential

parts there were *mobile phone financial service shops*, where people do their money transaction through mobile phones (sending and receiving money). One of the two was actually beyond mobile phone financial services, it served as a NMB (*National Microfinance Bank*) agent providing some banking services (cash withdrawals and deposits could be done like in a bank branch) and I was personally able to withdraw some cash as well the time I was on the island.

This seemed very helpful especially to government employed islanders and those working in the gas plants that get paid their monthly salaries through bank accounts. Thus, there is no need to travel to district headquarters, Kilwa masoko for cash withdrawals. There are small scale business kiosks selling home items such as cooking oil, maize (corn) flour, wheat flour, juices, bottle water, soft drinks, beans, rice and cereals. There are also shops for clothes and shoes, tailoring, carpentry and construction and repair of fishing vessels all constitutes the small scaled businesses forming livelihood strategies on the island. Close to the landing beach is the Songosongo small market, where vegetables and fruits imported from the mainland are sold.

In the sampled household, only four households found engaged in coral lime making, used as building material in construction sector. However, my respondent told me that making and selling coral lime is a good business but depend on other income generating activities to do better and increase household's incomes which in turn stimulate the repair and building of new houses.

Summing up the livelihood activities operated on land (land based), one of the benefits locals enjoying from an extraction activity in their area is to get employed for some few islanders at the gas plants. A few among them had been employed as surveillance boat operators, while others in the plants as assistant operators. These are few and I was informed that, they got employed as formal plant workers influenced by the education level they had attained. To the majority who have only primary school education, they would end up being employed as unskilled labour, while others serving in catering companies which provide food services for the plant's workers in camps and security guards from security companies contracted to provide security services at gas plants, gas wells, camps and at the airstrip. Security guard's employment was also observed but more for men than women. I also noticed many employed in this section come from mainland compared to native islanders.

5.1.2 Major marine dependent livelihood activities

Artisanal fishery is the major livelihood occupation for most Songosongo men, providing households income and it is the main source of food on the island. From the fishermen households responded to the interviews, the income obtained from fishing range from 200,000- 250,000 TZS, equals to approximately 100USD, per household per months. This amount alone is too small to serve as the household's total cash requirement for the entire month. This is also a reason why many households combine fishing with other strategies to the raise household's income.

In terms of the number of households involving in fishing activities on the island, artisanal fishing is the main marine resource-based livelihood strategy, as the island is endowed with abundant and diverse of marine species, (Darwall 1996). More than 80 percent of the sampled and interviewed household's heads found involving in fishing or fishery related activities as the major income generating activity.

Fishing on Songosongo island is locally undertaken with the help of simple and locally made gears and vessels such as canoes, dhows, small sailing boats, while a few use motor engine driven boats. They often use simple gears to make their catch like traps, hook and line, nets and spears, others conduct diving fishing in shallow waters to hand catch some slow movers fish including octopus. As a result of inappropriate fishing gears used, fishers on the island are basically conducting subsistence fishing, and selling small amounts of their catch to fish vendors and businessmen who then transport fish to the big centers markets such as Kilwa town, while businessmen can transport catch as far away as to Dar es Salaam.

Some fishermen enter into a so-called exploiting support from businessmen who provide artisanal fishers with fishing gears, vessels, cash, food and other small requirements so that all the catch should be brought to them to buy at fixed price that their maximize profit. An independent Songosongo catch records does not exist, I requested the data from the local fisheries resource officer, but no records even if fishing is as important livelihood strategy throughout the whole Songosongo. Collecting of octopi, shells collection and seaweed farming which are discussed in next sections are all components of marine-based occupations that form livelihood strategies on the island. Although fishing is prevalent in many households and commonly understood to be male occupations the next three were also very important for female income generating activities on Songosongo island.

5. 2 Gender based livelihood division on Songosongo island

It has been observed that gender bias, which is socially constructed, is a determinant of what is considered appropriate occupation for men and women. Thus, this has resulted into both men and women exclusion from some of the productive activities on the island. From direct observation of women activities and through the conducted conversations with women during my fieldwork, some gender issues were evident on Songosongo islanders' ways of life regardless of the livelihoods and women contributions to the household's income. These issues include those based on division of labour by gender and decision making in the family authority. This is a socially constructed phenomena with some activities considered women work and others for men, while women decisions to engage in some livelihood activities strongly depend on men's influence.

Songosongo women for instance are not involved in fishing which is a major and prominent livelihood activity to the island's inhabitants. This was considered as men occupation since eras of their patriarchs *(grandfathers*), and is still passing from one generation to another. Although some women on the island collect octopi and shell it is not considered as fishing activity. As it was stated earlier, a large number of employed women in the gas plants and the associate companies are from the mainland. Songosongo islanders are mostly Islamic, thus adopting and practicing Islamic norms, values and general ways of life. These norms recognize women as house keepers, carrying more reproductive than productive responsibilities.

This was one among the responses given to the question I posed to my respondents when I noticed that many women employed in the gas plants and its associate companies on the island are from the mainland, and that the few from Songosongo were single (not married). Other responses were, married women on the island are not allowed to work at the gas plants by their husbands, because they don't trust other men working at the gas plants. Other men in the conversation added on, our religion principles and fundamental beliefs does not allows us to give *permission* to our wives to work far from home, that is why men here at Songosongo give their wives some capital for small business at homes like shops for small home items, selling fruits and fish frying and selling at evening hours, and that the business must be conducted around the domestic compound. The Songosongo local market where vegetables, fruits and some food components imported from the mainland like yams, cassava and potatoes are sold, is dominated by women from the mainland

who transport the products from different parts of the mainland such as Kilwa town, Somanga, Nangurukuru, and as far away as Lindi to fetch better price on the island.

5.2.1 Works and activities considered for women on Songosongo island

It has been argued that in Sub-Saharan Africa there is a very strong gender or sexual division of labour in reproductive and domestic works (Whitehead 2001). Rural women in these countries spends between an estimated 4 to 5 hours a day doing domestic chores such as fetching water and fuel, preparing food and looking after children. Contrary to that the number of hours men spend with such similar activities are totally negligible.

Towards the end of 1990s and at the beginning of 2000s, women on Songosongo island were just involved in handcrafts and other tasks associated with their reproductive responsibilities just around their household's compounds (Besha 2002). However, they are currently involving in more than the latter tasks. It is now possible to find Songosongo women in seaweed farming, collecting octopi and in small scale businesses like selling processed and fried fish and shops selling.

5.2.2 Seaweed farming the women livelihood on Songosongo island

Seaweed locally called *Mwani* was first introduced in Tanzania in 1989. It was the people in Zanzibar island who started to farm seaweed when introduced in the country for the first time from the Philippines with two main species *Eucheuma denticulatum* and *Kappaphycus alvarezii*. These two species are commercially known as *Spinosum and Cottonii* respectively (Bryceson 2002). On Songosongo island however, the seaweed farming started in 1996. It started as an alternative economic activity following the declines in fish catches (Msuya and Porter 2014).

Using seeds from Zanzibar the *Kappaphycus alvarezii* species was introduced and people started to farm this on Songosongo island, both men and women (Ibid.) Seaweed farming expanded fast on the island immediately after the introduction and Songosongo became an important part of Tanzania for seaweed farming as it used to produce large volumes of *Kappaphycus alvarezii.* The species is the most preferred in the world market owing to its stronger gel, kappa carrageenan than that from *Eucheuma denticulatum*, iota carrageenan and thus, fetched a higher farm gate price.

In 2003, the production on Songosongo island went up to reach a maximum of 423.9 tons per year bringing almost 82,000 US$ to farmers (Msuya et al, 2014). Seaweed farming on Songosongo had

proved to be an important livelihood activity to people especially women as most men dropped out from seaweed farming as the price started dropping down while at the same time the crop disease locally called *kuoza (die-off)* started affecting crops in farms. Being a small island farmer on the island which were mostly women had few livelihood alternatives and they adopted seaweed farming when it was introduced to the island in 1996 (Msuya et al, 2014). And persisted to farm the crop to date regardless of the factors which made most men to drop out.

5.2.2.1 The farming sites

Farming of seaweed is usually carried out in the shallow intertidal areas where the frequent flushing of water for good growth is available. Farming is done during the spring low tide when the tide is out. At this time the water level is appropriate as seaweed need to be submerged all the time which help to avoid an excessive exposure to the air that may led to stress to the seaweed and diseases as well. When tides come in the farmers have to move out of the sites, and if there is harvested seaweed it should be immediately taken out of the farm to the beach or taken straight at home. The suitable areas for farming according to farmers are those with sandy substratum to enable fixing of the wooden pegs in the substratum. An ideal area for seaweed farming water should be clean, free from pollution and turbidity since the species farmed are sensitive to pollution and also enough sunlight.

Farming seaweed in the shallow intertidal areas is referred to as peg and line or off-bottom method. This is a method commonly applied by seaweed farmers on Songosongo island as well. The method uses nylon ropes with seaweed being tied between the two wooden pegs. Nylon ropes of diverse length is stretched and tied to two wooden stakes that are anchored into the ground 20cm to 30cm below water surface at the shallow and low tide to avoid the crop getting exposed to direct sunlight. Farmers usually use pegs from the mangroves and other land-based plants.

Figure 12: A woman in her seaweed farm preparing seaweed branches for planting Songosongo island (Tanzania 2018).

Source: Field data

Farmers using this method argued that the method is more reliable and cheaper than other methods which requires higher investments and/or deep waters. This is a challenge to women who dominate this livelihood to reach such deep waters and do farming as well. The method is generally considered an environmentally benign when compared to other forms of mariculture (Bryceson 2002). According to farmers, one cycle of seaweed farming takes a maximum of six weeks and farmers can produce up to eight cycles a year. Die-off occurs mostly the in the season following the heavy rains season which is March to May. As from Msuya et al, (2014), this is probably due to fluctuation of environmental parameters including sedimentation from run-off, increased salinity in water, and the fluctuating temperature during such periods. In 2018 when I was on the island for my fieldwork there was only a single Philippine based mariculture company buying seaweeds from farmers. The company bought seaweed using Tanzanian agents who collect the seaweed from farmers and storing it in warehouses on the island waiting bring exported to seaweed

processing plant countries. The selling price on the island was 500 TZS/kg equals to 0.23 US$/kg of dried seaweed.

5.2.2.2 Institutions governing the farming process

Entry to seaweed farming is free, and sites to farm seaweed on the island is free of charge. Any villager can go to the sea and start farming where there is space. The farmed area will then belong to the lines owners. The village by-laws of farmers help in protecting each other's farms and farming areas against intruders. There is no seabed land demarcation like on land farms to which every piece of land is a property of the owner and can remain unplanted or a fallow if the owner has planted nothing on it.

An established farm is a property of the owner but after harvest and if there are no lines on the site it become a free property or open access resource that anyone can use. Prior to natural gas activities farmers used to do farming in the same areas as they lived. Someone from another side of the island could ask for a farming space from farmers of that particular side. There are no licenses or seabed land purchases. For now, farming seaweed can be conducted only in part of Pembeni as the farming site in Funguni is under the natural gas plants territory.

5.2.3 Other female activities on the island

Collecting octopus is a recently conducted activity by men and women on Songosongo island. It is one of the few marine based livelihood activities which has been deemed woman work/occupation. Women on Songosongo believe collecting octopus is a livelihood they inherited from their mothers, and grandmothers. It is a livelihood activity existed earlier than seaweed farming, but with an introduction of seaweed farming many women islanders withdrew from octopi collection and started to farm seaweed instead. Collecting octopi is tedious and a skilled activity which involve catching the organism in the inter-tidal reef flats and the sub-tidal inner reefs.

According to respondent's narratives the octopi collection is conducted mainly during spring tides. Octopi are collected and sold for local and inland consumption and when the collection is high octopi are exported outside the country by large scale businessmen even as far as Europe and Far East. The tasks need skilled and traditional knowledge helping collectors to recognize the holes

where the octopus hides. Octopus live in small holes and crevices which mostly are found concealed with small stones and sometimes with pieces of shells thus, the collector has to walk over the reaches of the inter-tidal reef flat and along the reef edge to spot holes and crevices containing octopus inside. A slender stick and metal spear are the local gears that the collectors use to catch the animal from holes and crevices and it is the simplest method of octopi fishing that most women apply in fishing octopi on the island. Some men dive in relatively deep water to catch octopus in their holes, only a few women manage to use the diving method.

In the discussion there was a claim about the decline of octopus catch in recent years. However, when the question was posed to the Fisheries Resources Officer on the decline issues, the responses were that the use of illegal fishing mentioning diving as one of the methods, which have been destroying the breeding sites of octopi through hampering the animal's ability to reproduce that could replace the harvested population. He also talked about an increasing number of artisanal fishers involving in octopus fishing (collectors) due to high octopi demand especially in large towns such as Lindi and Mtwara and in Dar es Salaam city.

Fish frying and selling is a small-scale business carried out by women on the island as it requires some small capital to start the business. Women buy fish from fishermen, process and fry them to sell the fried fish around home compounds, while few women allowed by their husbands or unmarried to take fish to the island's business centers during evening hours for selling. Both Pembeni and Funguni have small located areas where small-scale businesses are conducted. Fish salting and sun drying is another fish processing activity on the island. After salting and sun-dry the fish is transported to the mainland for selling. This type of processing requires high capital and mobile businessmen and women thus, it automatically become men dominated business with a few women based on the mainland.

This is because the married women need permission from their husbands to travel. The setback claimed by women on the fish business livelihood was the difficulties to get fish from fishers who often sell their catch to middlemen who follow them into the sea before they settle on the landing beaches. Thus, they often land on beaches without fish in vessels. Middlemen transport fish to Dar es Salaam and other markets on the mainland and they have enough capital to robe fishers to sell the fish to them, and not to women fish vendors.

Fetching water and firewood collection are women work also as for many other parts of the country. People in some societies in Tanzania do believe that all activities associated with home cooking are women activities. Men are responsible to bring food items but the preparation of that foodstuffs until bringing it to the table as a meal are women tasks. On Songosongo island the water is fetched from either Panga kiza caverns or from the water points in the village for the desalinated water provided by Songas and PanAfrican Energy Tanzania companies. Due to high population water supply on the island is insufficient. As a result, men and boys took it as an opportunity to make a livelihood strategy by fetching water from the caverns carrying it on their cycles (bike and motor) to sell to people in the village for home consumptions. Water selling is a livelihood activity to most boys on the island, with some fetching water on the island and transport it to the nearby islets which are parts of the village but having no source of fresh water. The time I was on the island the price of water was 500TZS/20 litre bucket when sold on the island and 1000TZS when transported and sold to people at the nearby islets. This price equals to 0.23 and 0.45 US$ respectively.

Figure 13: The Islanders fetching water in the caverns area Songosongo island Tanzania 2018.

Picture A, (selling water).

Picture B, (water for household's use)

Source: Field data.

Women spend most of their time on other responsibilities such as taking care of kids and elderly relatives, taking of the general households including cooking, housekeeping, washing cloths of both children and their husbands, preparing bed for husband to sleep and preparing bath water for their husbands. Most activities deemed as women work in the society are invisible and mostly unpaid. When men perform some similar activities like fetching water and firewood collection, they normally do them for business purpose.

5.2.4 Fishing, men's livelihood activities on the island

On Songosongo island, fishing is the main livelihoods activity for the bulk of men islanders. It is also the main source of food and income in most households on the island. Fisheries on the island is diverse and rich, and it also contributes to the foreign export in Tanzania. Various methods and fishing gears are employed which includes the locally called Ulimasi fishing, fishing from small vessels and fishing from vessels driven by an engine. The most common fishing gears used are hooks and the wickerwork fish trap, line and hooks, gillnets and also prawn trawlers.

From the discussions with my respondents' different forms of fishing are operated on the Songosongo island. These forms include gill-net fishing. Fishers use nets with different length sizes usually from 200-1000 m long, and the mesh sizes vary from 5-8 inch. The length size of the nets is directly influenced by financial ability of fishers. The nets are usually set on the seabed using markers on the water surface. Fishing by nets with such mesh size is specifically for catching larger, deep water species such as groupers, sharks, rays and snappers. The nets are set away from reefs at 10-40 m depth overnight and the hauling is done in daytime. Few fishers are capable of this type of fishing as the methods requires high seed capital. Vessels with engine are used in this form of fishing.

People also fish by using lines and hooks. This is considered a fishing method for the poor due to inability to buy fishing gears which enhance high fish catching at time like in gill-nets methods. According to fishers 4000, TZS is the minimum amount of money for a fisher to have both the line and the hook and hence can go to sea and start fishing. By contrast, using nets a fisher will have to spend at least 120000 TZS as seed capital to start the fishing activities. Fishing by lines and hook only a small vessel capable of carrying the maximum of three people are used. Lines and

hooks are considered the fishing method for the poor on the island and other coastal parts in Tanzania, and *Ulimasi* is the lowest form of fishing conducted by the poorest people.

It is called Ulimasi in their coastal local language, and means the method where fishers only own one fishing line. He often leaves his house for fishing with his fishing line only in the hand, and often without any vessel. The fisher walks to the nearby reefs and start fishing by walking using feet. The fisher normally stands on the reef and throws the line. The method does not ensure good catches and it is often more like a subsistence fishing. Fishing vessels in some cases owned by other people calling them *Tajiri* (a rich man), not the fisher themselves who make the vessel crew. The Tajiri give their vessel and sometimes the nets as well to one fisher and he will look for other fishers to form a crew. An agreement on such a situation, is that the catch must be shared between the fishers who form a vessel crew and the *Tajiri.*

I also observed in some occasions that one of the crew members also would be a Tajiri (a vessel owner). This could make him receive twice the shared catch, and if the Tajiri provide both the vessel and the nets then he will receive thrice of the shared catch, because the distribution also involve the net maintenance share, so he receive the net maintenance share, the vessel share and a share as a fisher or crew member. People also fish prawns in the island vicinity by using prawn trawlers. According to the District Natural Resources and Fisheries Office data there are only a few vessels licensed to conduct prawns fishing in the Tanzania waters of the Indian ocean. Of the few odd vessels licensed in the country, one third of the fleet might be operating in the shallow areas of the Songosongo archipelago mainly towards the mainland (Songas 2011).

Songosongo island is one of the main centres in Kilwa District for fish collection and catches. Fisheries products from Songosongo are considered the best in terms of both quality and quantity compared to fisheries products from other collection centres in the District. Although there were no current data on catch quantities specifically from Songosongo island, centres around the archipelago were estimated to yield 3 tons of fish per month during the low season and 5 tons in the high season. Fish price on the island was 5000-5500TZS, per kilo the time I was conducting my fieldwork, and it was relatively low compared to other centres on the mainland. For example, Kilwa kivinje the nearby centre to Songosongo the price range between 6500-7500 TZS per kilo. Fish price varied with type of species.

Apart from fishing, about 5 percent of Songosongo villagers particularly men, involve in small-scale lime making as an income source as well. Lime is made from coral which is mined from the sea using local tools and burnt to lime. Lime is used as construction material in the village. To produce lime, coral is burnt by using wood as fuel. But with an increased human population in the village there is an anticipation of more damage to the environment as lime makers destroy the live corals and cut down trees to obtain wood fuel to burn corals.

5. 3 Contributions of extraction activities to household's incomes

This section the study portrays how natural gas extraction, processing and transportation to Dar es Salaam activities make livelihoods to local the Songosongo islanders. The findings revealed that, a majority of people inhabiting the Songosongo island are self-employed and depend on fishing or seaweed farming. Few people earn incomes from paid employment and casual labour from exploration activities or public services. Although exploration activities within the area have provided some temporarily employment opportunities to youth islanders, the direct contribution of gas activities for livelihood incomes for households has remained to be very low. Only a negligible number of islanders got employed in the gas plants in a formal Tanzania employment terms thus, only a small percent of the island's household's income is directly coming from extractions activities.

However, there are various indirect opportunities created by natural gas activities on the island which help to generate or enhance income savings for the islanders. Sosovele (2010), revealed some interesting of economic aspects that indirectly touches islanders' livelihoods. These among others include opening up of business activities and connections between islanders and people on the mainland. For instance, currently most people on the island owns durable goods, as compared to the years before the gas project was started. With electric power availability on the island ownerships of electronic appliances such as TVs and mobile phones has significantly increased.

These appliances are also used as income generating tools in the village. For example, due to an increased number of people in the village resulted from the established gas plants TVs are now used to generate income for some of the households by running video shows businesses in the village. I observed people paying 500 to 1000 TZS to watch a football match and other TV programmes which seemed interesting to watchers as well as the local cinemas. Although there

was only Airtel Tanzania a mobile phone company operating on the island the time, I was conducting my fieldwork, the use of mobile phones is estimated to reach 71 percent of the islanders who owns some kind of mobile phone services (Sosovele 2010). The use of mobile phones has enabled most people to receive remittances from friends and relatives living on the mainland which add on the household incomes, but also as a media for money transfer connecting businessmen and women on the island to those on the mainland side.

There is also an indirect contribution to household incomes through the village electrification process. According to Songas official interviewed, about 70 percent of the villagers use electricity as a major source of energy for lighting their houses. Prior to the natural gas project, the Songosongo villagers used to light up their house using kerosene as the energy source. Kerosene is obtained from shops in the village and brought to the island in a way similar to other commodities, and used to fetch a high price. According to the interviewees the average amount of money people used to spend on kerosene was about 10,000 TZS per month, making 120,000 TZS a yearly expenditure for kerosene. The amount equals to 54.5 US$. With the village electrification program by Songas which was conducted in free of charge terms, most households now keep such an amount per year that can possibly be allocated into other household's expenditures or be part of the savings.

5. 4 Social corporate responsibilities (SCR), livelihoods and well-being on the island

Some agreements were made between Songas Tanzania limited and the Songosongo village for either Songas, TPDC or PanAfrican energy to fulfill to improve livelihoods and the social welfare on the island. Some of these agreements were given the name *Songas community projects* for projects conducted by Songas. According to the discussion with Songas officials during my fieldwork, the natural gas extraction on the island has promoted some social services making them available or by improving their standards for those which were available in unsatisfactory standards.

In this section we look at some agreements made between Songosongo villagers and the companies operating their activities on the island (i.e. Songas TPDC or PanAfrica energy) prior to the extraction and transportations activities and disclose how the fulfillment has been effected. From the discussion with the village chairperson Songas limited which is a Tanzania-registered company

engaged in power generation using natural gas from Songosongo promised to support among others health, water, education, transport and energy project in the village and other infrastructure measures that may improve society and individual development in the village.

However, though the agreements were made in the village meetings there is no contracts between the sides validating these agreements, thus weakening the village local government's ability to make follow ups and supervisions especially when for example Songas, TPDC or PanAfrican energy start fulfilling some of the projects under the agreements. There have been many projects on the island undertaken by natural gas associated companies, however, their fulfillment has been blamed by villagers to be operated under standard of people's expectations. The village chairperson also argued that in absence of the valid papers to guide what were agreed between the sides the legal agreements have changed to become charity services that natural gas companies choose to provide in whatever standards or forms. Not a single village or ward leader has mandate to ask anything about what Songas company is doing for the village as far as no villager is contributing a penny for what is being done. All that natural gas companies are doing in the village seem to be done for charity and not as an agreement in a right varied spirit.

5.4.1 Water services on the island by TPDC and PanAfrican energy

Prior to the natural gas activities on the island the only source of fresh water for domestic consumption was the Panga Kiza Caverns. Thus, the quality of drinking water was very poor as water from the caverns are uncovered and hence prone to pollution. Through the Songas community project through TPDC and the PanAfrican Energy villagers have been enabled to access clean drinking water. Desalinated sea water is provided in the village through communal stand pipes that are located in different distribution points locally called *viosks.*

According to PanAfrican energy the aim of the project was to provide clean and safe drinking water in the village, however water from the caverns can be used for other uses such as bathing, washing, animal watering and for cooking. With water in the village viosks (water points), time and distance used by women who are socially responsible for bringing water home, have been shortened significantly. Currently the distance to reach a water point is approximately 400-500m from most households. But the distance from Panga caverns to most households range from 1500-200m. The project has also made water availability close to the dispensary making it easier to run

treatment of patients. Discussions with the Clinical officer in-charge of the Songosongo dispensary, he noted that there is a decrease of water borne diseases like diarrhoea on the island, and he attributed the situation to an availability of desalinated water which many households use it as drinking water.

Figure 14: Women at the water point fetching water in Songosongo village, Tanzania 2018

Source: Field data Songosongo island.

At the water points other women see it as an opportunity to display their vegetables to sell as captured in the photo above. Water project in the village is managed by the village government through *Kamati ya maji (village water committee).* There is a total of five water points in the village delivering water in sequence. Every single households in the village is assigned to fetch water at respective water point. No household member is allowed to fetch water from water point not assigned to. Assignment of the households to respective water point was done by the village water committee and household distance to the water point was considered making sure that no one go more than 500 m away to fetch water at a water point. Not all the 5 water points can deliver

water per day, two or three water points will deliver and the other should operate on the next day. At the water points women are allowed to carry five 20litres buckets (100 litres), while only two buckets of 20 litres (40 litres). The maximum time for water to flow at the water points is about three hours. For every respective water point only an assigned group of households by names will be called to fetch water. In case some households miss to fetch water, by flow termination before their fetch call, then the next flow for the group the fetch calling will start right to the missed households of the previous flow before proceeding to other households.

5.4.2 Education support

The education level in the village is generally low. From the sampled households' only 25 percent of respondents had attended secondary education, the figure encompasses both the attended and the attending groups. 60 percent attended only primary school education while 15 percent have not attended any formal education. Due to this the village leaders prior to the start of the extraction activities, made some agreements with TPDC to help uplift the education levels and services in the village. TPDC handed all the activities for Songas limited and remain as a monitoring agency for petroleum activities in the country. This means that even the agreements were handed to Songas as well. When Songas Limited mandated PanAfrican energy to run the extraction, processing and transportation of the Songosongo natural gas then some of the agreements were also handed to the PanAfrican energy.

The village has one primary school and a secondary school as well. According to the Songosongo ward executive officer the agreement to support education in the village involved that 3 percent of revenue obtained from Songosongo natural gas should be sent back to the village to support the education sector. However, according to the headmaster Songosongo secondary school argued, "*the amount has not been used in accordance to the purpose, but often the money is allocated to perform other activities in the village by leaders and frequently stimulate misunderstandings in our meetings if happen someone question the village leaders on the use of this money"* (The headmaster Songosongo Secondary school 2018).

Responses from the village chairperson when I posed this question to him was "there is an interference from general government on this issue. No money has been brought to village for almost three years because the general government decided that all government money must be

collected in a single pot before allocating the fund to their respective uses. But due to differing in development priorities between general government and we the local government this money has been prioritized to other development activities so we don't receive it directly" (Songosongo village chairperson 2018). During the fieldwork I also observed an underway construction of new buildings in Songosongo secondary school which is a project under PanAfrican energy.

Discussion with PanAfrican Energy officer revealed that the project involved construction of student kitchen and supply it with all the necessary furniture for kitchen. The completed project involved construction of habitats for teaching staffs, and student laboratory and dormitories with all the laboratory and dormitory necessary accessories. Pan African energy also give sponsorships to ten students from the village each academic year from secondary education to University given that the sponsored student will manage to attain the University level.

In addition, Songas limited provides lunch for students and the teaching staff through a contribution of 100,000 TZS per head per year in the school budget. In 2018, the total number of students were 120 and 7 teaching staffs thus, more than 12 million Tanzania shillings was sent to Songosongo secondary school by Songas Limited. The sponsorship is provided to the ten best students who join secondary school up to high school level. They also give 50,000 TZS to all students enrolled to join secondary school from primary school as a preparation fund. Finally, a 50,000 TZS is provided by Songas to all students attaining the pass mark of 35% in average for internal examinations as a promotion for students to study hard and perform better in external examinations which allow them to join the next education level in Tanzania.

5.4.3 The village electrification project

According to Songas (2011), the share of households on Songosongo island supplied with electric power in their houses is 70%. When the figure was calculated from my sampling frame the share of households electrified was about 87%. Of 79 respondents visited and the interviewed, 69 use electricity as lighting source in their houses or at the household one is coming from. Prior to the gas project in the village, almost all Songosongo villagers used kerosene as a major source of house lighting as it was noted in previous section, with only a negligible number of inhabitants who used to light up their houses by electric power from solar panel. The village electrification was one of the agreements and a promise by TPDC to the villagers prior to the gas plants operation.

According to the village chairperson there was a promise to villagers to get electric power distributed in their houses free of charge immediately when the gas plant started operation. The promise was that each and every house on the island will be electrified as far as someone is living inside that particular house, and so were the villager's expectations. Free of charge involved not only for the distribution costs but even the consumption and service costs were termed free for Songosongo villagers to date. However, the electrification scene came two years later after the gas plants operations. Distribution of electricity into villagers' houses started in the year 2006 and only 108 houses distributed with electric power equals to 18% of the 600 houses present in the village by then. All the costs were actually covered by Songas limited company. The number of houses supplied with an electric power has significantly increased in the current years in the village. However, most houses were electrified under the expenses of the owners and not Songas Limited. The complaints here is why an agreement and the promise fulfilled only to 108 houses while Songas Limited was supposed to carry out the whole process of the village electrification.

Figure 15: One of the electrified houses in Songosongo village Tanzania 2018.

Source: Field data.

Though electricity is used free of charge on Songosongo island, some households still depend on kerosene to light up their houses. Owing to poverty such households failed to buy necessary materials, for example wiring materials and also the costs of an electrician. Some of the houses received this service are in poor condition and prone to fire in case of electric shock, (see figure 14). Another shortcoming of the electrification program is that an electric power distributed in houses is mainly for lighting purpose, and for running low power devices such as TVs, radio, and to recharge mobile phones batteries. Households cooking and house heating still depend on wood fuel. An increased population on the island resulting from natural gas project, has simultaneously increased the number of households too. All the households on the island depend on environmental source of cooking and heating energy, ultimately this leads to degradation of the island environment.

5.4.4 Transport system and accessibility of the island

Songosongo island is accessed only via the sea or through air transport. The presence of an airstrip constructed to enhance transport mainly for the investors and staff of the gas plants has enabled landing of small planes on the island. There are two flights to Songosongo from Dar es Salaam airports which mostly target the visitors who visiting the private Hotel in Funjovi islet. Otherwise getting to Songosongo island via air transport one has to hire a charter plane. In some cases, Songosongo residents get an offer for a free travel to Dar es Salaam and also from Dar es Salaam to the island by the investor's plane. This is possible if the booking is done early or if there are free seats left after staff from the gas plants. Hiring a plane is very expensive especially for ordinary people with the fact that it cost up to 2000 US$ just for a one-way trip. Owing to such a situation Songosongo community and any other ordinary people who wish to visit the island have remained with only single option which can make them have access to the island and out of it, this option is water transport.

Songas limited through community project decided to make improvement regarding water transport in the village by rehabilitating the village jetty. This is because jetty is the main and only transport facility on the island having direct and significant influence to local livelihoods. All imported goods from the mainland and people to and from the island are currently using an improved jetty. The jetty rehabilitation involved an extension of the jetty length, width and raising

up the height, it also involved fixing the lighting system which allowed the jetty being used in all times day and night.

Figure 16: The operating Songosongo jetty rehabilitated by Songas Songosongo island Tanzania 2018.

Source: Field data

Although the jetty has been rehabilitated to a modernized form the number of vessels anchoring on it is still not enough to catter for the transport problem facing people inhabiting the island. There are only two small locally manufactured boats ferrying passengers from Songosongo to Kilwa kivinje and back. One boat ferries people from Songosongo early in the morning to Kilwa kivinje where they can take road transport to their destinations. Another boat ferries the passengers coming from various parts on the mainland including visitors back to the island in late afternoon. Transport to and from the island is an evident problem because if one misses to board a single boat available per day then will have to wait the next day schedule to reach an intended destination. In more than

one occasion I observed passengers being left on the island when they have already reached the jetty site to make their travels to the mainland because the vessel capacity does not allow more passengers. Apart from the maritime transport, all roads on the island are compacted and earthen graded.

5.4.5 Health services in the village

Songosongo village has a dispensary which serves Songosongo village and the small inhabited islands which are parts of the Songosongo archipelago. Inhabited islands apart from Songosongo village include islets such as Njovi, Nguzi, Ukuza and Simaya. From the discussion with the Songosongo dispensary clinical officer in-charge, the number patients have increased with increased population on the island. The most common disease cases which prevail in the island according to Songosongo dispensary data includes Malaria, STDs (sexual transmitted diseases) where Gonorrhea and Pelvic inflammatory disease being the most common cases. Gonorrhea prevalence is observed for both male and female while the Pelvic inflammatory disease is a female's case. Respiratory complications and diarrhoea are the most common cases for children. HIV/ AIDS which was not prevalent on the island in the past is currently becoming prominent and the blame from both health workers and village leaders on the matter, is directed to population increase in the village which enhance human interactions and the sexual interaction as well.

Data from the dispensary showed that 91 people have been registered as HIV/AIDS victims on the island this equals to 1.5 percent of the island population. However, the HIV/ AIDS status on the island, according to the Clinical officer in-charge is possibly higher than the stated because the figure above represent only the voluntarily registered victims who attend clinics and receives the ARVs tabulate at the village dispensary. From the study findings we see that HIV/AIDS is a threat to the island's inhabitants. This is because there are also other HIV infected islanders not registered in the village dispensary. Some people would rather use mainland to avoid people on the island knowing about this.

Natural gas Development project on the island have been the major factor for seasonal increases in number of people in the village especially when activities such as construction is undertaken on the island. The seasonal influx of new people enhances social interactions as well including sexual interaction as noted earlier thus, increasing the possibility of protracting sexual transmitted

diseases. In supporting the health sector in the village, the village dispensary has been rehabilitated by TPDC through improvement of the buildings and water point has been established in the dispensary compounds to carter for the water requirements for the patients and dispensary workers. However, I observed that the health personnel serving people on Songosongo not satisfactory for a population of more than 6000 people residing on the island. The dispensary had only three workers, one Clinical officer, one medical attendant and one midwife.

5. 5 The natural gas extraction and economic outcomes on Songosongo island

As noted earlier, households combine a number of assets or capital, activities and choices to achieve the livelihoods goals (Zhang et, al, 2017). Assets include human, financial, social, physical and natural capital. In addressing the economic outcomes in Songosongo I have analyzed some livelihood capital as indicators of the village economic situation.

5.5.1 Financial and Savings status in the village

From a financial perspective the village economic situation is generally low. Most of the respondents had savings neither in banks nor in any other form of savings so that they will have funds to solve their future need of money. Most of the income generation activities Songosongo people are doing are subsistence activities. The only opportunity one can do to access credit in time s/he need money to overcome shocks and stress especially during times of no fishing is by VICOBA (Village Community Bank). It is a formal village microfinance bank in most villages in Tanzania where both men and women members can access credit. To access credit from VICOBA you need to be a member first so that you make your stock contribution in the VICOBA fund. This is a form savings. A member can receive credit with a very low interest rate.

Nevertheless, only 5 percent of respondents were members of VICOBA in my sampling frame. The study findings have revealed that most villagers only afford to gain a daily sustenance income which give them no excess to enable them make their stock contribution into the VICOBA fund. There is further more a large group of people that needs more education on how to make savings and what benefits are embedded in making savings. From the findings these two seems to be the major setbacks of the VICOBA development in the village.

5.5.2 The purchasing power in the village

The purchasing power as per discussion with shopkeepers and shop owners on the island showed that it is very low. There are few shops in the village selling important items necessary for the daily household's consumptions. However, it takes relatively long time for some of the imported products to get sold out in shops. For example, a 50kg bag of sugar need an average of 30 days in a shop before making another purchase. The same quantity of rice takes 15 days and the maize flour of the same quantities as well that the shop owner will have to wait at least for 20 days to make the new purchase of the product. These are the most used foodstuffs making the daily table meals in the village. The study findings however, have revealed most households on the island takes only two meals per day there is a combined breakfast-lunch meal and a dinner. It was even harder to me getting food in the afternoon hours if no booking was made prior with the *Mama lishe* (women food vendors). *Mama lishe* often start selling their food late the evening hours to night hours (7 pm – 9 pm). This is the time fishers which is the targeted group are back from the sea.

5.5.3 Housing standard and living conditions

From own observation, the housing standard in the village is generally low. Most houses in the village are constructed by mud and tree poles with coconut leaves used as roofing materials. From the sampled households visited only 25 percent had houses roofed by corrugated iron sheets, and only 18 percent of houses had a cemented floor. Sewage management is poor as most households on the island lack sustainable latrines, with only few using shallow pit latrines making a large percent of villagers to use bushes and other alternatives such as the sea where the sewage dumping is done.

Figure 17: The common housing standard on Songosongo island Songosongo island Tanzania 2018

Source: Field data

5.6 Summing up the chapter

This chapter highlighted the impacts of natural gas extraction activities on social-economic perspective of the Songosongo island. The theory of sustainable livelihood approach (SLA) was employed in the analysis of different livelihoods undertaken by people on the island, assets and livelihood outcomes in the context of natural gas exploration, extraction and processing. These activities are considered a major disturbance enhancing various shocks and stresses to the local Songosongo inhabitants. The study findings have revealed that there is strong gender influence on issues such as livelihood activities generating household's incomes, assets ownership and so for the livelihood outcomes as well. Thus, examining livelihood strategies under gender perspective make it easier, meaningful and understandable. The chapter covered two research objectives (**a &b**) with four research questions (**4, 5, 6 and 7**).

CHAPTER SIX

GENERAL DISCUSSION OF THE HINTS AND RELATED THEMES OF THE STUDY FINDINGS, AND THE STUDY CONCLUSION

6.0 Introduction

This chapter sum up the main study findings and give a conclusion to the study. The study findings are basically rooted in the resilience and ecosystem services concepts and on the theory of sustainable livelihood approach (SLA) and its framework. The chapter begins by expatiating on the effects of natural gas activities on the Environmental services (ecosystem services) in relation to livelihoods. Consequently, the threshold and the Songosongo ecosystems status quo are discussed in light of a resilience perspective. The chapter also expands on, the vulnerability concept, the issue shocks and stresses and social relations as a coping strategy to these shocks and stress, based on natural gas exploration and extraction on the island.

6.1 The effects on ecosystems and ecosystem services

Coastal petroleum projects normally affect livelihoods of people residing in coastal communities (Adusah, K., 2015) even if the projects are off-shore. The natural gas extraction and transportation from Songosongo island to Dar es Salaam have brought a variety of effects on the environment on Songosongo as noted in the previous chapters. The effects on the environment are in turn passed on to livelihood assets, activities and outcomes of the coastal communities as man do depend on nature for a living. The findings showed that an extensive amount of the island land was taken to establish all infrastructures for the gas plants. Vegetations and coastal shrubs have been cut down to pave way for the construction of roads, accommodation camps and clearing site for gas plants construction.

The coastal shrubs on Songosongo island like many other coastal areas play important ecological services such as the stabilization of the thin layer of top soil keeping the top soil intact. This is very crucial for Songosongo as soil nature is characterized by coral rag. The modification of the micro-climate on the island can threaten services like prevention of excessive soil moisture evaporation, conserving the island biodiversity as well as providing habitats for faunas including birds, reptiles and arthropods. The gas plants thus, though counted beneficial overall at national

level, at local level one can see it that ecological values have been lost with land clearance and vegetation cover cut down and degraded. For a small island like Songosongo where much of natural and indigenous vegetation have been cleared for the sake of people's settlements any new land clearance and vegetation cut down shall constitutes a significant loss which is often irreversible.

6.1.1 Environmental resilience and the current ecosystem state

Resilience in this study means the capacity of a system to absorb disturbance and reorganize while undergoing some alterations so as to still retain essentially the same functions, structure, identities and outcomes (Walker et al, 2004). With the ecosystem services degradation on Songosongo island as portrayed in the study findings, systems resilience has been lowered. Under the natural gas exploration and extraction activities as a major disturbance and all subsequent perturbations such as high population growth the Songosongo ecosystem is still resilient. It is resilient as it is still able to make people and other living organisms on the island sustain, and it is still retaining the essential ecosystem services functions.

However, though an essential function may still be retained the structure and identity have been undergoing gradual changes over time indicating negative feedback to activities taking place affecting the environment. The term feedback in a conventional systems sense refers to the result of any behaviour which may reinforce (positive feedback) or modify (negative feedback) subsequent behaviour (Berkes and Folke 1998). Environmental feedbacks include for example depletion of particular resources and decline of catch per unit of effort, that signal for changes in management responses and the ability of resource management institutions to receive and respond to these signals (Berkes et al, 1998).

From the findings the Songosongo environment through its ecosystems structures and functions is alarming with substantial negative feedbacks. This is a signal to resource management institutions in Tanzania to respond to these signals before attaining the threshold. According to Berkes et al, (1998) at threshold a system flips from one equilibrium state to another. There are two equilibrium states desirable state, in which the system still maintains its functions, structure and identity. While undesirable state is when a system has lost its structure and identity thus, so its functions. A gradual process of environmental degradation can lead to change of state. For

example, this can be a change from green landscape to a desert. Although it is still a desirable state Songosongo environment is currently under win-lose ecosystem state with reduced functionality of ecosystem and some loss of biodiversity (Scheffer et al, 2001). Win-lose situation involve more resource exploitation from ecosystem without better management mechanisms laid down to help system regeneration.

6.2 The vulnerability, social relations and coping strategies

Vulnerability is an important concept often used as powerful tool for analyzing and describing states of susceptibility of both physical and social systems. The concept is also vital for guiding normative analysis of actions to enhance well-being through risk reduction (Adger 2006). Most authors portray vulnerability in negative terms as the susceptibility to be harmed. The susceptibility to and is inability to cope with adverse effects of stressors such as climate change is vulnerability. In whatever research formulation the key parameters of vulnerability will still remain as the stress to which a system is exposed, its sensitivity and the adaptive capacity of the particular system (Adger 2006). People on Songosongo island depend on marine livelihoods. Vulnerability to shocks and stress is thus, very important feature on Songosongo island and the whole Songosongo archipelago as well. With differing livelihood activities between households on the island, different households' experiences different shocks and stresses. Households also have different range of assets, stores and claims that change over time. Households have different strategies to use these assets in accordance to the type of shock or stress affecting them. According chambers (1995), vulnerability involve two parts external and internal. An external part of vulnerability is about exposure to shocks, stresses and risks and the internal part of it is the defenselessness which portray the lack of means to cope with perturbation without damaging loss (Chambers 1995). The study findings have revealed that, Songosongo islanders are susceptible to a number of shocks and stresses such as disease affecting seaweed (die-off disease), zonal restriction for fishermen, drowning in sea and death, resettlement and conflicts arising between and the naval officers. Seasonality seems to influence population, migration and relative price of goods and items on the island. The impact of shock is a function of its frequency, intensity and duration while persistent shocks make the coping very complicated (Dercon 2001), and thus causing more adverse impacts on livelihoods and livelihood systems.

6.2.1 The no-go zone and the blue grabbing in Songosongo village

With natural gas activities on the island fishermen are directly affected as they engage in offshore fishing. The no-go zone demarcated around the gas plants prevents fishermen from fishing in these areas. Benjaminsen and Bryceson (2012), termed such a scenario the blue grabbing. This is a modification made by paraphrasing of the word land grabbing. In blue grabbing fishermen are gradually loose access to their fishing grounds as a result of marine operated petroleum activities (Benjaminsen and Bryceson 2012). Government rules and regulation put in place to guide the use of fisheries resources facilitate fishermen dispossession of fishing grounds. These rules and regulation are what Allison and Ellis (2001), refers to as policies and institutions and in some cases their enforcement involve using force from naval officers.

Marine resources such as fish are natural capital which are core to obtain livelihood for the coastal communities, a restriction to fish in some zones that previously used to be accessed by fishermen has serious implication on their livelihoods. Fishermen on Songosongo island direct their blames to the natural gas extraction activities with accusation as the cause of their recently poor fish catch. As fishermen normally value the sea as vital asset providing them fishing grounds for their livelihoods. The claim is that all the operations involving natural gas exploration, extraction, processing and transportation have affected their catch level. The principal objective of fishers is to have as high catch of fish as possible thus, any offshore petroleum project is perceived as an obstacle, creating shock and stress to fishermen on Songosongo.

6.2.2 Social relations, the coping strategies

It has been observed that people in Songosongo village copes to shocks and stress they face in a diverse way depending on the type of shock or stress. As it was noted earlier social relations are how people and households position themselves in the society. Factors such as religion, class, age, ethnicity and gender influence this positioning. This enhance social networks which are very important for the Songosongo community especially when people face shocks and stress. It has similarly been observed that through the social network women on the island have formulated their financial systems that make them cope to small shocks related to finance. The system of *Mchezo* whereby an amount of cash is collected on weekly or monthly basis and given to one member of the group once and sequentially until the cycle is complete is a famous social-financial network

on the island. VICOBA on the other hand is a formal micro finance system in which men and women on the island can access credit to solve their financial problem in times of financial shocks. This is the implication that people at local levels make use of any possible opportunity to meet demands of their livelihoods. Such local financial systems observed in Songosongo village indicates the intrinsic potential that local people have, helping them find solutions to their problems. Remittances and assistance from friends and relatives is also part of the social networks helping to overcome shocks and stress.

6. 3 Hints on governance issues

In the World Bank report (2010) on environmental governance for oil and gas producing countries, it is stated that in a large number of developing countries surveyed it is revealed that there was a sufficiently appropriate, but largely theoretical, environmental policy and legal framework in place for most countries (Alba E.M in World Bank 2010). Most countries have some form of environmental impact assessment (EIA) systems that has been incorporated within their legal and regulatory framework.

However, much of the emphasis of the EIA process appears to be directed toward the approval of oil and gas projects rather than a life-cycle management approach to environmental and social issues across the entire project life. Evidence of this effect is that most countries make use of insufficient and sometimes totally absent control and enforcement mechanisms during the post-EIA approval phase. Environmental monitoring and project follow-up are considered part of the EIA regulatory framework enforced in the majority of countries surveyed, but indeed, in many cases, actual enforcement practices are inadequate, environmental monitoring is insufficient, and monitoring data are either not disclosed or are not made widely available to the public and affected stakeholders, (World Bank 2010). This is vividly the case for NEMC in Tanzania as well.

In addition, the report revealed that the human and financial resources needed for effective environmental governance are generally lacking. The budgetary setback and lack of human resources in low administrative levels for environmental monitoring were noted in NEMC too. Taking into account the society and other public consultations and involvement as we have noted above is critical for environmental governance. Governments may check on oil and gas activities, but they disclose little information to the public and affected stakeholders.

Consultation is more about informing stakeholders about proposed oil and gas projects than involving them in project-related decisions (World Bank 2010). Similarly, the report reveals that there are significant barriers to the disclosure of information about oil and gas projects and the natural and social environments in which they occur. Most governments lack a commitment to establish and implement a centralized information system, whether electronic or otherwise (World Bank 2010).

6.4 The study conclusion

The main purpose of this study was to explore the impacts of natural gas exploration and extraction activities on a diverse way of livelihood perspective for people on Songosongo island. I focused on impacts on the island environment and how the impacts have been passed on to ecosystem services which support the livelihoods and wellbeing of the human community on the island. In this study I specifically sought to understand how the island environment and its benefits to human for livelihoods have been affected by the petroleum activities in the area. This facilitated to understand the effects of the ongoing natural gas project on livelihoods of the islanders in a wide range of perspective. The various categories of ecosystem services have been investigated, and that they have been altered by the natural gas activities making their availability to people for livelihoods hampered. The concept of ecosystem services with millennium ecosystem assessment (MA) and TEEB ecosystem categories were employed in the study to identify important ES on the island. Consequently, various livelihood activities that men and women inhabiting Songosongo are engaged in have been explored. And it was revealed that gender is still important factor determining what livelihoods should a man or woman undertake in the society. The theory of sustainable livelihood approach (SLA) was engaged and help to understand the various livelihood assets on Songosongo island and how these assets are vital for people to make their living. Vulnerability concept in the sustainable livelihood framework was applied in the analysis of shocks and stress the islanders do encounter due to the natural gas offshore operations.

In order to understand the realities of people's livelihoods on Songosongo island and meet the main research objective, three specific objectives with seven research questions were formulated. In chapter 4, I addressed the three research questions formulated for the first objective of the study which is termed as objective **"a".** The questions addressed in chapter 4 are (**1**) what have been important environmental services for livelihoods support on the island? (**2**) what are costs caused

by the natural gas activities on the island's ecosystem services? (**3**) how has the environmental governance system in Tanzania played its role to manage ecosystem resilience in Songosongo village?. Chapter 5 dealt elaborately with four research questions formulated in the second and third objectives namely objective **"b"** and **"c"** in the study**.** The research questions addressed in the chapter are 4, 5, 6, and 7. Question (**4**) what are the livelihood strategies that men and women on Songosongo island are engaged in?, (**5**) what are the contribution of extraction activities to livelihoods of local Songosongo islanders?, (**6**) how have the corporate social responsibility (CSR) on the island supported people's livelihoods? and (**7**) what are the livelihoods social economic outcomes of extraction activities to local Songosongo inhabitants?.

The summary of the findings by research questions are as follows. The first research question highlighted on important ecosystem services ranging from provisioning, support regulating and cultural services and how they enhance livelihoods on Songosongo island. The second research question consequently looked at the costs associated with natural gas extraction on ecosystem services and the implication for livelihoods of Songosongo people. The third question sought to reveal how entities associated with governance of the environment in Tanzania plays its roles to for the sustainability of the island's environment and system resilience.

Chapter five begin with highlights of livelihoods and livelihood activities that men and women on the island undertake which was an attempt of answering the fourth research question. However, the findings revealed that there are strong relationships between livelihoods and gender thus, livelihood activities in relation to gender have been explored and discussed. As it was noted that, people expected much from the gas plants operating in their area, the fifth question explored on the realities about the extraction activities in the area and contribution of these activities to individual and household's incomes both direct and indirect way. The sixth one attempted to find out what have been corporate social responsibility projects on the island. The findings found out a good number of CSR projects which aim to improve social services on the island. These projects had been implemented and being implemented to encourage the wellbeing of the islanders. Though there are some challenges around the implementation of some of these projects like for the village electrification project, having them on the island is quite better than not having them at all. This is in favour of the English saying **"***something in hand is better than nothing.***"**

The wind up of the chapter came by an attempt to answer the seventh research question with assessment of the implications of extraction activities for people's livelihoods by looking at the social-economic outcomes. The concept of livelihood assets was applied and issues regarding financial and savings, purchasing power in the village and the housing standard were explored to indicate the economic stand of individual and households on the island. Chapter six sought to highlight generally the hints related to the findings of the study and some related themes of the study.

REFERENCES

Adger W., N, (2000). Social and ecological resilience: are they related? *Progress in Human Geography*, *24*(3): 347-364.

Adger W., N, (2006). Vulnerability. In *Global Environmental Change* (16). Elsevier.

Adom, D., Joe., A. A, and Husssein E., (2018). Theoretical and conceptual framework: A mandatory ingredients of a quality research. International journal of scientific research 7(1) 438-441.

Adusah, K., A, (2015). Black gold in Ghana: Changing Livelihoods for Women in Communities Affected by Oil Production. *The Extractive Industries and Society*, *2*(1): 24-32.

Agrawal, A., and Lemos, M. C, (2006). Environmental Governance: Annual Review (31) 297-325.

Alba, E. M., (2010) in The World Bank (2010). Environmental Governance in Oil-Producing Developing Countries: Findings from a Survey of 32 Countries. Extractive industries and development series; no. 17. World Bank, Washington, DC.

Aliaga, M. and Gunderson, B., (2005). *Interactive Statistics*. Third edition. Upper Saddle River, NJ: Pearson Education, Inc.

Allison, E. H. and Ellis, F., (2001). The livelihoods Approach and Management of Small-scale Fisheries. *Marine Policy* 25: 377- 388.

Anderies J. M, Janssen M. A and Ostrom E, (2004). A Framework to Analyze the Robustness of Social- ecological Systems from an Institutional Perspective. In: *Ecology and Society9*, **(1)**:18

Anderies J. M, Walker, B. H and Kinzig, A. P., (2006). Fifteen Weddings and a Funeral: Case Studies and Resilience based Management. In: *Ecology and Society**11***(1): 21.

Badgley, C., (2011). Fishing and the Offshore Oil Industry: A Delicate Imbalance. *The Center for Public Intergrity*. http://www.iwatchnews.org/2011/06/10/4859/fishing-and-offshore-oil-Industry delicate imbalance

Basedau, M., (2005). Context Matters - Rethinking the Resource Curse in Sub-Saharan Africa: Elektronisk resurs. Hamburg: Dt. Ubersee-Institut.

Beesta, N. A., (2010). Seaweed Farming and Intra-Household Gender Relations on Songosongo island Tanzania. PhD thesis: School of International Development. University of East Anglia.

Benjaminsen, T. A., and Bryceson, I., (2012). Conservation, Green/Blue Grabbing and Accumulation by Dispossession in Tanzania. *Journal of Peasant Studies 39*(2): 335-355.

Berkes, F., and Folke, C., (1998). Linking social and ecological systems for resilience and sustainability. In *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience.* Cambridge University Press: New York.

Berkes, F., Colding J. & Folke, C. (2003). Introduction. In Berkes, F., Colding J. and Folke, C. (eds) *Navigating social-ecological systems: Building resilience for complexity and change*. Cambridge, UK: Cambridge University Press.

Besha, R. M, (2002). Songosongo Island Economic Study Updates.

Bhattacherjee, A. (2012). Social Science Research: Principles, Methods, and Practices. *USF Open Access Textbooks Collection*. Book 3 University of South Florida Textbooks Collection.

Boohene, R. and Peprah, J. A., (2011). Women, Livelihood and Oil and Gas Discovery in Ghana: An Exploratory Study of Cape Three Points and Surrounding Communities. *Journal of Sustainable Development* Vol 4. http//www.ccsenet.org/jsd

Brown, K., (2016). *Resilience, development and global change*. London, UK: Routledge. 212

Bryceson lecture notes (2017).
Bryceson, I., (2002). Coastal Aquaculture Development in Tanzania: Sustainable and Non-sustainable Experiences. Western Indian ocean. *Journal of marine Science* 1(1): 1-10.

Bryman, A., (1998) Quantitative and qualitative research strategies in knowing the social world. In T. May and M. Williams (eds) *Knowing the Social World* (Buckingham: Open University Press).
Bryman, A., (2008). *Social Research Methods* 3rd (Eds). Oxford: Oxford University Press: New York.
Bryman, A., (2012). *Social research methods*. 4th (Eds). Oxford: Oxford University Press.

Camp, W. G., (2001). Formulating and evaluating Theoretical frameworks for career and Technical Education Research. Journal of vocational Education Research, 26(1) 27-39.

Carpenter S., Folke C., Foley J. A, Scheffer, M., and Walker B, (2001). Catastrophic shifts in ecosystems Review article nature (413):541-596.

Chambers, R. and Conway, G. R., (1992). Sustainable Rural Livelihoods: Practical Concepts for the 21st century. *IDS Discussion Paper* No 296. Brighton: UK

Chambers, R., (1989). Editorial Introduction: Vulnerability, Coping and Policy. *IDS Bulletin*, (20)1-7.

Chambers, R., (1995). Poverty and Rural Livelihoods: Whose Reality Counts?, Discussion Paper 347, Institute for Development Studies, University of Sussex, Brighton

Chapin, F. S, Kofinas, G. P., and Folke C., (eds.) (2009). *Principles of ecosystem stewardship: Resilience- based natural resource management in a changing world*. Springer: New York.

Clifford, N. J. and Valentine, G. (2010). *Key Methods in Geography.* Sage Publications, London.

Cresswell, J. W., (2003). Research Design Qualitative, Quantitative and Mixed Methods Approaches. 2nd Edition. Sage Publications, Inc

Darwall W. R. T (1996). Marine Biology and Resource use Surveys in the Songosongo Archipelago: Frontier-Tanzania Marine Research Programme report 7. ISSN 1369-8788.

Dasgupta, P, and Mäler K.G, (eds), (2004). *The economics of non-convex ecosystems*. Kluwer Academic, Dordrecht, The Netherlands.

De Haan, L. and Zoomers, A. (2005). Exploring the Frontier of Livelihoods Research. *Development and change*, *36*(1): 27-47.

Denscombe, M, (2007). *The Good Research Guide for Small-Scale Social Research Projects*. Maiden head: Open University Press.

Denzin N. K. and Lincon Y. S., (2000). *Handbook of Qualitative Research* (2nd ed). Thousand Oaks, CA: Sage publications.

Denzin, N. and Y. Lincoln (2005). Introduction: The Discipline and Practice of Qualitative Research. In Denzin N and Lincoln. Y. *The Sage Handbook of Qualitative Research*. Sage

Dercon, S., (2001). Assessing vulnerability. *Publication of the Jesus College and CSAE, Department of Economics, Oxford University*

Deveson, A., (2003). Resilience. Allen and Unwin, St Leonards, Australia.

DFID, (2000). Sustainable Livelihoods Guidance Sheets. Department for International Development. http://www.livelihoods.org/info/info_guidancess.html [Accessed 8/05/2019].

Dorsey, N. S, and Kharaka Y. K., (2005). Environmental Issues of Petroleum exploration and production: *Environment Geoscience 12* **(2**): 61-63.

Edwards, J. D., (1997). Crude oil and alternate energy production forecast for the twenty-first century: The end of the Hydrocarbon era: *AAPG Bulletin 81*, 1292-1305.

Egyir, I. K., (2012). The Impacts of Oil and Gas Activities on Fisheries in the Western Region of Ghana. Maters Thesis. Norwegian College of Fisheries Science. University of Tromsø.

Ellis, F., (2000). The determinants of Rural Livelihood Diversification in Developing Countries. *Journal of Agricultural Economics, 51*(2): 289-302.

Energy Information Administration [EIA] (2004). Annual energy outlook 2004 with projections to 2025: Overview, Washington D.C

Eneyew, A., and Bekele, W., (2013). Analysis of Wealth and Livelihood Capitals in Southern Ethiopia: A lesson for policy makers. *Current Research Journal of Social Sciences* 5(1): 1-10

Folke, C., (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. *Global Environmental Change*, *16*(3): 253-267.

Folke, C., Carpenter, S. R, Walker, B. H, Scheffer, M., Elmqvist, T., Gunderson, L. H, and Holling, C, S. (2004). Regime shifts, resilience, and biodiversity in ecosystem management. Annual Review of Ecology, Evolution and Systematics (35) 557-581.

Folke, C., Carpenter, S. R, Walker, B., Scheffer, M., Chapin, T. and Rockström, J. (2010). Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society 15*(4): 20.

Fraser, M., Richman, J., and Galinsky, M. (1999). Risk, protection, and resilience: Towards a conceptual framework for social work practice. *Social Work Research*, *23*(3): 131-144.

Glazer, B. G., Strauss, A. L., (1967). *The Discovery of Grounded Theory***:** *Strategies for Qualitative Research,* (New York, Aldine).

Grant, C., and Osanloo A., (2014). Understanding, selecting and integrating a Theoretical Framework in Dissertation Research. Creating the blue print for House.

Greene R. R., Galambos C. & Lee Y., (2004). Resilience Theory, *Journal of Human Behavior in the Social Environment, 8* (4): 75-91.

Gunderson, L. and Holling, C. S., (eds), (2002). *Panarchy. Understanding Transformations in Human Natural Systems.* Island Press: London.

Gunderson, L. H., and Pritchard, L., (eds), (2002). Resilience and the behavior of large-scale ecosystems. Island Press, Washington, D.C., USA.

Hay, I., (2010). *Qualitative research methods in Human Geography*. Third edition. Oxford Canada: University Press.

Holling, C. S., (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics,* 4: 1-23.

Holling, C. S., (1996). Engineering resilience versus ecological resilience. Pages 31-44 in Schulze, P. (eds). Engineering within ecological constraints. National Academy Press, Washington, D.C., USA.

Holling, C. S., (2004). Regime shifts, resilience and biodiversity in ecosystem management. Annual Review of Ecology, Evolution and Systematics (35) 557-581.

Jacob A, Mevius F. X., and Moyo, M., (2012). Background Notes: Natural Gas Development in Tanzania Challenges and Opportunities.

Kapinga, W., and Thorns A., (2013). The Oil and Gas Law Review, Strong B.C (ed), Law Business Research LTD: 243-272.

Kharaka, Y. K., and Hanor J.S, (2003). Deep Fluids in the continents: Sedimentary basins. *Treatise on Geochemistry (5)* 499-540.

Kharaka, Y. K., Thodsen, J. J and Ambats, G., (1995). Environmental degradation associated with exploration for and production of Energy sources in USA.

Kloff, S. and Wicks, C., (2004). *Environmental Management of Offshore Oil Development and Maritime Oil Transport.* A background document for stakeholders of the West African Marine Eco Region. IUCN Commission on Environmental, Economic and Social Policy: http://cmsdata.iucn.org/downloads/offshore_oil_eng.pdf,

Kollmair, M. and Gamper, S.T, (2002). The Sustainable Livelihood Approach. Input Paper for the Integrated Training Course of NCCR North-South. Development Study Group. University of Zurich

Kombo, D. K., Tromp, D. L. A., (2006). *Proposal and Thesis Writing: An Introduction,* Paulines Publication Africa.

Krantz, L., (2001). The Sustainable Livelihood Approach to Poverty Reduction. An introduction

Kreitler, C. W., (1993). Geochemical technique for sources of Groundwater salinization. CRC Press USA.

Kusekwa, M. A., (2011). A Review on the Renewable Energy Resources for Rural Application in Tanzania, Renewable Energy - Trends and Applications, Dr. Majid Nayeripour (Ed.), ISBN: 978-953-307-939-4, In Tech, Available from: http://www.intechopen.com/books/renewable-energy-trends-and-applications/areview-on-the-renewable-energy-resources-for-rural-application-in-tanzania.

Lankshear, A. J., (1993). The use of Focus Groups in a Study of Attitudes to Student Nurse Assessment. *Journal of Advanced Nursing* (18):1986-89.

Longhurst, R., (2010). Semi-Structured Interviews and Focus Groups. In Clifford N., French S., and Valentine G. (Eds.) (2010). *Key Methods in Geography*. Sage publications, London.

Mason, J., (2002). Qualitative Researching, London Sage

McClanahan, T.R., Sheppard C.R.C and Obura D.O (eds), (2000). Coral reefs of the Indian Ocean; their ecology and conservation. An online book: Oxford University Press, Oxford, No. of pages: 525. ISBN 0 19 512596 7 (hardback). https://doi.org/10.1002/gj.923

Merriam, S., (2009). *Qualitative research: A guide to design and implementation*. San Francisco, CA: Jossey-Bass.

Mesaki, S., (2005). *A portrait of Kilwa, A Glorious Past, Abundant Potential and Prosperous Future,* University of Dar es Salaam.

Millennium Ecosystem Assessment, (2003). Ecosystems and Human Well-being: A Framework for assessment. Island Press.

Millennium Ecosystem Assessment, (2005). Ecosystem and Human wellbeing: Synthesis. Island Press, Washington, DC.

Miller, K., Charles A., and Barange M. et al. (2010). Climate Change, uncertainty, and resilient fisheries: Institutional responses through integrative science. In: *Progress in Oceanography* **87**: 338 - 346. Elsevier.

Morgan, D. L., (1997). *Focus Groups as Qualitative Research*. 2nd Edition London: Sage

Msuya, F. E., and Porter M, (2014). Impact of environmental changes on farmed seaweed and farmers: the case study of Songosongo Island Tanzania. Journal of applied Phycology 5(26): 2135-141.

Mullings, B., (1999). Insider or Outsider, Both or Neither: Some Dilemmas of Interviewing in Across - Cultural Setting. *Geoforum* 30: 337-350.

Natural Resource Governance Institute (NRGI), (2015). The Resource Curse. The political and Economic Challenges of Natural Resource Wealth.

Natural Resource Governance Institute (NRGI), (2018). The natural Resource Charter Decision Chain. Converting Resources into Development.

Off shore Technology: Songo Songo Gas Development and Power-Generation Project: Retrieved from, http://www.offshore-technology.com/projects/songosongo/

Olajire, A. A., (2004). The Petroleum industry and Environmental challenges: *Petroleum and Environmental Biotechnology* (*5*)**:** 1-19.

Olesen, V. L., (2000). Feminisms and Qualitative Research into the Millennium. In Denzin N. K. and Lincoln Y. S. (eds.) Handbook of Qualitative Research. Second Edition. Thousand Oaks. London, 215-255.

Palloni, A, Massey, D. S., Ceballos, M., Espinosa, K. and Spittel, M. (2001). Social Capital and International Migration: A Test Using Information on Family Networks1. *American Journal of Sociology*, *106*(5): 1262-1298.

Pedersen M. L. and Petersen E. K., (2010). The Sustainable Livelihoods Approach, From a Psychological perspective: Approaches to Development. Institute of Biology, University of Aarhus.

Peshkin, A., (1993). The Goodness of Qualitative Research. Educational researcher 22(2): 23-29

Pimm, S., (1991). The balance of nature: University of Chicago Press, Chicago, Illinois, USA.

Pope, C., Ziebland S, and Mays N., (2000). Qualitative research in health care: Analyzing qualitative data, *Education and debate* 3(20):114-116.

Rakodi, C., (2002). A Livelihoods Approach-Conceptual Issues and Definitions. In *Urban livelihoods: A people-centred approach to reducing poverty*, London: Earthscan

Rice, S., (2010). Sampling in Geography. In Clifford, N., French S. and Valentine G. (Eds) (2010). *Key Methods in Geography*. London: Sage Publication.

Robson, C. (2002). *Real World Research: A Resource for Social Scientists and Practitioner-Researchers*. England: Blackwell.

Rud, J. P. and Aragon, F., (2013). Natural Resources and Local Communities: Evidence from a Peruvian Gold Mine. *American Economic Journal: Economic Policy 5*(2):1-28.

Sachs, J. D. and Warner, A. M (1997). Natural resource Abundance and Economic Growth. (Cambridge M.A: Centre for International Development and Harvard Institute for International Development, Harvard University).

Scoones, I., (1998). Sustainable Rural Livelihoods: A Framework for Analysis. *Working Paper* 72, righton, UK: Institute for Development Studies.

Sechrest, L. and Sidani, S., (1995). Quantitative and qualitative methods: is there an alternative? *Evaluation and Program Planning*, 18, 77-88.

Serrat, O., (2008). The Sustainable Livelihoods Approach. *Knowledge solutions.* Manila, Philippines: Regional and Sustainable Development Department, Asian Development Bank.

Serrat, O., (2017). The Sustainable Livelihoods Approach. *Knowledge Solutions*. DOI:10.1007/978-98-10-0983-9_5

Shenton, A. K., (2004). Strategies for Ensuring Trustworthiness in Qualitative Research Projects. *Education for information, 22*(2): 63-75.

Silverman, D., (2006). *Interpreting Qualitative Data: Methods for Analyzing Talk, Text and Interaction*, (3rd Ed.). London: Sage Publications.

Solesbury, W., (2003). Sustainable Livelihoods: A Case Study of the Evolution of DFID Policy. Working Paper 217. London: Overseas Development Institute.

Songas, (2001). Environmental and Social Assessments and Management Plan: A Summary of Environmental Impact Studies and Detailed Management Plan Tanzania. Songas, Dar es Salaam.

Songas, (2002). Environmental and Social Management Programme for the Songosongo Gas to Power Project. Dar es Salaam World Bank/TPDC

Sosovele, H., (**2010).** Songo Songo Socio-Economic Impacts/Livelihood Assessment and Jetty Utilization a May, 2010 report.

Stevens, P., Kooroshy, J., and Lahn, G., (2015). Research Paper. Energy Environment and Resources: Resource curse revisited. (Chatham House, The Loyal Institute of International affairs).

Tewksbury, R., (2009). Qualitative versus Quantitative Methods: Understanding Why Qualitative Methods are Superior for Criminology and Criminal Justice. *Journal of Theoretical and Philosophical Criminology*, 1 **(**21).

The Economics of Ecosystems and Biodiversity (TEEB), (2010). The Report for Business.
UNEP, (1997). *Environmental Management in Oil and gas exploration and production. An overview of issues and management approaches*. Joint E and P Forum/UNEP Technical Publication

United Nations Environment Programme (UNEP), (2009). Environmental Governance.

Vatn, A., (2015). *Environmental governance: Institutions, Policies and Actions.* Edward Elgar Publishing Ltd Cheltenham, ISBN:9781781007242.

Walker, B. and Meyers, J. A., (2004). Thresholds in Ecology and Social – Ecological Systems: A Development Database. In: *Ecology and Society* **9**(2): 3.

Walker, B. H, Anderies J. M., Kinzig, A. P. and Ryan P., (2006). Exploring resilience in social-ecological systems through comparative studies and theory development: introduction to the special issue. *Ecology and Society 11 (1*):12, http://www.ecologyandsociety.org/vol11/iss1/art12/

Walker, J., Mitchell, B. and Wismer, S., (2001). Livelihood strategy approach to community-based planning and assessment: A case study of Molas Indonesia, impact Assessment and project Appraisal 19(4) 297-309.

Walsh, F., (2003). Family resilience: A framework for clinical practice. Family Proceedings (42):1-18.

Walsham, G., (1993). Interpreting Information Systems in Organizations. Chichester: Wiley.

Whitehead, A., and Kabeer, N., (2001). Living with Uncertainty: Gender livelihood. Diversification and Poverty in Sub Saharan Africa. Social Programme, IDS working paper 134 Sussex.

World Bank, (2013). Tanzania Gas Sector Scoping Mission Dar-es-Salaam October 15-19 and December 10-13, 2012. Final Report.

World Commission on Environment and Development (1987). *Our Common Future*. Oxford: Oxford University Press.

WWF, (2005). Collaborative Marine &Coastal Resources Management & Livelihood Development in Rufiji, Mafia and Kilwa, Tanzania, Rufiji-Mafia-Kilwa (RUMAKI) Seascape Programme (2004-2009). Tanzania Programme Office.

Zhang, J., Yi, S., Paudel B., Khatiwada R. J., Khatiwada P.S. and Deng W (2017). Household Strategies and implication for Poverty Reduction in Rural Areas of central Nepal: *Sustainability* 9(612): 1-20.

Websites

FAO (2013). Sustainable Livelihoods

www.fao.org/ag/againfo/programmes/en/lead/alive_toolkit/pages/pageB_livelihoods.html

https://en.wikipedia.org/wiki/Resource_curse***)***

Wikipedia from https://en.wikipedia.org/wiki/Resource_curse

(Johnson 2018 in https://www.britannica.com/science/ecosystem-services.

IUCN in https://www.iucn.org/commissions/commission-ecosystem-management/our-work/cems-thematic-groups/ecosystem-services

APPENDICES

Appendix 1: The 12, Natural Resource Charter percepts for decision chain in extractive industry

Charter percept.	Primary questions covered by the percept.
Percept 1. Resource management should secure the greatest benefit for citizens through an inclusive and comprehensive national strategy, clear legal framework and competent institutions.	**1.1 Fundamentals of the resource endowment.** Has the government clearly identified the country's resource endowment, who owns it, and the positive and negative impacts of extraction? **1.2 Resource strategy.** Does the government have an inclusive and comprehensive national strategy for the management of resources?
Precept 2. Resource governance requires decision-makers to be accountable to an informed public.	**2.1 Transparency.** Does the government ensure that resource management is sufficiently transparent for all actors to effectively understand and scrutinize decision-making and its implications? **2.2 Official oversight.** Do government oversight bodies hold officials to account? **2.3 Communications and public oversight.** Is there a critical mass of informed citizens that holds the government to account?
Precept 3. The government should encourage efficient exploration and production operations, and allocate rights transparently.	**3.1 License planning.** Does the government adequately prepare before allocating license? **3.2 Awarding resource licenses.** Does the government allocate licenses to competent and law-biding companies and in a way that maximizes value for the country?
Precept 4. Tax regimes and contractual terms should enable the government to realize the full value of its resources consistent with attracting necessary investment, and should be robust to changing circumstances.	**4.1 Setting fiscal terms**. Does the fiscal regime secure a reasonable return for the government while still attracting sufficient investment? **4.2 Legal framework of fiscal terms.** Does the legal framework of fiscal terms provide sufficient accountability to citizens stability to investors and flexibility to respond to changing circumstances? **4.3 Tax administration.** Do government authorities collect the full value of taxes and other payments owed to the state? **4.4 Accountability and transparency of fiscal regimes** Is the government held to account for setting and collecting taxes and other company payments?

Precept 5. The government should pursue opportunities for local benefits and account for, mitigate and offset the environmental and social costs of resource extraction projects.	**5.1 Trust** Does the government ensure that there are good working relationships between stakeholders within affected communities? **5.2 Impact assessment** Does the government maintain an effective system for assessing the potential impacts of resource projects**?** **5.3 Cost mitigation** Does the government mitigate environmental, social and health costs of resource projects? **5.4 Local benefits** Does the government help affected communities to benefit from resource projects?
Precept 6. Nationally owned companies should be accountable, with well-defined mandates and an objective of commercial efficiency.	**6.1 SOE role and funding.** Does the government clearly define the SOE's role and establish a working funding mechanism for the company? **6.2 SOE corporate governance** Do the SOE's corporate governance systems limit political interference in the company's technical decisions, while ensuring effective oversight? **6.3 SOE transparency and accountability** Are SOE decision-making and operations transparent and accountable?
Precept 7. The government should invest revenues to achieve optimal and equitable outcomes, for current and future generations.	**7.1 Long-term fiscal sustainability** Is the government's spending and borrowing fiscally sustainable given that non-renewable natural resources are finite? **7.2 Absorptive capacity** Does the government adequately manage the rate of spending in the domestic economy?
Precept 8. The government should smooth domestic spending of revenues to account for revenue volatility.	**8.1 Expenditure volatility** Is the government spending independent short-term changes in revenues?
Precept 9. The government should use revenues as an opportunity to increase the efficiency of public spending at the national and subnational levels.	**9.1 Public spending planning** Does the government spending align with national plans? **9.2 Revenue distribution** Does the government distribute revenues in an accountable and transparent manner and avoid off-budget transfers and spending? **9.3 Budget and project execution** Does the government spend public revenues as intended? **9.4 Accounting, reporting and oversight of public spending.** Does the government account for and report on revenues and public spending and is there strong oversight of public expenditure?

Precept 10. The government should facilitate private sector investments to diversify the economy and to engage in the extractive industry.	**10.1 Private sector enabling environment** Does the government make general purpose investment and remove bottlenecks to non-resource sector growth? **10.2 Local content** Does the government ensure that domestic businesses and workers have the opportunity and capacity to operate in the extractive sector? **10.3 Sharing infrastructure** Does the government ensure that extractive industry infrastructure is open to third parties wherever economically feasible? **10.4 Domestic value addition and consumption** Does the government take the opportunity to use oil, gas and mineral resources domestically, when the opportunity cost of doing so are less than the benefits?
Precept 11. Companies should commit to the highest environmental, social and human rights standards, and to sustainable development.	**11.1 Trust** Does the company work transparently and seek to build trust with all stakeholders related to its activities? **11.2 Sustainable development** Does the company work to maximize the potential benefits and minimize the social and environmental costs associate with resource extraction? **11.3 Corporate integrity** Does the company act with honesty and integrity?
Precept 12. Governments and international organizations should promote an upward harmonization of standards to support sustainable development.	**12.1 Transparency** Does the international community advance public disclosure requirements for the extractive industry? **12.2 Environmental, social and health protection** Does the international community ensure that resource projects comply with internationally recognized standards of human rights and environmental, social and health protection? **12.3 Corruption and illicit financial flow** Does the international community tackle corruption and illicit financial flow?

Appendix 2: Households Interview guide

2.1 Fishermen

1. Age ……..

2. Marital Status …….

3. Number of Children (what do they do for a living?) ……

4. Ethnicity or place of birth ……

5. Nationality ……

6. Religious background ……

7. Level of education ……

8. Who is the owner of the house you are now occupying? .....

9. What type of materials does the house you are occupying is built with? ……. (Materials here mean the type of bricks e.g. burnt bricks, cement bricks etc. or the wooden materials).

10. How many bedrooms does the house contain? .....

11. What are the roofing materials…… (Observe and note down)

12. What type of energy do you use in your house for,

    a) Cooking? ……..

    b) Lighting? …….

13. How long have you been fisherman in this area?
……..

14. Where is your fishing activity undertaken? ……

15. How many times do you go fishing in a month? ……

16. What is your expenditure for a fishing trip? ……

17. Have you gained any assets from your fishing activities?
……

18. What are your sources of capital (loans from banks, friends and relatives etc.) ……

19. Do you have any other sources of income? ……..…..

20. Do you migrate? If yes, under what circumstances and to where? ……

21. What has been your personal experience in fishing?

a. Before the exploration and production the Natural gas? ……

b. After the exploration and production of the Natural gas? ……

22. Do you experience lean seasons? ……

a. What have been some of your coping strategies during the lean season? ……

23. Are there any projects by the Natural Gas Company which has been beneficial to you as a fisherman? ……

24. Have there been any employment possibilities or opportunities? (for children, relatives?)
.....

25. In your opinion how do you perceive the natural gas project is it an opportunity or a threat to your livelihood activities? .....

2.2 Fish traders

1. Age ……..

2. Marital Status …….

3. Number of Children ……

4. Ethnicity or place of birth ……

5. Nationality ……..

6. Religious background ……

7. Level of education ……

8. Who is the owner of the house you are now occupying? .....

9. What type of materials does the house you are occupying is built with? …….
(Materials here mean the type of bricks e.g. burnt bricks, cement bricks etc. or the wooden materials).

10. How many bedrooms does the house contain? .....

11. What are the roofing materials…… (Observe and note down)

12. What type of energy do you use in your house for,
    a) Cooking? ……..
    b) Lighting? …….

13. How long have you been a fish trader in this area? ……

14. What type of fish do you trade in? ……

15. Have there been changes in fish supply? ……

16. What are some of the market destinations of the fish in Songosongo? ……

17. What is your average daily expenditure? ……

18. Have you gained any assets from fish trading? ……

19. What are your sources of capital (loans from banks, friends and relatives etc.)?
……

20. Do you have other sources of income? ……

21. What has been your personal experience as a fish trader

a. Before the exploration and production the Natural gas? ……

b. After the exploration and production the Natural gas? ……

22. Do you experience lean seasons? ……

a. What have been some of your coping strategies during the lean season? ……

b. Are there any projects by the Natural Gas Company which has been beneficial to you as a fish trader? …….....

c. Have there been any employment possibilities or opportunities to any of your family members or relative? ……

23. In your opinion how do you perceive the natural gas project is it an opportunity or a threat to your livelihood activities? .....

Appendix 3: Interview guide for Songas Company

3.1 Songas official

1. What position do you hold in the company?
.....

2. Can you give a brief history about the natural gas extraction and production in Songosongo?
.....

3. What is your outfit's role in the gas industry? .....

4. What are some of the achievements of the company in Songosongo?

a. Any projects? .....

b. Employment possibilities or opportunities? .....

5. What are the effects of the activities of your company on the livelihoods of people residing in Songosongo? .....

6. What form of compensation do you pay to people whose assets are destroyed with effects of the natural gas operations? .....

7. How would you describe your relations between your company and the residents of Songosongo so far? .....

8. What are the challenges the company faces in Songosongo? .....

Appendix 4: Interview guide for key informants

4.1 Ward/District agricultural and food security officer

1. What types of agricultural activities are undertaken in Songosongo Island? …….
2. As the agricultural officer for Kilwa district how has the Natural gas development in Songosongo affected food production for peasant farmer? .....
3. Do you think food production in Songosongo has increased/gone down with the effects of natural gas development in the area?
4. Give the reasons for the increase or the decline in food production ……
5. Are there farmers who have lost their agricultural land with the effects of natural gas development? ……

6. How has this affected the food security status in Songosongo? ……

7. Was there any compensation given to victims of land loser with effects of natural gas development? .....

8. If yes in 7, explain the type of compensation ……

9. What roles do you play in such a situation as an agricultural and food security officer to maintain food security in the area? ……..

10. In your opinion, currently what are the main source of livelihood for the affected peasant farmers……..

4.2 District Fisheries Officer

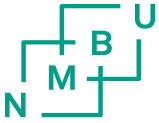
1. What are the fisheries activities undertaken in Songosongo Island? …….....
2. As the fisheries officer for Kilwa district how has the Natural gas development in Songosongo affected fisheries? ……..
3. Is there change in annual catch for the Songosongo and nearby landing beaches before and after the commencement of natural gas project operation? ……..
4. If yes to 3 above, do you think the annual catch has gone down with the effects of the natural gas development? ……
5. Explain the associated reasons for the decline in annual catch……
6. Is there some restriction to fishermen from accessing fishing in areas where they were used to fish before with effects natural gas activities in the ocean? ……
7. What are the effects of gas development in the area to fisheries products? …….

8. How have the fishermen and women communities generally affected by the natural gas development in the area? ……..
9. How has fishery management and conservation activities affected by the natural gas development? ……..
10. How have other aquatic resources affected with the effects of natural gas development? ……..
11. What have been the advice of the fisheries department towards a sustainable run of this project? ……
12. In your opinion do you think the advice have been observed in implementation? …….

4.3 District Natural resources and Environmental management officer

1. Do you think the natural gas development in Songosongo has effects to the environment? ……
2. What were the pre-operational effects to the environment
    a) On land……
    b) In ocean…….
    c) In the atmosphere…….
3. What are the environmental effects with an on-going operation?
    a) On land……
    b) In ocean……
    c) In the atmosphere……..
4. As a district officer for natural resources and environmental management what roles do you play to ensure sustainable run of the natural gas project in your area? ……
5. What do you think is the source of environmental degradation on Songosongo Island? …….
6. In your opinion the natural gas project operates with observance to the national environmental policy? ……

7. Explain how in either way…….
8. Are there some environmental NGOs you are working with in the district? ……..
9. If yes to (8) above what environmental projects does the NGOs run in your area? ……
10. How do local communities involve in environmental management activities and projects? ……..
11. What do you see as environmental challenges in your area including Songosongo Island? ……..
12. What are the causes of the challenges in the specific areas? ……..
13. What hindering challenges do you face when fulfilling your duty? .....



Norwegian University
of Life Sciences

Postboks 5003
NO-1432 Ås, Norway
+47 67 23 00 00
www.nmbu.no