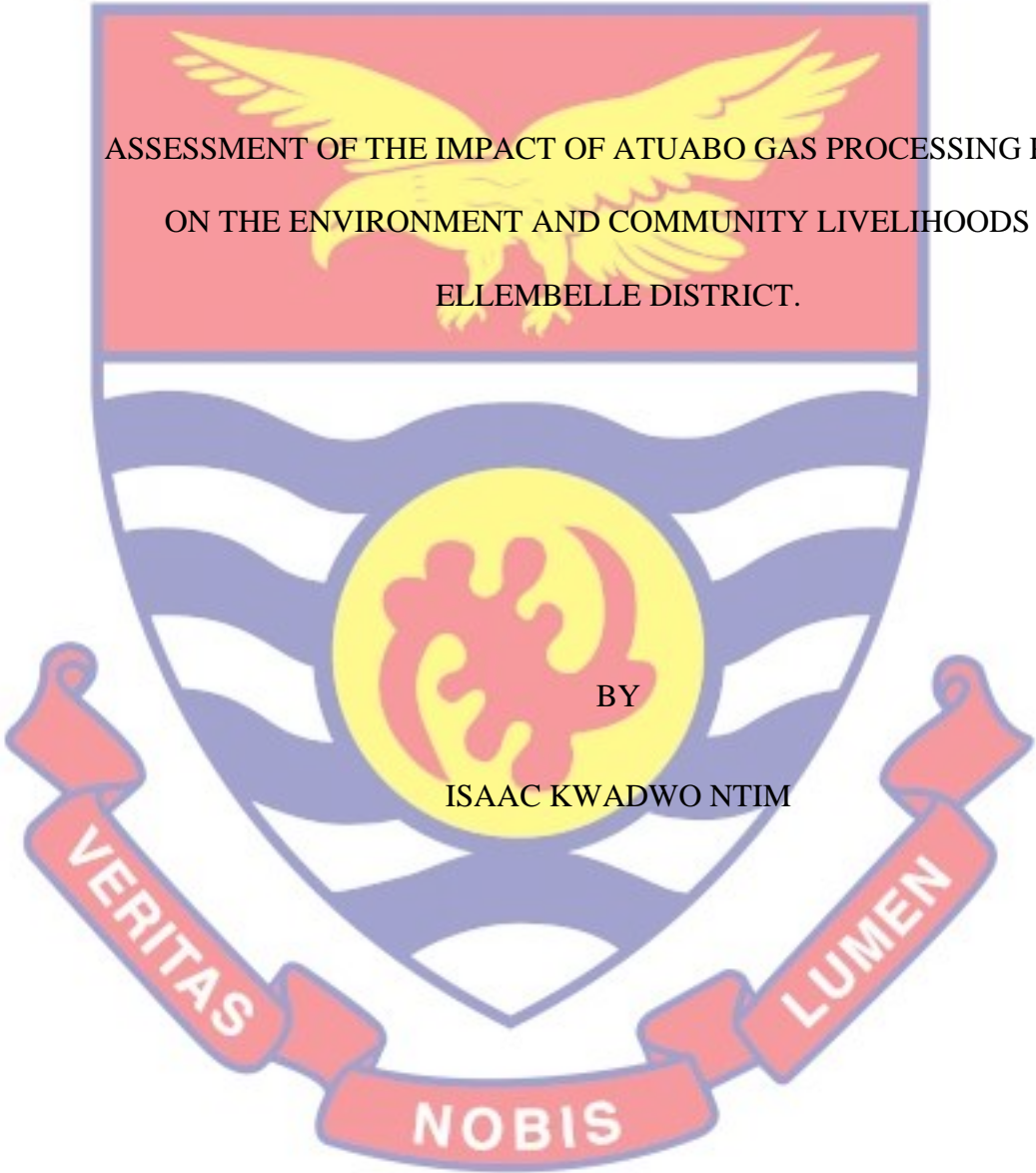


UNIVERSITY OF CAPE COAST



ASSESSMENT OF THE IMPACT OF ATUABO GAS PROCESSING PLANT  
ON THE ENVIRONMENT AND COMMUNITY LIVELIHOODS IN  
ELLEMBELLE DISTRICT.

BY

ISAAC KWADWO NTIM

2021

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THE EFFECT OF ATUABO GAS PROCESSING ON THE ENVIRONMENT  
AND COMMUNITY LIVELIHOODS IN ELLEMBELLE DISTRICT.

BY

ISAAC KWADWO NTIM

Dissertation submitted to the Institute for Oil and Gas Studies of the College of Humanities and Legal Studies, University of Cape Coast, in partial fulfilment of the requirements for the Award of the MBA Degree in Oil and Gas Management.

JULY 2021

## DECLARATION

I hereby declare that; this work was made en route for the acquisition of a degree in a Master of Business Administration in Oil and Gas Management (MBA. OIL and GAS MANAGEMENT) from the Institute for Oil and Gas under the Faculty of Social Sciences. In the process, no component of this work is from previously written works from other persons within or outside this university. To the best of my knowledge, articles consulted have been properly cited within and out of the work.

**Candidate's Name**

**Signature**

**Date**

**Ntim Kwadwo Isaac**

.....

.....

### Supervisors' Declaration

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

**Supervisor's Signature** .....

**Date** .....

**Name: Dr. Edward Kweku Nunoo**

## ABSTRACT

The study sought to provide insights into the effect of Atuabo Gas Processing Plant (GPP) on the environment and community livelihoods of some selected communities in the Ellembelle District. Using a quantitative survey design, a structured questionnaire was administered to assess the effects of gas production and processing on subsistence agriculture and on the physical environment, to analyse the potential impacts of gas production and processing on the coastal and marine ecosystems, and to examine and proffer sustainable coping strategies for residents to deal with the impact on livelihoods. A total of 147 participants were sampled using systematic and convenience sampling techniques. Data collected was then analysed with STATA 14. In addition, institutions and organizations that are related to gas production, environmental and health issues were engaged for relevant data. Findings from the study indicate that gas processing activities to an extent has brought about some livelihood challenges to the inhabitants of Anochie, Atuabo and Essiama and surrounding communities. The challenge is reflected in the loss of lands worsened by poor compensation, continuous decline in fish harvest, higher cost of living and among others. To mitigate such impacts, respondents adopted coping strategies broadly classified into Problem-Oriented Coping Strategies (POCS) and Social-Support Coping Strategies (SSCS). Against these findings, the study recommends among others the establishment of a committee to liaise with companies, government and the community to help mitigate and provide satisfactory compensation to parties affected by gas processing activities.

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## DEDICATION

This dissertation is devoted to my family for their voice of wisdom, commendation, and influence in all the endeavours of my life. In the same vein you inspired and supported me, at this occasion due to your expressive certainty in me to accomplish greater endeavours.



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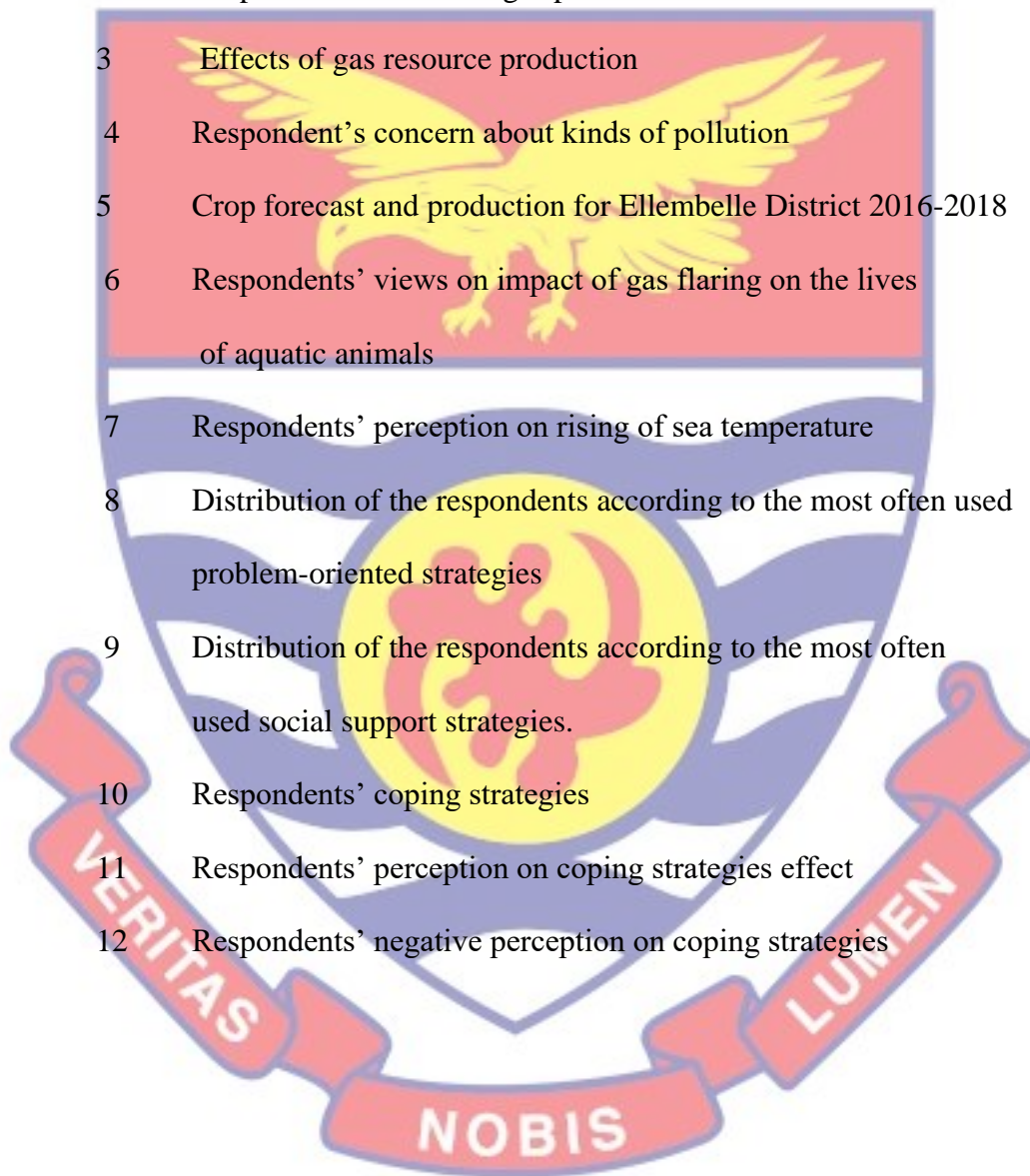
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## LIST OF ABBREVIATIONS



EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERL	Effect Range Low
GHGs	Greenhouse gases
GSS	Ghana Statistical Service
JHS	Junior High School
LMICs	Low Middle Income Countries
NDR	Niger Delta region
NEPA	National Environmental Policy Act
PAHs	Polycyclic Aromatic Hydrocarbons
POCS	Problem Oriented Coping Strategies
SHS	Senior High School
SSSCS	Seeking Social-Support Coping Strategies
UN	United Nations
WHO	World Health Organization

## CHAPTER ONE

### INTRODUCTION

This section will provide background information to the study as well as the problem statement. Also, research objectives and questions will be stated and additionally provide information on how the research will be organized. Together, the following provides a general introduction to the study in question.

#### **Background Information**

The discovery of oil is most of the times associated with great optimism and higher expectation for positive economic development (Agbefu, 2011). This is because of the financial and economic benefit that accompany the discovery of natural resources (Heinberg, 2006; Darkwah, 2010; Osei-Tutu, 2012; Kaku, 2018). The optimism according to Heinberg (2006), is due to society's dependence on petroleum resources. According to him, society has developed technologies that are fuelled by gas and has over the years become a major source of energy especially for transportation (Darkwah, 2010). The availability of such natural resources is seen as a recipe for economic transformation and has the tendency to determine the economic fortunes of most countries. With the world's population projected to increase from the current 6 billion to about 9 billion in 2050 (UN, 2003), it is also expected that global energy demand will increase. Thus, energy supply should correspondingly rise to reliably meet the growing demands.

According to a report by the Energy Information Administration (EIA, 2009) without any reforms to the current energy laws and policies the world marketed

energy consumption is projected to grow by 44 percent between post 2006 to 2030 period. Total world energy use was also expected to increase from 472 quadrillion Btu to 678 quadrillion Btu within the same period. The EIA again reported that the most rapid growth in energy demand is expected to come from nations outside the Organization for Economic Cooperation and Development (non-OECD nations) whiles liquid fuel and other petroleum products are expected to remain the world's dominant energy source. Already, nations have relied on uninterrupted supply of oil and gas over the years to meet their energy needs and it remain critical especially for industrial growth.

The energy situation is quite not different for Ghana that discovered oil in commercial quantities in 2007. For some time now, the Western Region has experienced some level of oil and gas operations in the form of explorations, drilling, development, production, and transportation. These operations without any doubts have generated substantial revenues for both the government of Ghana and operating companies. Oil revenue according to PIAC Report (2014) was about GH¢ 3billion cash or 21% of Gross Domestic Product.

Ghana — the land of Gold was yet again blessed with another natural resource oil – following a successful exploration in 2007. The oil production however started in 2010. With about 368 million tonnes of oil and a commercial amount of associated gas found 60km offshore, between the Deep-water Tano and West Cape Three Points, the government decided to develop a strategic plan to commercialize the associated gas.

In view of this, a ‘National Gas Development Task-force was commissioned in February 2011 by the government to review and make appropriate recommendations for the speedy realization of a national gas commercialization infrastructure system. In April 2011, the Task-force submitted its report recommending the transport and processing of associated gas produced from the Jubilee Field. The government then sanctioned the establishment of an indigenous gas company to undertake the project. As a result, the Ghana National Gas Company (GNGC) was inaugurated in July 2011 as a limited liability company in with the responsibility to build, own and operate the infrastructure required for the gathering, processing, transporting and marketing of natural gas resources in the country.

The Offshore Pipeline, the Onshore Pipeline, the Gas Processing Plant, the Natural Gas Liquids (NGLs) Export System, and the Office Complex and other facilities were to be established as part of the Western Corridor Gas Infrastructure Development Project also known as the Early Phase Infrastructure Development Project.

The GNGC is now Ghana’s premier mid-stream gas processing company that owns and operates infrastructure required for the gathering, processing, transporting and marketing of natural gas resources to customers. GNGC although incorporated in July 2011, started official. production in November 2014. The company is responsible for processing and commercializing lean gas, condensate, LPG and isopentanes and also plays a key role in accelerating the nation’s industrial sector by providing cost competitive natural gas based products for

domestic markets including the development of petrochemical industries, fertilizer and power generation, as well as export promotion.

Ghana Gas operates on a business model and thus, obtains revenue through the processing, transportation and sale of natural gas and NGLs. GNGC currently supplies gas to Volta River Authority (VRA) for power generation.

The company has its headquarters in Accra, with their main infrastructural gas processing plant situated at Atuabo, in the Western region of Ghana.

According to Palley (2003), African oil producing countries derived revenues from this resource and yet has not helped to improve the quality of life of their citizens especially those living very close to the drilling sites. Palley (2003) further argues that natural resource curse most often occurs because the income from these resources is often misappropriated by corrupt leaders and officials instead of being used to support growth and development. Following oil discovery, the inhabitants of the Western region had hopes that the oil and gas discovered would result in higher wages, increased employment, and a better standard of living because to most Ghanaians, the nation has struck gold (Kaku, 2018). Scholars have investigated the impact of petroleum exploitation over the years. Land degradation, air and water pollution as well as biodiversity loss and others have been found to be caused by oil exploitation. The ecology of host communities is typically threatened by oil and gas activities in the form of gas flaring, effluents discharges and others leading to environmental degradation. In a study by Hermas (2016), he found out that several residents within the Ellembelle District complained that huge bushes on the beach were caused by oil and gas



production – contaminating their ecosystem, increased temperature, hurting fishermen activity and taking away arable lands and loss of local economic activities which serve as sources of livelihoods to indigenes (Hermas, 2016). According to Omajemite (2008), oil industries in Niger Delta have introduced pollutions as liquid discharges and oil spills into air, land, and water components of the environment. Environmental degradation theory states that oil spills and gas activities has worsened the economic level of people by destroying the once abundant fishing grounds and decreasing availability of quality agricultural lands thereby furthering impoverishment of those affected (Kingston, 2011).

The prevalence of negative environmental impacts from oil and gas activities is partly due to ineffective Environmental Impact Assessment (EIA). EIA began as a reactionary regulatory control for identifying and mitigating environmental contamination. However, it is today viewed as a more strategic, holistic, and complete instrument for ecological development and preparation (Morrison, 2018; Gibson, 2006). Nonetheless, notwithstanding the over 40 years of practice and significant investigations, there is an absence of a clear assessment of EIA's effectiveness as a means of assuring better sustainability monitoring of sustainable innovations (Boyden, 2007; Cashmore et al., 2004), and the magnitude to which EIA has backed environmental management is basically invisible (Cashmore et al., 2004). As a result, this research is focused on determining the influence and impacts of gas processing on agricultural production and the environment in Atuabo and its surrounding communities.

## Statement of the Problem

According to Palley (2003), impacts of oil and gas production on host communities in Africa have posed challenges to several nations. Countries such as Angola, Cameroun, Equatorial Guinea and Nigeria have been producing oil and gas on their continental shelves over some years now. However, the extraction of these resources does not always translate to improved living standards of the indigents around production and operations sites. This as a result in some cases makes those living in Project Affected Communities (PAC) bitter as they developed hostile attitudes towards the operations of the oil and gas companies. Ghana in the Sub region for the past decades been engaged in oil and gas operations. In many areas around the world, scholars have recognized and studied the impacts of exploration of oil and other natural resources on livelihoods. While some of these scholars (Adusah-Karikari, 2015; Amoasah, 2010; Barker & Jones, 2013; Kumar et al., 2013; Manu, 2011; Obeng-Odoom, 2013; Planitz & Kuzu, 2015; Planitz, 2014) have conducted several studies to examine the potential impacts of the Ghanaian petroleum industry on the environment and society, there are only a few that acknowledge the differential impacts of the industry on different segments and subgroups within the society (Adusah-Karikari, 2015; Ayelazuno, 2014; Boahene & Peprah, 2011; Obeng-Odoom, 2013).

The rigorous scientific and industrial activities and operational routines of Ghana Gas have made host communities (Anochie, Atuabo and Essiama) perceived that their environment is been severely endangered by oil and gas pollution in the form of oil spills, gas flaring (isopentane), effluents and destruction of vegetation

cover. For instance, host communities claimed there are certain large weeds on the seashore purported to have come because of oil and gas operations, which are polluting their environment and affecting fishing activities. Furthermore, the oil and gas activities through liquid discharges and oil spills as well as gas flaring have rendered the soil infertile, burns vegetation and kill useful soil organisms which has hampered growth agricultural output and productivity within the surrounding communities.

Regardless of the measures put in place to ensure adequate and pragmatic lean gas processing, transporting and management of pollution levels and Environmental Impact Assessment (EIA) as a reactive regulatory control for environmental pollution at Ghana Gas, surrounding communities experiences some form of pollution most of which have been attributed to the oil and gas operations. In the same vein, traditional authorities no longer have the power to enforce local customary laws that once preserved and ensured the sustainable use of coastal and marine ecosystems and the physical environment due to the current system of governance in the country. There is the fear that if nothing is done to reverse the deteriorating condition of the agricultural lands and the ecosystems, it will soon deteriorate, both physically, biologically and hydrologically (Adger et al., 2001). It is thus time to consider restoration or rehabilitation program needed to curb the continual deterioration of the water bodies and biodiversity to restore the health of the rivers and the lands to a 'good' ecological status. Improving damaged ecosystems is a way of conserving aquatic species, ecosystem functions and biodiversity. However, not many studies have been conducted to critically access

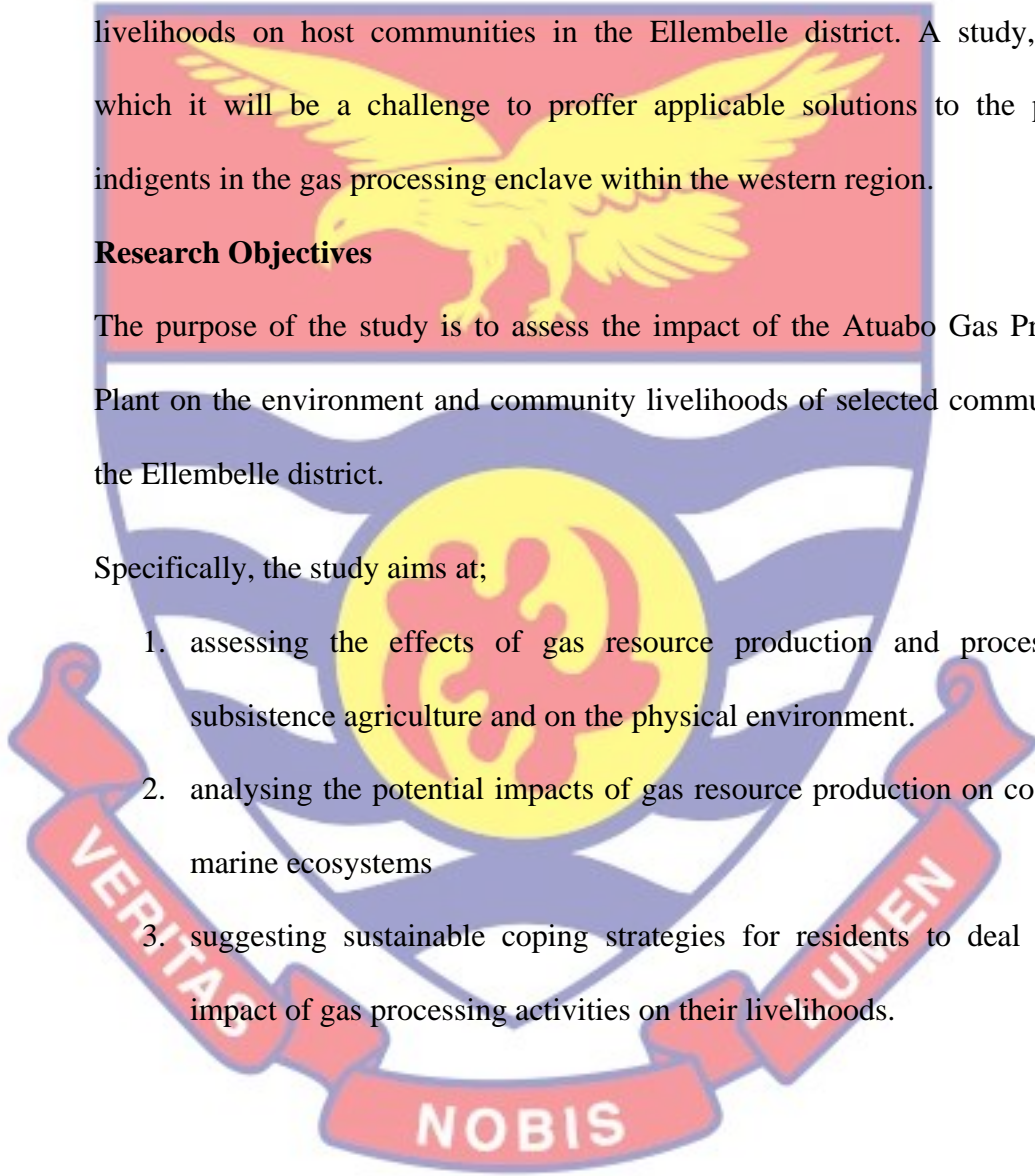
the impact of Gas processing in the area to help authenticate the truth or otherwise of the many challenges purported to have been borne out of gas processing in the vicinity. Therefore, the aim of this research is to assess the effect of Atuabo gas processing plant and its operations on the environment and community livelihoods on host communities in the Ellembelle district. A study, without which it will be a challenge to proffer applicable solutions to the plight of indigents in the gas processing enclave within the western region.

### **Research Objectives**

The purpose of the study is to assess the impact of the Atuabo Gas Processing Plant on the environment and community livelihoods of selected communities in the Ellembelle district.

Specifically, the study aims at;

1. assessing the effects of gas resource production and processing on subsistence agriculture and on the physical environment.
2. analysing the potential impacts of gas resource production on coastal and marine ecosystems
3. suggesting sustainable coping strategies for residents to deal with the impact of gas processing activities on their livelihoods.



## Research Questions

The study's goal is to respond to the research questions below:

1. What are the effects of gas resource production and processing on subsistence agriculture and on the physical environment?
2. What are the potential impacts of gas resource production on coastal and marine ecosystems?
3. What are the sustainable coping strategies for residents to deal with the gas processing impact on livelihoods?

## Organization of the Study

This research is divided into five chapters. The first chapter of this project deals with the study's broad introduction. It examined the study's background, problem description, study rationale, research questions, study objectives, and study organization. The second chapter examined a review of related literature. It discusses the study's theoretical basis. The third chapter focuses on the study methodology used in the project's execution, which includes: research design; study population; sample and sampling procedure; data collecting; and data analysis. The fourth chapter summarizes the study's findings and accounts for debates on the outcomes. The research ends with chapter five, which discusses conclusions and suggestions.

## CHAPTER TWO

### LITERATURE REVIEW

#### Introduction

This chapter reviews literature on the concept of assessment of the Atuabo gas processing plant on the environment and community livelihoods. It expatiates on the effects of gas resource production on subsistence agriculture and on the physical environment, potential impacts of gas resource production on coastal and marine ecosystems and coping strategies adopted by residents in dealing with the environmental impact.

#### Theoretical Review

Three theoretical frameworks which are considered appropriate in this study would bring out relevant problems caused by oil and gas operations on the environment and community livelihoods. The theories are Environmental Degradation theory, Socio-economic Problems theory and Environmental Externality theory.

#### Environmental Degradation Theory

The Environmental degradation theory broadly assumes that oil spills and gas activities has worsened the economic level of people by destroying the once abundant fishing grounds and decreasing availability of quality agricultural lands thereby furthering impoverishment of those affected (Kingston, 2011). Diverging views have been given to explain the concept in context by some scholars. In a recent study, Maurya et al., (2020) defined environmental degradation as the deterioration of the environment through depletion of resources which includes all

the biotic and abiotic element that form our surrounding that is air, water, soil, plant animals, and all other living and non-living element of the planet of earth. Such a phenomenon, as identified by Sarah Wiggins (2009), is proceeding rapidly and is already affecting many communities in developing countries. According to Singh (2009), environmental degradation to some extent is an inevitable consequence of natural processes and human activity. These natural processes have significant impact on humans and the environment. Evidently, Suhrke (1993), had pointed out that environmental degradation did play a part by contributing to poverty in affected communities.

The impact of environmental degradation is enormous and Sarah Wiggins (2009), in her study identified (5) of such impacts as;

1. destruction of forests, causing soil degradation and threatening agricultural livelihoods
2. building of dams or diverting rivers upstream causing water shortages and increased workloads to collect water
3. destruction of coastal protection such as mangroves, leading to exposure to storm damage, water-logging of soils, and relocation of communities
4. smoke and air pollution from factories using chemicals causing increased ill health
5. all the above can lead to increased poverty.

Thus, environmental degradation theory tries to appreciate the remote causes of the phenomenon. Hydrocarbon exploration and productions and its associated

impact on communities, including environmental degradation, affect humans and the environment in general.

### **Socioeconomic Problems theory**

Socioeconomic Problem theory may refer to a combination of economic and social theories. The activities of the oil industry have often resulted in a different multitude of social, environmental, and economic problems such as environmental pollution, occupational dislocation, rural-urban drift, unemployment and poor human health (Ugbomeh, 2007; Omajemite, 2008). Oil and gas pollution cause damage to human health, agricultural land and fishponds. Also, arable farmlands have been lost to oil pollution as a sizable farmland in the Niger-Delta Region have been rendered barren due to oil spillage and leakages (Elis, 1994).

### **Environmental Externality Theory**

Environmental Externality theory on the other hand states that externality are benefits or cost generated as an unintended outcome of an economic activity that do not accrue directly to the parties involved in the transaction and when no compensation takes place. They manifest themselves through changes in the physical-biological or a group confers to others positive effects or reward. A technological spill over is a positive externality which occurs when the firm's invention not only benefits the firm but also enters the society's pool of technical knowledge and benefits the society. On the other hand, pollution is a negative externality which occurs for instance, when a factory discharges its untreated effluents in a river, the river is polluted and consumers of the river bear cost in the form of health cost or/and water purification. Pigou (1920) externality theory



deals with the problem of smoke emission by a factory damaging nearby business or residents. His solution for correcting the negative externality is to impose a per unit tax on output to the factory generating the negative externalities. The per unit tax should be equal to the difference between the social marginal cost and the private marginal cost corresponding to the social optimal output, the output satisfying the condition, the price equals the social marginal cost. Imposition of such a tax will raise the output price and reduce the demand thereby helps in internalizing the environmental cost to some extent in the decision of producers and consumers of the product. Negative externality theory has been described earlier, arises when the welfare of one party is adversely affected by the action of another party and the loss in welfare is uncompensated for due to a lack of liability to third parties who suffered the damages. The negative externality theory as proposed by Pigou is very much relevant to this research. In this instance government of Ghana should not rely only on economic incentives to dealing with environmental pollution, economic challenges or those adversely affected groups in host communities but must also critically regulate via law in addressing negative consequences.

### **Empirical Review**

#### **Natural Gas Flaring**

Crude oil extraction is frequently characterised by the generation of contaminated natural gas, thus the phrase associated gas. Approaches for managing associated natural gas from crude oil production involve re-injection into the earth, on-site power generation, combustion and tube transfer to natural gas treatment plants on the way to marketisation. Combustion of natural gas is the deliberate combustion

of natural gas for economic and operational purposes (Cathles et al., 2012). The technical explanation may be a lack of necessary technology and natural gas facilities, whilst the monetary cause might be the high capital-intensive aspect of establishing natural gas facilities and the sustainability of such a venture. In the absence of the facilities to commercialise the associated gas, the gas is sometimes flared. The World Bank described gas natural flaring as a human activity that results in the inefficient production of greenhouse gases (GHGs), which contributes to global warming, soil imbalance, unpredictable weather patterns, and major natural catastrophes (Uchegbu, 2014). It goes on to say that natural gas flaring releases several toxic chemicals, including but not limited to benzene, that are hazardous to humans, animals, plants, and the whole physical environment (Epstein *et al.*, 2002). Natural gas flaring happens when undesired or flammable natural gas and liquids are burned through the flare stack throughout crude oil activities. Other causes for natural gas flaring include safety precautions and crises, machinery and power outages, or necessities that endanger employees or residents. However, the abhorrent practice is increasingly prevalent in several underdeveloped economies (World Bank, 2011).

### **Negative impact of natural gas flaring**

Natural gas flaring in places such as the Niger Delta Region (NDR), according to Oni & Oyewo (2011), has several detrimental impacts on the plants, humans, and the microclimate. The idea is that using natural gas has resulted in huge environmental pollution, accompanied by ecological degradation. Environmental pollution affects fisheries, agriculture, and other agricultural activities, resulting in reduced crop production and productivity, as well as increasing poverty in the

Niger Delta area. Also, Ubani & Onyejekwe (2013), in a similar study that used soil and rainfall samples from locations and populations around natural gas flaring sites, discovered that gas flaring has resulted in increased soil temperature and the formation of acid rain in these areas. The increased soil temperature and acidity content of rainfall are thought to be to blame for marine organism loss and water-borne illnesses widespread in the vicinity.

Rainwater acidity, according to Ubani and Onyejekwe (2013), accelerated the amount of deterioration and devaluation of roofing system or sheets in buildings, resulting in a shorter life span and higher building maintenance expenses in the nearby communities. Natural gas flaring, according to Jideani et al. (2012), increases the risk of respiratory illnesses, asthma, cancer, and early mortality. Because remains from natural gas flaring comprise a combination of extremely hazardous chemicals such as carbon dioxide, methane, oxides of nitrogen, and sulphide that are released into the environment. According to Jideani *et al.* (2012), incomplete combustion of natural gas produces benzene, toluene, xylene, and hydrogen sulphide. These chemicals are hazardous to human health. Combustion from burned natural gas comprise about 250 chemicals that have been proven to be harmful and toxic to the ecosystem and human environment. Furthermore, studies indicated that direct natural gas leaking into the atmosphere triggered several days of bush fires in the NDR, heating up the atmospheric air and destroying plants and animals (Zabbey, 2004). Additional harmful environmental issue of natural gas flaring in the NDR is light pollution. Light pollution is defined as a continual massive flame with infinite brightness emitted by natural

gas flaring stacks, exposing inhabitants, plants, and living organisms to artificial sunshine. Because of the detrimental effects of light pollution, animals were driven to relocate from their native habitats, resulting in decreased fertility and a high death rate (Agbebi, 2011; Uhren & Doucet, 2004).

Aghalino (2009), highlighted the loss of prominent botanical forest species with economic and medicinal significance by natural gas flaring in the NDR, emphasizing the detrimental impact of natural gas flaring on the environment and people. Natural gas flaring generates screaming sound from flare stacks, forcing residents of the area to converse in an unusually high range tone due to prolonged exposure to strong noise and vibrations from natural gas flaring stacks (Agbebi, 2011; Uhren & Doucet, 2004). Again, according to the World Health Organization (2011), the adverse consequence of excessive noise includes sleep and cognitive disruption, interruption with spoken interaction, partial deafness, cardiovascular disruption, and other adverse health concerns. Natural gas flaring has been linked to lower mortality rate and greater poverty in the resource rich NDR, according to Sunday and Ubi (2012). This is a classic case of the "resource curse." With additional detrimental consequences on agricultural production, revenue, capital (buildings), health, relocation, and labour specialization from agriculture (Esu & Dominic, 2013). Further investigations revealed the frequency of respiratory illnesses, a high new-born death rate, and complications after labour. Two popular fishery lakes (Ovie and Eni lakes), which were formerly sources of livelihood and sustenance for the neighbourhood, turned poisonous and

disappeared because of evaporation caused by the high heat from flare stakes (Nyong, 2017).

### **Effects of gas resource production on subsistence agriculture**

The standard of living is essential to the development and growth of humans, as well as the longevity and nourishment of animals and plants in general. Omorede (2014), placed environmental degradation second only to economic challenges as one of the world's contemporary issues. Tyonongo (2008) states that “environmental degradation is critical because the ability of the environment to support and sustain life depends on the proper natural balance of its properties; soil, water, air, plants and animals.” Oil resource extraction, which entails the creation of different chemical and seismic waves, is a major cause of environmental damage, notably through liquid discharges, oil spills, and gas flaring. As a result, different materials are discharged into the environment during oil production and related activities (Rana, 2008). Petroleum production has some impact on soil fertility, destroys plants, and kills important soil organisms and thereby reducing agricultural production and productivity in the process. Adekoya (2003), contends in his study that before mineral resources can be exploited, they must first go through the stages of exploration, extraction, and refining; various forms of environmental degradation and risks often follow these three stages of mineral development. According to his reasoning, petroleum is a complex combination of aliphatic, alicyclic, and aromatic hydrocarbons, as well as polar organic molecules. When these elements encounter the environment, they may change into various arrangements. Oil spills (whether crude or purified), natural gas flaring, and deforestation, all of which are closely connected with oil

production, are prevalent in oil towns and have resulted in significant environmental damages (Eweje, 2006). Because of the hazardous nature of the chemicals released, they contaminate the environment and create water and land pollution, with serious repercussions for human health, aquatic and terrestrial life (Whitney, 1996). Furthermore, once the environment has been poisoned, it might pose a hazard for many years. For example, fish in surface waters are destroyed, causing fishermen in such locations to lose their source of livelihood. Furthermore, when there is an oil spill on water, it spreads quickly and the gaseous and liquid elements evaporate. Others react with water and even oxidise, while others go through bacterial alterations and finally fall to the bottom due to gravity activity (Nwilo & Badejo, 2006). This land is then polluted, having a significant impact on living organisms. As the evacuation of the volatile lower molecular weight elements has an impact on aerial life, so does the dissolving of the less volatile components in the resultant emulsified water have an impact on aquatic life (Akpofure et al., 2000).

In Nigeria, for instance, approximately 62.8% of oil leak incidents happened on farm fields (Omoredede, 2014). A significant consequence has been the decline in the supply of fish items, which has also resulted in their high price. Statistics also show that between 1976 and 2005, there were a total of 9,107 oil leak incidents in Nigeria, culminating in about 3,121,909.8 barrels of oil discharged into the environment (Omamuyovwi & Akpomuvire, 2017). The Escravos disaster (Funiwa-5 blow-out) of over 400,000 barrels of oil flowing across the Delta area contaminating over 1,200 km<sup>2</sup> is one of these big disasters (Nwilo & Badejo,

2005). Around 180 people died in the tragedy, and 300 more became ill because of drinking contaminated water and consuming poisoned foods in the impacted districts (Nwilo & Badejo, 2005). In addition, the Jesse spill in 1998 caused in a fire that took over a thousand lives and devastated the delicate environment. The UN System (2001) and Jaiyeoba (2002) all concurred on the significant negative impacts of hazardous compounds emitted by oil spills on land, water, minerals, and living things. Oil spills have also resulted in significant deforestation and insufficient restoration techniques.

According to Essoka et al (2006), heavy metal concentrations were detected in the Warri area of Nigeria, and the oil sector posed a possible threat to its immediate surroundings owing to the high amounts of heavy metals reported. Farming, which is the foundation of the area's agricultural economy, is affected to an extent and human health is also at risk.

These points to the devastating impacts of oil and gas activities and its impacts on the environment and human health.

### **Oil and gas production and its effects on the environment**

Indigents who reside near drilling sites face environmental hazards because of oil production. According to Bisina (2004), oil extraction and excavation in Nigeria's Niger Delta Area have created acid rain, polluted the air and water, and caused severe erosion to the ecosystem, loss of the vegetation cover of the land. The whole process of acquiring resources, including discovery, exploitation, preparation, transportation, preservation, and use generate pollution. All these activities have a negative impact on the environment (Iwejingi, 2013). Destruction to petroleum pipelines, accidents involving oil vehicle tankers, oil spills, and

hydrocarbon emissions all contribute to environmental issues. As a result, the overall process of oil exploration has a detrimental impact on the environment, occasionally resulting in pollution and health issues (ibid). The Ghanaian government penalised Kosmos Energy US\$35 million in 2010 for dumping 706 barrels of hazardous material into the sea, causing environmental harm (Obeng-Odoom, 2014). According to Kaku (2018), this leakage might result in the loss of aquatic life, as well as suffering for those whose livelihoods rely on such aquatic life. The environmental impacts of oil extraction can be harmful to the health of residents in the nearby communities (O'Callaghan-Gordo *et al.*, 2016). This effect is exacerbated in Low and Middle-Income Countries (LMICs), where it is projected that around 638 million people, primarily in rural areas, experience oil exploration-related health problems (O'Callaghan-Gordo *et al.*, 2016). They have health problems because of factors such as lengthy periods of stay at mineral deposits and the use of polluted water and food. Individuals who are not involved in oil operations, such as pregnant women, children, babies, and the aged, are also affected. Administering environmental regulations in LMICs is thus difficult. Furthermore, regulatory bodies could be missing. As a result, communities near drilling sites are more exposed to petroleum environmental concerns. Regarding this, catching fish and agriculture purposes, the population's primary professions, are no more appealing or feasible, resulting in poverty, starvation, and hopelessness between these individuals, who on daily basis struggle to make a living (Concannon, 2004).



### **Impact of Oil Production on Marine and Coastal Ecosystems**

The expansion of the petroleum industry has resulted in significant economic benefits for several countries across the world. Nevertheless, harvesting these financial advantages has not been without drawbacks, since a variety of adverse environmental effects may endanger the long-term efficient, biological and environmental sustainability of aquatic and coastal ecosystems (Barker & Jones, 2013; Perhar & Arhonditsis, 2014). As per Barker & Jones (2013), the Millenary Ecosystem Research outcomes show a reduction in biodiversity loss that is accompanied by slow success rates in the world's seas. As per Perhar and Arhonditsis (2014), several of the pessimal bionomical disasters in worldwide commerce have occurred because of crude oil spillage in submerged environments. As a result, Evans (1986) advocated for a conscientious balance among deep-sea hydrocarbon exploration and the possibilities for aquatic contamination. The largest perceived dangers in offshore oil and gas production are oil spills and ejections, which have received a lot of attention in current history (Barker & Jones, 2013; Ko & Day, 2004; Perhar & Arhonditsis, 2014). Aquatic organisms have age long been recognized to be highly robust and an inexhaustible fender, but the ongoing strain in which they have been under owing to fast developments in technological advancement and limitless human need has revealed that, although incredibly adaptable, marine ecosystems may also be equally susceptible (Perhar & Arhonditsis, 2014). Within the marine ecosystem, complicated relationships between ecosystems and environment occur to keep equilibrium for optimal productivity. This delicate equilibrium might be fragile in respect to contamination from anthropogenic sources like as oil and gas activity

(Barker & Jones, 2013; Evans, 1986; Perhar & Arhonditsis, 2014). The mechanisms that initiate crude-related operations influence oceanic lives and seaward habitats have been classified as unswerving (oil spillage and waste product discharges) and intermediate (modification of hydrology and water status consequences of generated water system) (Jiang et al., 2001). The emergence of oils and gas into marine ecosystem via oil spills and flares threatens marine organisms, varying from non-lethal impacts such as intoxication and physical adaptations to the potential of total ecosystem interruption due to the destruction of responsive, insensitive living forms. The annihilation of these existence reduces nutrients supplies, resulting in cascade impact toward all biological process levels and harming all underwater creatures much as plant life, fauna, fish, mammalians, and others (Barker & Jones, 2013; Ko & Day, 2004; Perhar & Arhonditsis, 2014). Numerous research have already been undertaken to examine the effects of oil and gas services industry operations on aquatic habitats in peculiar places and occurrences.

Evans (1986), again examined the effects of poor waste management in the oil and gas sector on the body of water ecosystem, with a focus on Scotian Ledge in Canada. This study focused on benthonic and different highly delicate populations to identify the immediate but also the sub-lethal and long-run environmental consequences of oil spills in the ocean. He discovered that sub-lethal and chronic poisoning induced even greater worry than chronic. After the lengthy exposure time, crustaceans were lethargic and moulted slowly, and their food chemoreceptors were hindered. Mussels' rate of growth was likewise

reduced by 68% after 30 days of vulnerability, whereas fin fishes developed slowly and had lower nesting efficiency. Evans (1986), stated that the heaping of organic chemical compounds onto the marine environs may possibly trigger severe disturbance in the fishing business since almost industrial organisms would sustain harm. According to Sojinu et al. (2012), discharge of different waste products such as heavy metals and Polycyclic Aromatic Hydrocarbons (PAHs) from pyrolytic and petrogenic processes endangers viability of environments, inhabitants in Nigeria. In animals, PAHs associated with the atmosphere have been proven to be having carcinogenic and mutagenic in nature. Sojinu *et al.* (2012) discovered the proximity of PAHs in substance examined after conducting routine deposit toxicity tests on matter and soil particles obtained albeit research region by evaluating results. The major source was petroleum mining processes. All singles PAHs identified in sediments from all sites in which samples obtained, according to Eco toxicity testing. Aside from naphthalene and chrysene quantities that has unreasonable higher content to cause biologic abnormalities in species at specific places, majority of PAHs were below the impact region minimal (ERL) and offset impression level (TEL), indicating that have devalued significant Eco toxicity impacts.

#### **Coping strategies of gas processing victims**

Coping is defined as adaptations that are “an array of short-term strategies adopted in response to crises” (Patnaik, 2010). Attempts to understand how families and people reacted to crises led to the development of the notion of "coping strategies" (Skoufias, 2003). People cope to sustain collective well being, which includes job stability and communal standing. When shock or stress threaten the

foundation of a livelihood, it shifts into stress management, which are short-term analyses of previous performance efforts to sustain the foundation of the survival while the pressure is current (Weichselgartner & Kelman, 2015). Dietary intake and wellness are medium - term objectives that every household must address daily. Longer-term goals such as livelihood stability and community status include strengthening assets and social standing to enhance future claims on resources (Armah *et al.*, 2010). To handle a household's various requirements and expectations, successful coping must be adaptable. The capacity of a family to cope effectively is connected to the household's resilience in the face of exogenous ecological conditions, as well as endogenous qualities such as socio-economic status or demographic make-up. Successful adaptation can be attributed not just to the nature, duration, and degree of the catastrophe encountered, but also to the household's underlying resistance (Armah *et al.*, 2010). Nevertheless, it is uncommon to discover situations in which the trigger for an individual level survival tactic to be utilized can be attributed to a single external or endogenous characteristic (Mertz, 2009). Individual level coping strategies are techniques that farm workers employ to respond to local problems or disasters (Mortimore & Adams, 2001). Lazarus' Cognitive Appraisal Model of Coping provides the theoretical framework for this research study's coping analysis. According to the Lazarus Framework, stress dealing composed of three processes: primary appraisal – the process of viewing a situation as a misery, a danger, or an opportunity; secondary appraisal – the process of perceiving a possible reaction;

and tertiary appraisal – the process of dealing reserves or asset evaluation. Within this paradigm, the way community folks see their shared clash is an appraisal.

Folkman *et al.* (1984), categories farmers coping as problem-oriented and social support oriented based on the prevailing circumstances. Problem-solving or problem-management activities are directed towards resolving or managing the source of the suffering. It covers techniques for obtaining knowledge, making choices, organizing, and dispute resolution. This sort of coping attempt is typically aimed towards collecting resources to aid in the resolution of the root issue and comprises manipulative, situation-specific, and task-oriented behaviours (Folkman & Moskowitz, 2004). Stress could have negative socio-psychological impacts on farmers (Johnson & Ortega (1994)). As per Stansfeld *et al.* (2006), social support centred is a sense or feeling of being loved and cared for by others, of being regarded and cherished, and of being a member of a social network of mutual help and duties. Social support regularly decreases psychological discomfort, such as sadness or worry, during periods of stress and facilitates psychological adjustment to a wide range of persistently stressful situations, according to research (Taylor & Stanton, 2007). Physical health and survival are also aided by social assistance.

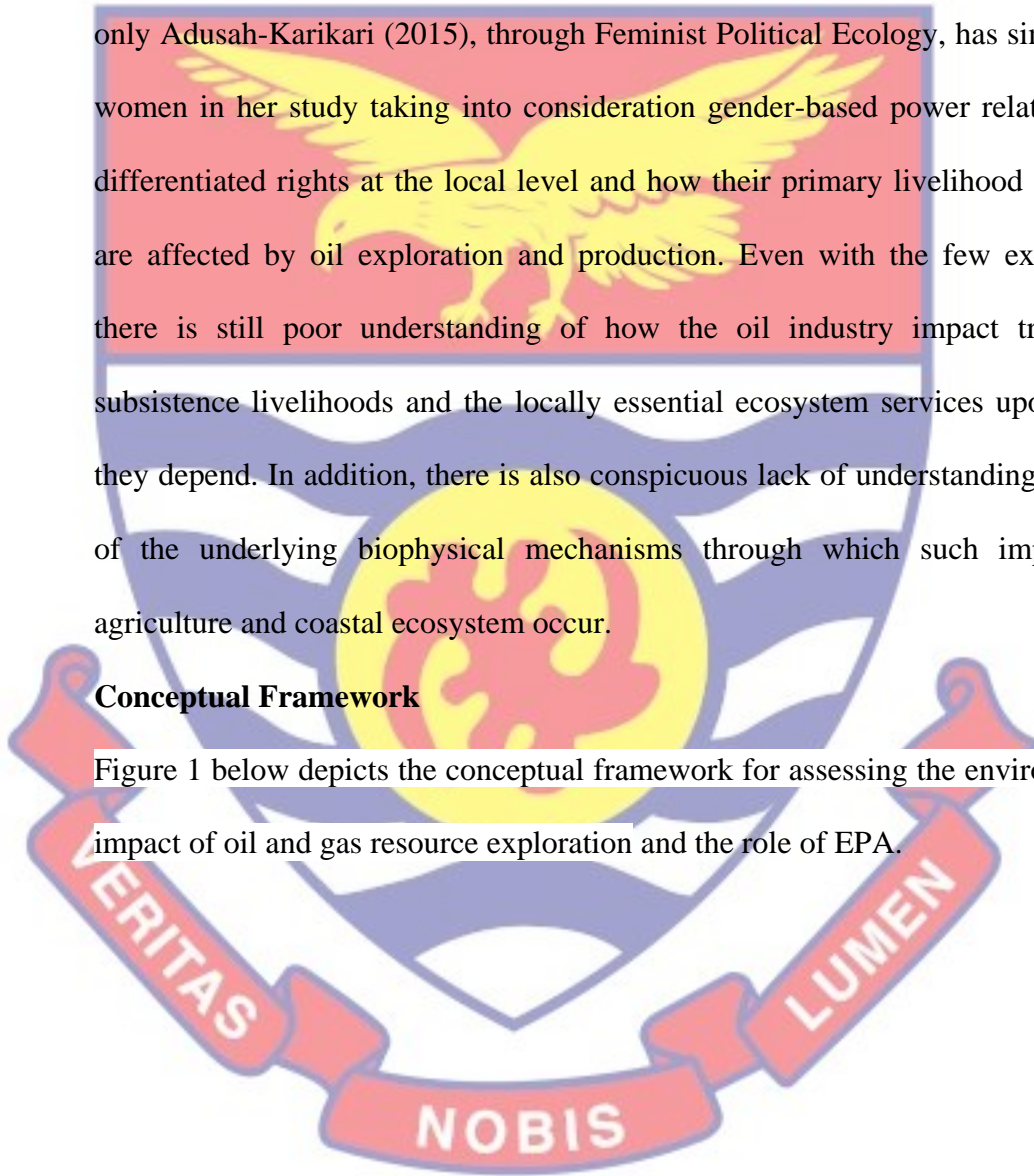
### **Gaps in Existing Studies**

In many areas around the world, scholars have recognized and studied the impacts of oil and gas processing and other natural resources. While many scholars (Adusah-Karikari, 2015; Amoasah, 2010; Barker & Jones, 2013; Kumar *et al.*, 2013; Manu, 2011; Obeng-Odoom, 2013; Planitz & Kuzu, 2015; Planitz, 2014) have already conducted several studies to examine the potential impacts of the

Ghanaian oil industry on the environment and society, there are only a few that acknowledge the differential impacts of the industry on different segments and subgroups of the society (Adusah-Karikari, 2015; Ayelazuno, 2014; Boahene & Peprah, 2011; Obeng-Odoom, 2013; Obeng-Odoom, 2009). As a matter of fact, only Adusah-Karikari (2015), through Feminist Political Ecology, has singled out women in her study taking into consideration gender-based power relations and differentiated rights at the local level and how their primary livelihood activities are affected by oil exploration and production. Even with the few exceptions, there is still poor understanding of how the oil industry impact traditional subsistence livelihoods and the locally essential ecosystem services upon which they depend. In addition, there is also conspicuous lack of understanding of some of the underlying biophysical mechanisms through which such impacts on agriculture and coastal ecosystem occur.

### **Conceptual Framework**

Figure 1 below depicts the conceptual framework for assessing the environmental impact of oil and gas resource exploration and the role of EPA.



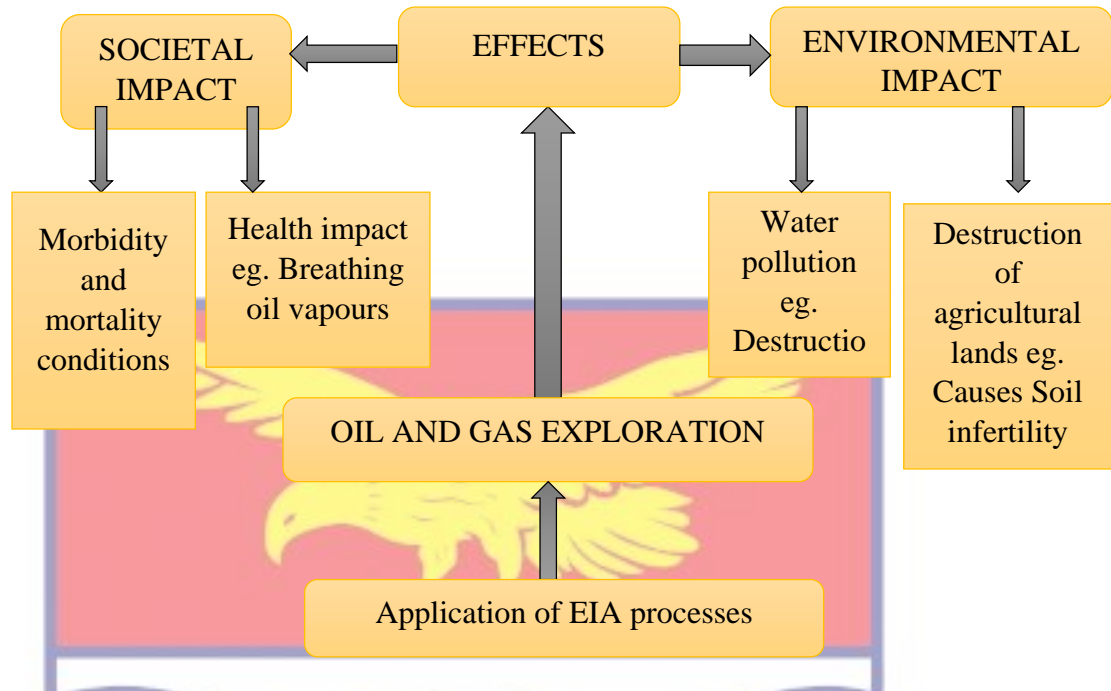


Figure 1: Conceptual framework of effect of oil and gas resource processing on the environment

Environmental and societal effects are the possible consequences of oil and gas processing. Therefore, effective application of EIA processes can help reverse these menaces if not totally mitigate it. Figure 1 above depicts and oil and gas related activity and its potential impact on the environment. The role of a regulating institution such as the EPA is to ensure that oil and gas operations have minimal or no impact on the environment and people. Through an effective EIA process, it is expected that the oil and gas activity will have little and manageable societal and environmental impact. The absence, and the existence of an ineffective EIA process will to some extent make the oil and gas operations have adverse effect on society and the environment. Such impact could reflect in a degraded agricultural lands, water and air pollution with its corresponding impacts on human health.

## CHAPTER THREE

### RESEARCH METHODS

#### Introduction

The research technique utilized in this study is described in this chapter. It describes the research field, sample technique, data gathering procedures, data analysis, and the ethical assertion.

#### Research Design and Approach

The study was quantitative using survey design. Broadly speaking, the purpose of the quantitative research is to examine the relationship between variables and to determine whether the predictive generalizations of a theory hold true (Creswell, 2009). Rahman (2016), also adds that quantitative research is a research strategy that emphasises quantification in the collection and analysis of a data. A survey on the other hand is a research strategy that involves the collection of information from a sample of individuals through their responses to questions (Ponto, 2015). In other words, it involves the structured collection of data from a sizeable population. Glasow (2006), finds survey research useful to quantitatively describe specific aspects of a given population.

The choice of the method is motivated by the fact that it best helps to describe the preferences, behaviour, or information of respondents being considered and helps in using numerical values to explain the responses provided. It will as well ensure that the objective of the study is met by producing a good amount of responses from the selected respondents.



### Study Population

The report's target population comprised of the head of household or any representative of the residence who is willing to participate in the study. They were selected because they are visible and active members of the communities and have witnessed and experienced over time the operations of Ghana Gas Company and its associated impact on the environment. Their views and perception about negative effects of gas flaring was being sought for.

### Selection of the Communities

The communities are selected as a case study because of their relative proximity to the gas production site or containment point and being the settlement communities where the gas processing plant is situated. Thus, surrounding communities of the Gas processing plant were considered for this study. These communities were Atuabo, Anochie and Essiama.

### Sampling

#### Sample Size

Yamane's sample size estimate algorithm was utilized to establish the needed sample size for the investigation (Yamane, 1967). It makes use of factors such as population size and error margin. The total household of the study area is 233 (GSS, 2013). The sample size is therefore estimated at 147.

Mathematically, the formula is given below:

$$n = \frac{N}{1+N(e)^2} \quad n = \frac{233}{1+233(0.05)^2} = 147$$

Where,

n = the sample size

N= total number of households

$e$  = the desired precision = 0.05 (i.e. allowable or acceptable error in the estimate).

### **Sampling Method**

Both probability and non-probability sampling technique were used to draw the study participants. Stratified sampling method, convenience sampling and purposive sampling were applied to generate the research sample. The stratified sampling procedure was used to produce the test sample. The approach recognizes the presence of stratification with distinctive properties within the target group. The stratified sampling approach guarantees that the survey is representative of the general population by means that information is obtained from each stratum (Kothari, 2004). Stratified sampling method was applied at each stage. In the first stage the sample frame is made up of all the communities within the Ellembelle district. The second stage is done by selecting groups within the sample communities, and finally the respondents in the groups are selected. This sampling procedure is suitable because the communities are dispersed and situated in different places within the district. Though, there are several communities within the district, only three were surveyed (Anochie, Atuabo and Essiama), this is because of the limited time. All these communities were selected using the ballot technique without replacement until the three names were obtained.

At the community level, the convenience sampling technique was used to identify the respondents. The selection was done after careful explanation of the rationale behind the study to the respondents. Based on these 147 respondents were selected.

Purposive sampling was used to get samples from an environmental health officer of Ghana Gas, an official from Environmental Protection Agency and Ministry of Food and Agriculture. The requirements for the collection of samples are centred on the person's years of experience and understanding of the work.

### **Data Collection Technique and Tools**

A standardized questionnaire was used to gather primary data from the research participants. Primary data, unlike secondary data is data that is originated by the researcher for the first time and collected in real time (Ajayi, 2017). The questionnaire was administered with the assistance of research assistants who were trained by the researcher. The questionnaire was administered to the individual's respondents at their respective communities. The questionnaires, with collected by the researcher. Questionnaire was divided into sections; section A evaluated the socio-demographic of the respondents, section B assessed the effects of gas resource production on subsistence agriculture and on the physical environment, Section C analysed the potential impacts of gas resource production on coastal and marine ecosystems and section D examined and proffered sustainable coping strategies for residents to deal with the impact on livelihoods.

### **DATA SOURCES**

Both primary and secondary data was gathered for the study. Secondary data which are data that have already been collected for the purpose other than the problem at hand can help in sample designs and in the details of primary research methods. For this reason, the researcher first reviewed existing literature made up

of textbooks and other materials found useful from other sources such as the internet (Malhotra & Birks, 2007).

Primary data is data that will originate by the researcher specifically to address the research at hand. The primary data for the study were generated from the questionnaires.

In order to ensure good quality levels within the research, findings were correlated to other related research (secondary data) with an aim of establishing the relationship between them. This research also took into account aspects of personal judgment and instructions of how to complete them, was distributed to respondents by the research assistants.

In addition, in an effort to eliminate bias, the above mentioned data collection methods were applied in-depth so that the deficiencies of using one method was minimized by the strength in another method.

#### **Quality control**

To ensure data quality and accuracy, two research assistants were recruited and trained to assist in data abstraction, supervised by the principal investigator. For consistency and completeness, the principal investigator each day cross-checked data handled by the research assistants. Also, data was double entered by the research assistants to ensure accuracy.

#### **Data Analysis**

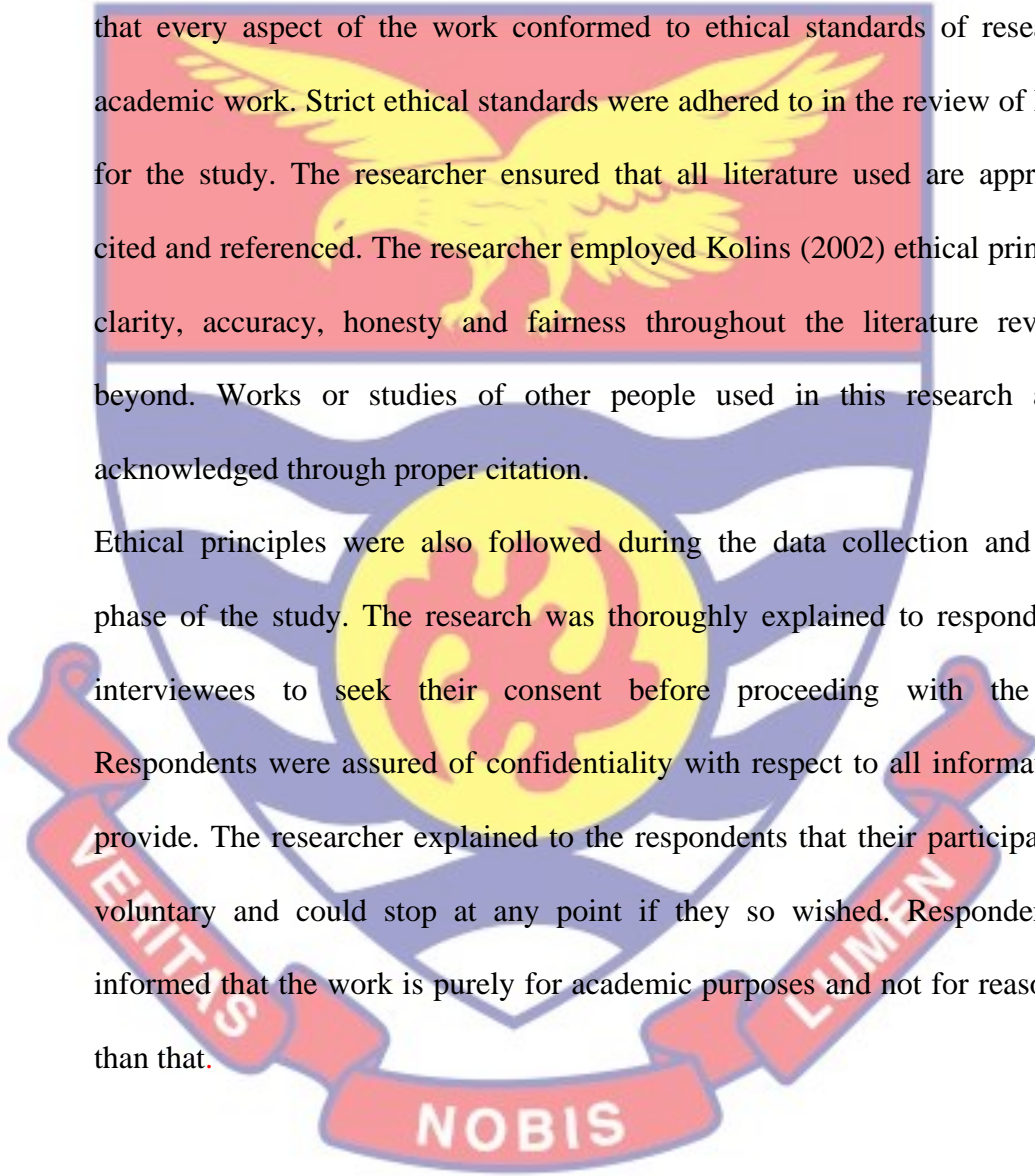
Data was coded and entered using Microsoft Excel 2016 and imported into STATA 14 for analysis. The results were presented using descriptive statistics. With this, statistical tables were used to analyse the data for interpretation. A chi square test of association was used to draw relationships among variables to

determine whether the means of two groups are statistically different from each other. Statistical significance was set at a p-value of 0.05.

### **Ethical Issues**

Ethical concerns were paramount during this research and the researcher ensured that every aspect of the work conformed to ethical standards of research and academic work. Strict ethical standards were adhered to in the review of literature for the study. The researcher ensured that all literature used are appropriately cited and referenced. The researcher employed Kolins (2002) ethical principles of clarity, accuracy, honesty and fairness throughout the literature review and beyond. Works or studies of other people used in this research are duly acknowledged through proper citation.

Ethical principles were also followed during the data collection and analysis phase of the study. The research was thoroughly explained to respondents and interviewees to seek their consent before proceeding with the survey. Respondents were assured of confidentiality with respect to all information they provide. The researcher explained to the respondents that their participation was voluntary and could stop at any point if they so wished. Respondents were informed that the work is purely for academic purposes and not for reasons other than that.



## CHAPTER FOUR

### RESULTS AND DISCUSSIONS

#### Introduction

This chapter presents the research's outcomes and commentary, which are founded on the study objectives. Charts are used to display the findings. This chapter's primary subsections cover the socio-demographic profile of respondents, the effect of gas resource production on subsistence agriculture, impacts of gas resource production on coastal and marine ecosystems and the coping strategies adopted by residents in dealing with the environmental impact.

#### Demographic profile of respondents

Respondents interviewed in the questionnaire survey were 147 from the three communities. The results shown in Table 1 represent the demographic characteristics of respondents in the study. Majority of the respondents were males (Table 1). At Atuabo community the age ranges of 26-35 years had the highest representation with 19 representing 12.9%, as against 17 representations from Anochie community representing 11.6 % between the age ranges of 36-45. This indicates that a greater number of the respondents are young adults. The respondents' level of education ranged from non formal education (26.5%), basic education (47.6 %), JHS (14.3%), SHS (5.4%), vocational/technical (4.1%) and 2% for degree. The results revealed that most of the respondents did not have strong educational background which could have aided them in claiming or fighting for their compensation for lost lands and other livelihoods opportunities. Huber and Stephens (2012) brings to the fore the negative implication that accompanies lack of education. They argue that education is in fact the main

driver of socio-economic inequality in society. In the present case, Ghana Gas has taken advantage of the limited capacity (low education level) of respondents and treated the compensation as inconsequential. This act has brought untold hardship on farmers and fishermen.

Only four respondents comprising two primary sustainable livelihoods that were of interest in this research 2.7% of the 147 were unemployed. As seen in the table 1 below, 15 respondents, making up 10.2% of the respondents were retired farmers only, while 16 representing 10.9% formed retired fishermen. People engaged in only farming formed 8.2% in Anochie, 9.5% in Atuabo and 8.8% in Essiama. Concerning fishing only, 5.4% came from Anochie, 6.1% from Atuabo and 4.1% from Essiama. People engaged in artisanal livelihood formed 24.5% of the respondents. The differences in survey respondents are attributable to the varied sample frames used in the three research regions. The populations from which the participants in the Ellebelle area were selected were mostly farmers and fishermen from various locations and villages. Occupation of respondents in general has been affected by the land acquisition as result of the gas production activities. There has been a shift in occupation, whereby farming and fishing, which used to be a major means of sustenance in the communities have given way to other occupations such as hairdressing, driving, sewing, carpentry, blacksmith and petty trading. This is consistent with findings of Patel, Sliuzas and Mathur (2015) who identified loss of access to common property resources as one of the eight development-induced displacement or resettlement impoverishment risk.

**Table 1: Summary of respondents' demographic characteristics**

Profile	Anochie		Atuabo		Essiama	
	No. of responses	% of Respondents	No. of responses	% of Respondents	No. of responses	% of Respondents
<b>Gender</b>						
Male	29	19.7	32	21.8	24	16.3
Female	20	13.6	25	17	17	11.6
<b>Age range</b>						
15-25	9	6.1	7	4.8	5	3.4
26-35	12	8.2	19	12.9	10	6.8
36-45	17	11.6	10	6.8	12	8.2
46-55	8	5.4	9	6.1	7	4.8
55+	5	3.4	11	7.5	6	4.1
<b>Level of Education</b>						
No formal education	13	8.8	11	7.5	15	10.2
Basic education	23	15.6	28	19	19	12.9
JHS	10	6.8	8	5.4	3	2
SHS	4	2.7	3	2	1	0.7
Vocational/	2	1.4	3	2	1	0.7



Technical

First degree	1	0.7	2	1.4	0	0
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**Occupation**

Retired farmer	4	2.7	8	5.4	3	2
Farmer	12	8.2	14	9.5	13	8.8
Retired fishermen	3	2	5	3.4	8	5.4
Fishermen	8	5.4	9	6.1	6	4.1
Artisans	11	7.5	10	6.8	15	10.2
Trader	9	6.1	5	3.4	10	6.8
Unemployed	2	1.4	1	0.7	1	0.7

Source: Field Survey (2021)

**Effects of gas resource production on subsistence agriculture and on the environment**

**Idea about gas production activities**

Generally, respondents were asked whether they have idea about gas resource production activities in their dwelling towns. Majority of the respondents (98%) responded yes and 2% responded no (Table 2).

**Table 2: Respondents idea about gas production activities**

Response	Frequency	
	(n=147)	Percent (%)
Yes	144	98
No	3	2

Source: Field Survey (2021)

About 77% of the respondents believed that gas flaring has been an ongoing activity in their communities. The respondents were quick to add that some years after the commencement of Atuabo Gas Processing Plant, the quantities of their farm produce have reduced and it is recorded over time which may be due to the gas flared on the environment. One Environmental Officer and an Environmental Protection Agency worker confirmed that there had been gas flare at Atuabo some years back, which was harmful and a threat to human lives and plants. Flaring gas in host towns, as per the main source, is an illegal conduct for oil and gas firms. Heat is being felt by residents of Anochie, Atuabo, and Essiama because of exothermic processes at the Gas processing facility.

#### **Effects of gas resource production**

Gas resource production has multifaceted effects, not excluding environmental impact which is also inclusive of subsistence agriculture impact. Respondents expressed divergent opinions and noted varied of degrees of effects of gas production in the local communities. Approximately 93.7 percent of participants recognized ecological threats such as soil degradation and emissions (which include air and water pollution) as being affiliated with gas manufacturing

operations in their various localities, while approximately 6.3 percent of respondents recognized no impact of gas production operations on the environment. This corroborates the findings of Oni and Oyewo (2011) that natural gas flaring produces multiple negative effects on human and the environment.

Surveyed farmers in the study had a wide variation in the number years in which they had been engaged in sustenance farming production, with a duration of 1 year and an upper limit of 45 years. From the study, 16.6% respondents from Anochie, 20.5% from Atuabo, and 13.3% of respondents from Essiama mentioned that they have recently observed a change in the vegetation cover and believe is because of the seasonal dumping of waste by Ghana gas during gas processing which is affecting farmers yield (Table 3). About 23% were in sharp contrast to this assertion, they believed that now the gas company do not dump waste on the physical environment. Some aggrieved farmers from Anochie (7%), Atuabo (9%) and Essiama (4%) expressed their displeasure about their significant yearly loss of farm produce due to the pollution and degradation of the productive soil. This assertion conforms to Ubani and Onyejekwe (2013) who found that pollution of the environment diminishes cultivation and other agricultural practices, resulting in low agricultural productivity. As confirmed by 52% of the farmers, prior to the establishment and commencement of the gas activities many claims were made to project-affected individuals, varying from immediate additional payment for loss of agricultural lands (i.e. destruction of palm trees, coconut trees, citrus, other crops etc.), supply of motor, recruitment of local people into the company, and alternative land for farmers to undertake farming activities. This takeover of the

land has brought untold hardship to the people. Livelihood conditions have become worse as Ghana Gas has reneged on its promises to the local people. This confirms Yakovleva (2011) explanation that indigenous people are mostly removed from their farming property without prior notice or sufficient recompense. In unison, they mentioned that, before the commencement of the gas activities they had enough to eat and sell to cater for their families but now they are recording losses which is a big blow to them. Moreover, some farmers representing 2% of the total respondents across the three communities have died and are no longer able to profit from the fruits of their labour and their spokespeople believe that by the time they receive compensation, the value of the currency will have deteriorated, making it difficult for them to engage in any profitable business.

**Table 3: Effects of gas resource production**

Effects of gas production	Anochie		Atuabo		Essiama	
	Freq.	%	Freq.	%	Freq.	%
Degradation of land and vegetation	55	16.6	68	20.5	44	13.3
Air pollution	42	12.7	52	15.7	50	15.1
No effect	7	2.1	5	1.5	9	2.7

Source: Field Survey (2021)  
(Multiple response allowed)

Respondents further mentioned air pollution in Anochie (12.7%), Atuabo (15.7%) and Essiama (15.1%) as detrimental to their survival. This study's findings are consistent with those of Sojinu *et al.* (2012), who stated that the discharge of different contaminants, such as trace elements and polycyclic aromatic hydrocarbons (PAHs), endangers the health of ecosystems and people. The participant's worries were obvious in expressing anxiety regarding air pollution which comes with unpleasant smell and its associated ailments or diseases. They expressed worry as this can cause cardiovascular diseases in residents from time to time. Jideani *et al.* (2012), stated that natural gas burning increases the risk of respiratory illnesses since the leftovers comprise a combination of extremely hazardous chemicals including carbon dioxide and methane. To most of the respondents (94%) such diseases attributable to gas production was new to them. However, 6% were of the view that such ailments are eminent in their communities and cannot be pinned to the gas establishment and activities.

Respondents were asked to indicate their concerns about the kinds of pollution going on in their communities. Twenty-three point-one percent (23.1 %) were extremely concerned, 12.2% were very concerned, 7.5% were moderately concerned, 4.1% were slightly concerned, 1.4% were not at all concerned about air pollution. On the other hand, 27.2% of the total respondents were extremely concerned, 15.6% were very concerned, 6.1% were moderately concerned, and 2.7% were slightly concerned about soil pollution (Table 4).

**Table 4: Respondent’s concern about kinds of pollution**

<b>Kinds of Pollution</b>	<b>Extremely concerned (%)</b>	<b>Very concerned (%)</b>	<b>Moderately concerned (%)</b>	<b>Slightly concerned (%)</b>	<b>Not at all (%)</b>
Air pollution	23.1	12.2	7.5	4.1	1.4
Soil pollution	27.2	15.6	6.1	2.7	-

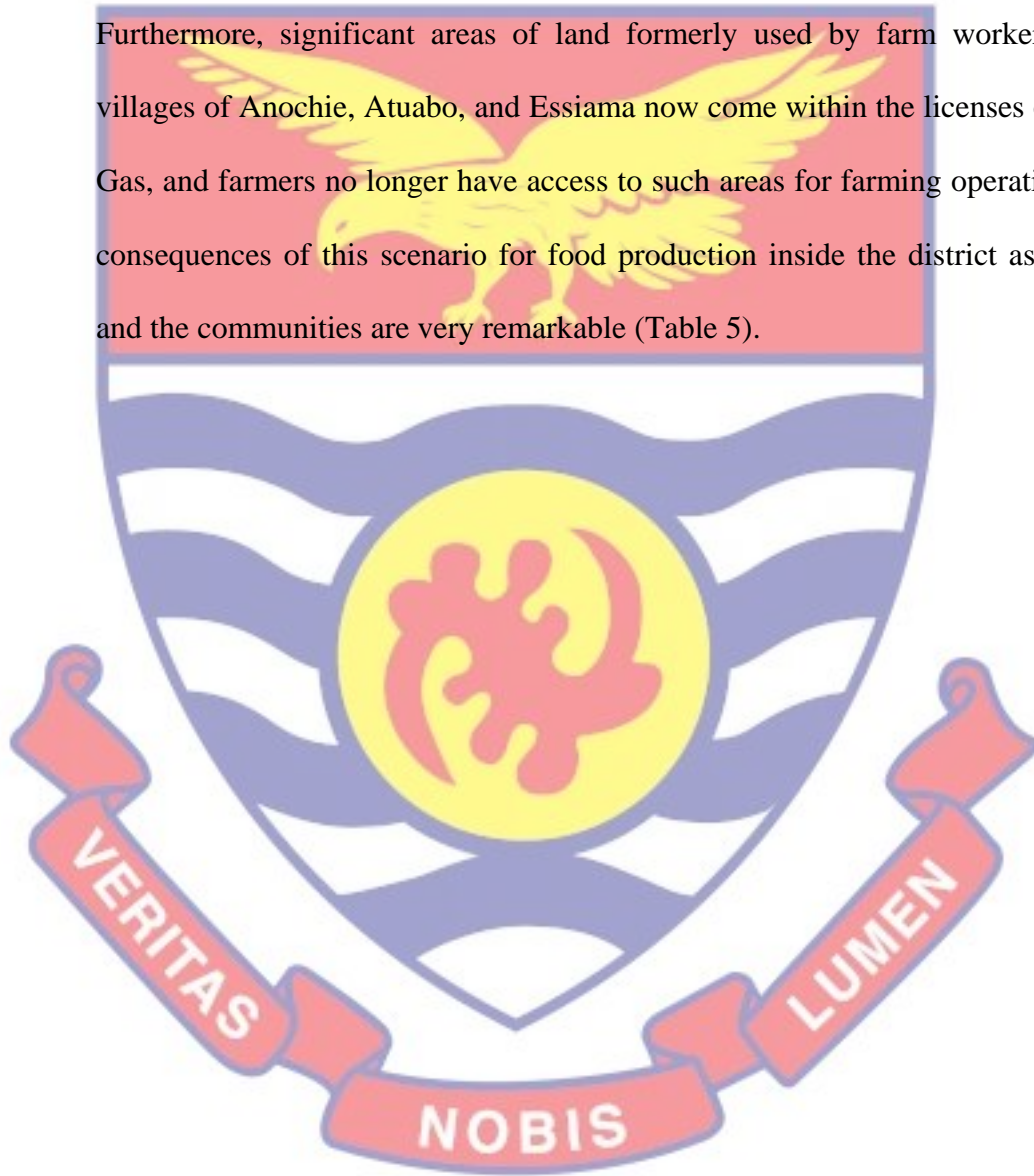
Source: Field Survey (2021)

**Effects of gas resource production on subsistence agriculture**

Within the studies areas, local food production is at a minimal rate as against the needs of the whole communities. Respondents (91%) opined that, this is because of the gas production activities, as several farmlands have either been engaged for gas activities. This report agrees with Adusah-Karikari (2015) as he reported that, Ghana National Gas Company obtained a large field of ground to set up processing installation that resulted to the loss of arable farmlands for numerous farmers. The establishment of the gas processing plant has caused the evacuation of most farmers with some losing their lands to the state with no compensation till date. This forceful act has affected agricultural production or yields of farmers over the years. This result is comparable to the findings of Esu and Dominic (2013) who finds that gas production and impact on farm outputs. Accordingly, few arable lands are obtainable for agricultural activities which are far away from home. Even the available lands, some have been contaminated with the flared gas and associated activities. This has depleted the land's micro-nutrients and left it

unproductive for agricultural uses, reducing output. The author's experiment results corroborated these assertions. This is in consonance with the findings of Jaiyeoba (2002), who agreed to the considerable adverse effects of gas production on soil due to the toxic substances it discharges.

Furthermore, significant areas of land formerly used by farm workers in the villages of Anochie, Atuabo, and Essiama now come within the licenses of Ghana Gas, and farmers no longer have access to such areas for farming operations. The consequences of this scenario for food production inside the district as a whole and the communities are very remarkable (Table 5).



**Table 5: Crop forecast and production for Ellembelle District 2016-2018**

		YEAR-2016			YEAR-2018				
CROP	TARGET		ACHIEVED		CROP	TARGET		ACHIEVED	
	Area (Ha)	Yield (Mt/Ha)	Harvested Area (Ha)	Output (Mt)		Area (Ha)	Yield (Mt/Ha)	Harvested Area (Ha)	Output (Mt)
Cassava	2000	1.6	650	8500	Cassava	1000	1.3	450	5200
Plantain	2000	7.0	700	6800	Plantain	1100	5.4	600	5800
cocoyam	150	1.8	500	800	Cocoyam	50	1.1	410	700
Maize	2000	7.0	750	2340	Maize	1800	6.3	620	1900

Source: Ministry of Food and Agricultural-Ellembelle District Directorate (2019)



The table above displays agricultural production objectives and successes in the district for crops including cassava, plantain, cocoyam, and corn from 2016 to 2018. The most important elements to consider are the desired area for growth (in hectares), the collected region (in hectares), and the production (in metric tonnes).

The intended areas for cassava, plantain, cocoyam, and maize cultivation in 2016 were 2000, 2000, 150, and 2000 hectares, correspondingly. There had been a decrease of 1000 hectares in maize output for the 2018 targeted region. When contrasted to 2016 figures, these (particularly cassava, plantain, and cocoyam) indicate a more than 90 percent drop in the planned area anticipated for farming. This indicates how much land (for agricultural purposes) was lost in three years. That is, between 2016 and 2018, approximately 2000 hectares of land (for livelihood agricultural uses) were lost. Farmers who were dissatisfied (35 percent) blamed this on land loss to Ghana Gas and limits on sections of farmlands owing to Ghana Gas activity. This gradually has an impact on crop yield overall. Furthermore, an official from the Ministry of Food and Agriculture contacted stated that the constant transfer of workers from the agricultural sector to other livelihood options has led to low crop output in the region over the past.

#### **Impacts of gas resource production on coastal and marine ecosystems**

Even though the gas sector is becoming more prominent in the Ghanaian economy, participants to this survey mainly expressed unfavourable attitudes regarding the effects of gas production on their fishing operations and incomes.

**Impact of gas flare on the lives of fishes and other aquatic animals**

Majority (89.9%) of the respondents’ revealed that flaring of gas has adverse effect on the lives of fishes and other aquatic animals. Also, 1.4% of the respondents strongly believed that gas operations do affect their communities’ fishes. Furthermore, 8.8% of the respondent’s don’t have any knowledge about the effect of gas resource production on aquatic animals of their communities (Table 6). However, the researcher could not undertake laboratory investigations to empirically determine extent of damage to coastal and marine ecosystem of the host communities.

**Table 6: Respondents’ views on impact of gas flaring on the lives of aquatic animals**

Response	Anochie		Atuabo		Essiama	
	Frequency	%	Frequency	%	Frequency	%
Yes	42	28.6	47	32	43	29.3
No	2	1.4	-	-	-	-
Don’t know	4	2.7	3	2	6	4.1

Source: Field Survey (2021)

About 78% of the respondents indicated that, the flaring of gas within the communities increases the sea/water temperature which affects the lives of the aquatics (Table 7). The fishermen discovered that the contemporary decrease in fish harvesting is owing to the rising of the sea temperature and the launching of

chemical compounds in the marine geographical region which has resulted in decreased catch and consequently affecting household incomes. This research agrees with Evans (2012), who stated that the accumulation of organic and synthetic chemicals compounds into the marine surroundings may create significant interruption in the fish harvesting value chain business as well as the whole enterprise. However, gas operations, like farming, result in the demotion of fisheries in terms of significance, resulting to rising impoverishment rates (Acheampong, 2018).

**Table 7: Respondents' perception on rising of sea temperature**

Response	Frequency	Percentage
Yes	116	78
No	4	2.7
Don't know	27	18.4

Source: Field Survey (2021)

The results demonstrate the importance of fisheries to the subsistence of the indigenous peoples of Anochie, Atuabo, and Essiama, since the preponderance of the questioned respondents stated that they relied entirely on fishing for a living. The establishment of exclusion zones surrounding the gas processing plant seems to have had a severe influence on the incomes of fishermen since there have been a significant decline of fish catch. Fishermen must travel at a distance on the sea before they get appreciable and quantifiable catch. The study's respondents claimed that the elision area has prohibited the fishermen from reaching prior catchment areas and the said limitation has negatively harmed their operations.

According to the stories, fishermen are not eligible to any type of partial payment of fishing areas. The viewpoint on the effects of the oil business on fishermen is not surprising, since a substantial number of individuals predicted that the extraction and processing of gas would result in a decrease in fish harvest even before the business formally began (Owusu, 2018). Obeng-Odoom (2014) voiced similar worry about the implications of fish capture limits. In his response, he stated that the restriction zone's good feature is that it would function as a sanctuary for fish, which will assist to control fish harvest and assist to breeding. The stories of fishermen appear to concur with this finding, even if they do not perceive it as good.

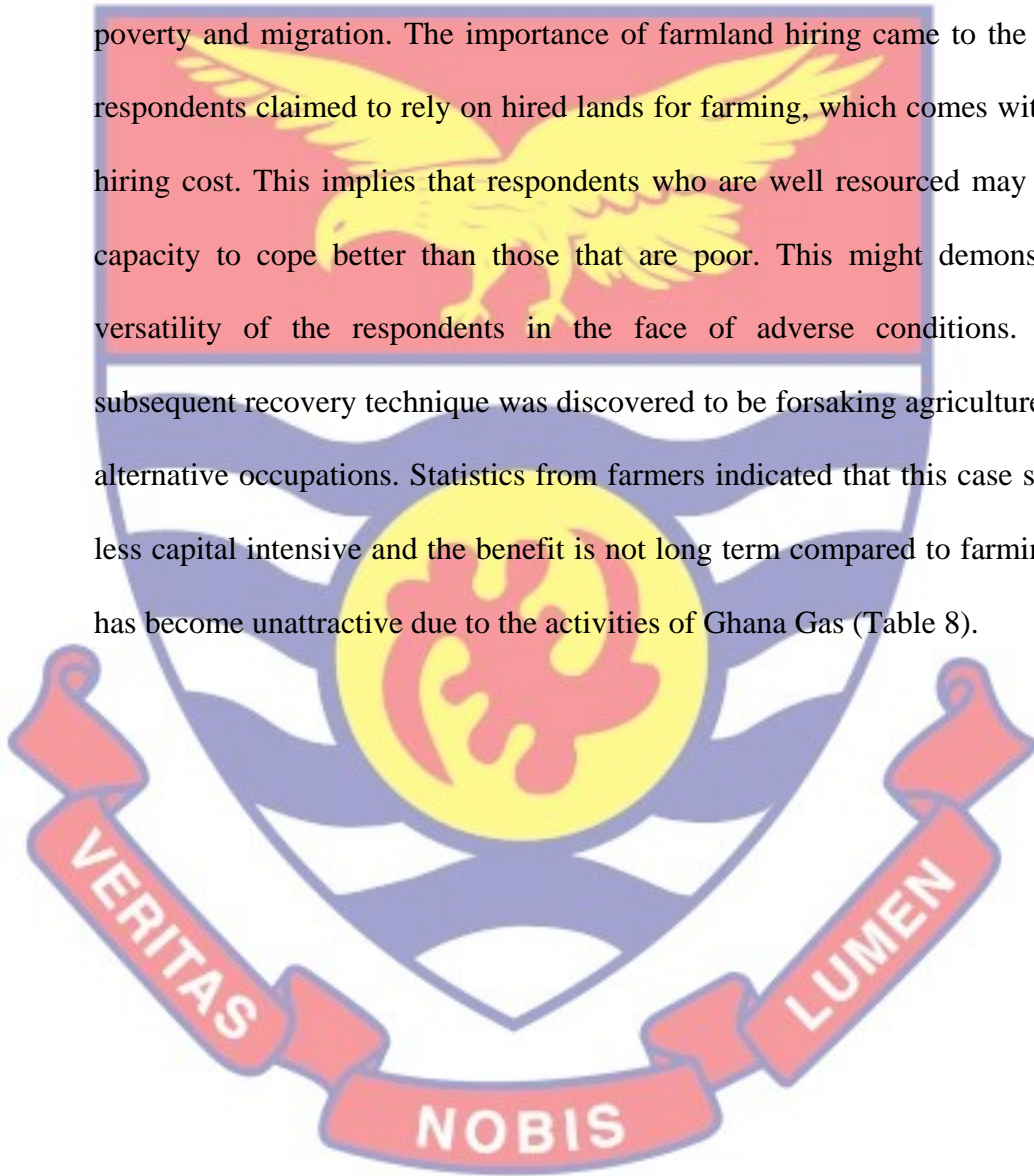
### **Coping strategies adopted by residents in dealing with environmental impact and its implications**

Respondents coping strategies were classified into two, namely: problem oriented coping strategies (POCS) and seeking social-support coping strategies (SSSCS). These were identified as the most frequently used coping strategies. This is in consonance with Rukema and Umubyeyi (2019) who said that households and individuals adapt coping strategies whenever shock or stress challenges the basis of their livelihoods. The purpose of each strategy among respondents was analysed. The study respondents employed coping strategies to protect their psychological intactness to withstand stress and shocks.

### **Problem oriented coping strategies**

Respondents' strategies in dealing with environmental impact revealed that; 28.9 % relied on hired farmlands, 50% have abandoned farming and opted for an

alternative occupation, and 21.1% migrating to seek livelihood opportunities. Migration was found to be a common practice among the young farmers and fishermen in the communities. This report agrees with (Elum, Mopipi & Henri-Ukoha, 2016) as they all reported that gas activities lead to problems such as poverty and migration. The importance of farmland hiring came to the fore, as respondents claimed to rely on hired lands for farming, which comes with a huge hiring cost. This implies that respondents who are well resourced may have the capacity to cope better than those that are poor. This might demonstrate the versatility of the respondents in the face of adverse conditions. Farmers' subsequent recovery technique was discovered to be forsaking agriculture to learn alternative occupations. Statistics from farmers indicated that this case scheme is less capital intensive and the benefit is not long term compared to farming which has become unattractive due to the activities of Ghana Gas (Table 8).



**Table 8: Distribution of the respondents according to the most often used problem-oriented strategies**

<b>Coping strategy</b>	<b>Frequency (n=152) *</b>	<b>Percent (%)</b>
Hiring of farmlands	44	28.9
Shift to other occupations	76	50
Migration	32	21.1

Source: Field Survey (2021)

*\*Multiple Response*

**Social support seeking coping strategies**

Channelling grievances through traditional leaders was found to be the most important SSSCS adopted by respondents (76.8%) to effect livelihoods change. It was followed by remittances from family members (13.8%). Borrowing (9.4%) was found to be the least coping strategies adopted by the respondents. The involvement of traditional leaders in the fight of justice with regard to unpaid compensation and unfair treatment meted out to them by Ghana Gas indicate their level of trust in the local leaders as the sole body in dispensing justice. The ability of farmers to go this extent reflects the respect and reverence local people accord to their leaders (Table 9).

**Table 9: Distribution of the respondents according to the most often used social support strategies.**

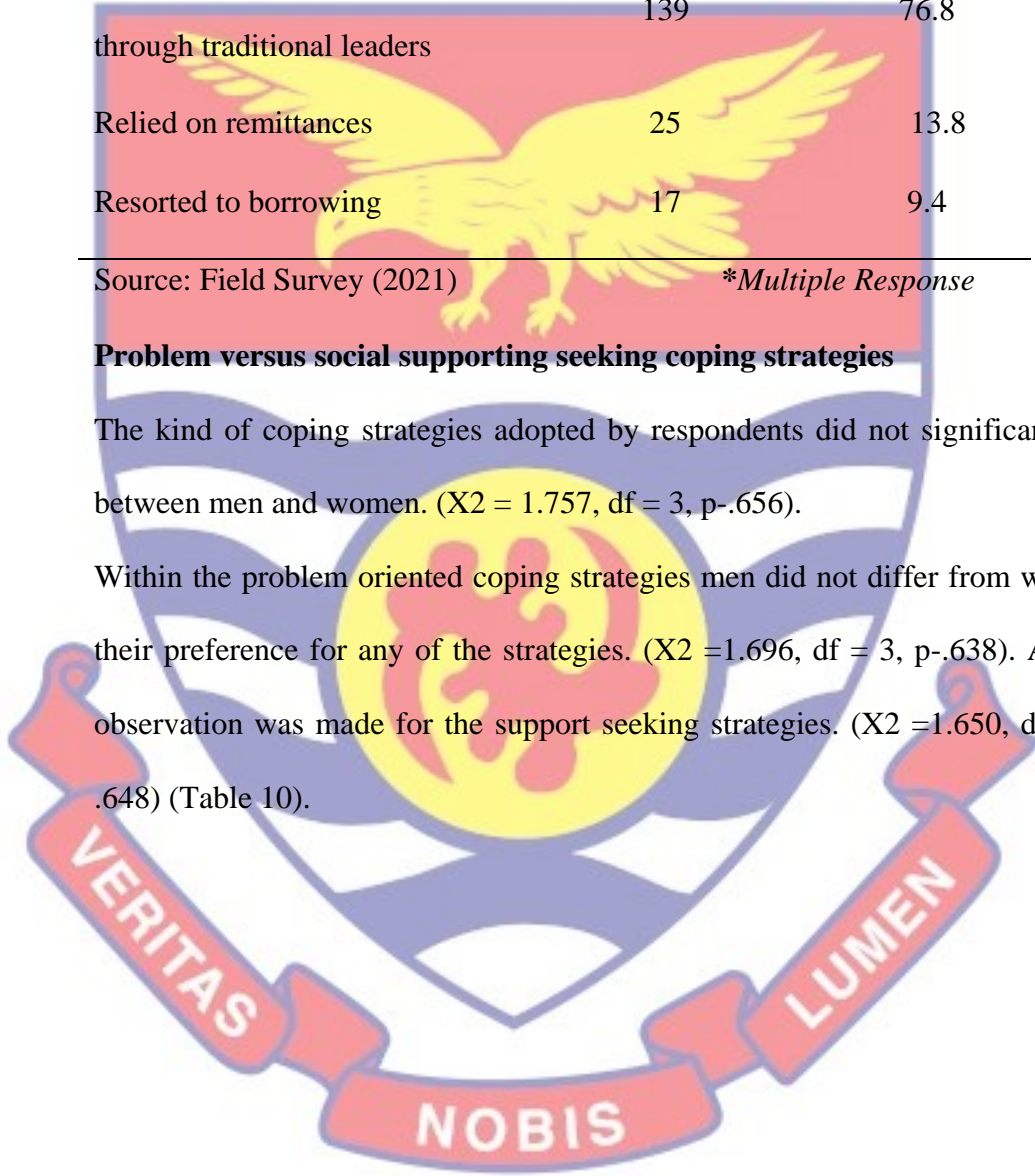
Coping strategy	Frequency (n=181) *	Percent (%)
Channelling grievances through traditional leaders	139	76.8
Relied on remittances	25	13.8
Resorted to borrowing	17	9.4

Source: Field Survey (2021) *\*Multiple Response*

**Problem versus social supporting seeking coping strategies**

The kind of coping strategies adopted by respondents did not significantly vary between men and women. ( $X^2 = 1.757$ ,  $df = 3$ ,  $p = .656$ ).

Within the problem oriented coping strategies men did not differ from women in their preference for any of the strategies. ( $X^2 = 1.696$ ,  $df = 3$ ,  $p = .638$ ). A similar observation was made for the support seeking strategies. ( $X^2 = 1.650$ ,  $df = 3$ ,  $p = .648$ ) (Table 10).



**Table 10: Respondents’ coping strategies**

	Problem oriented coping strategies			$\chi^2$	P-value
	Hiring of farmlands n (%)	Shift to other occupation n (%)	Migration n (%)		
Sex					
Male	45 (30.6)	51 (34.7)	15 (10.2)	1.69	0.64
Female	9 (6.1)	19 (12.9)	8 (5.4)		
	Social support coping strategies			$\chi^2$	P-value
	Channelling grievances through traditional leaders n (%)	Remittances n (%)	Borrowing n (%)		
Sex					
Male	52 (35.4)	9 (6.1)	6 (4.1)	1.65	0.65
Female	47 (32.0)	21 (14.3)	12 (8.2)		

(\* ) = p is statistically significant Source: Field Survey (2021)

**Perception on effects of coping strategies on livelihoods**

Table 11 reveals the general views of the respondents on the benefits of coping strategies to them. Only negative effects were indicated. More than half (56.6%) of the respondents indicated an increase in stress as a negative effect of coping strategy. This confirms the positions of researchers such as Adisa (2012) and Bosch (2003) that stress could have negative socio-psychological consequences on farmers, followed by weaken family ties (35.2%) then morbidity and mortality



(8.2%) rates respectively. Higher percentage (93%) of the respondents were dissatisfied with the negative implications that come with the coping strategies. Respondents acknowledged negative perception effect of their coping strategies as a Pandora box. The negative outcome, according to respondents has affected livelihoods considerably. Against this backdrop, it is evident from the study that, myriad survival strategies are adopted by respondents in dealing with the hardship situation at hand. Despite these coping strategies, farmers and fishermen are still faced with great distress of the gas operations.

**Table 11: Respondents' perception on coping strategies effect**

Effects	Frequency (n=244) *	Percent (%)
Increase stress	138	56.6
Weaken family ties	86	35.2
Morbidity and mortality	20	8.2

Source: Field Survey (2021)

\*Multiple Response

A test of chi-square showed a relationship between sex and respondents' negative perception on effects of coping strategies ( $\chi^2 = 6.372$ ,  $df = 2$ ,  $p = 0.041$ ).

**Table 12: Respondents' negative perception on coping strategies**

	Negative Perception			$\chi^2$	P-value
	Increase stress n (%)	Weaken family ties n (%)	Morbidity and mortality n (%)		
<b>Sex</b>					
Male	88 (26.8)	63 (19.2)	25 (7.6)	6.37	0.04*
Female	70 (21.3)	65 (19.8)	17 (5.2)		
<b>Occupation</b>					
Farming	76 (22.5)	52 (15.4)	18 (5.3)	7.71	0.46
Fishing	66 (19.5)	41 (12.1)	15 (4.4)	7.59	0.41
Both farming and fishing	31 (9.2)	18 (5.3)	21 (6.2)		

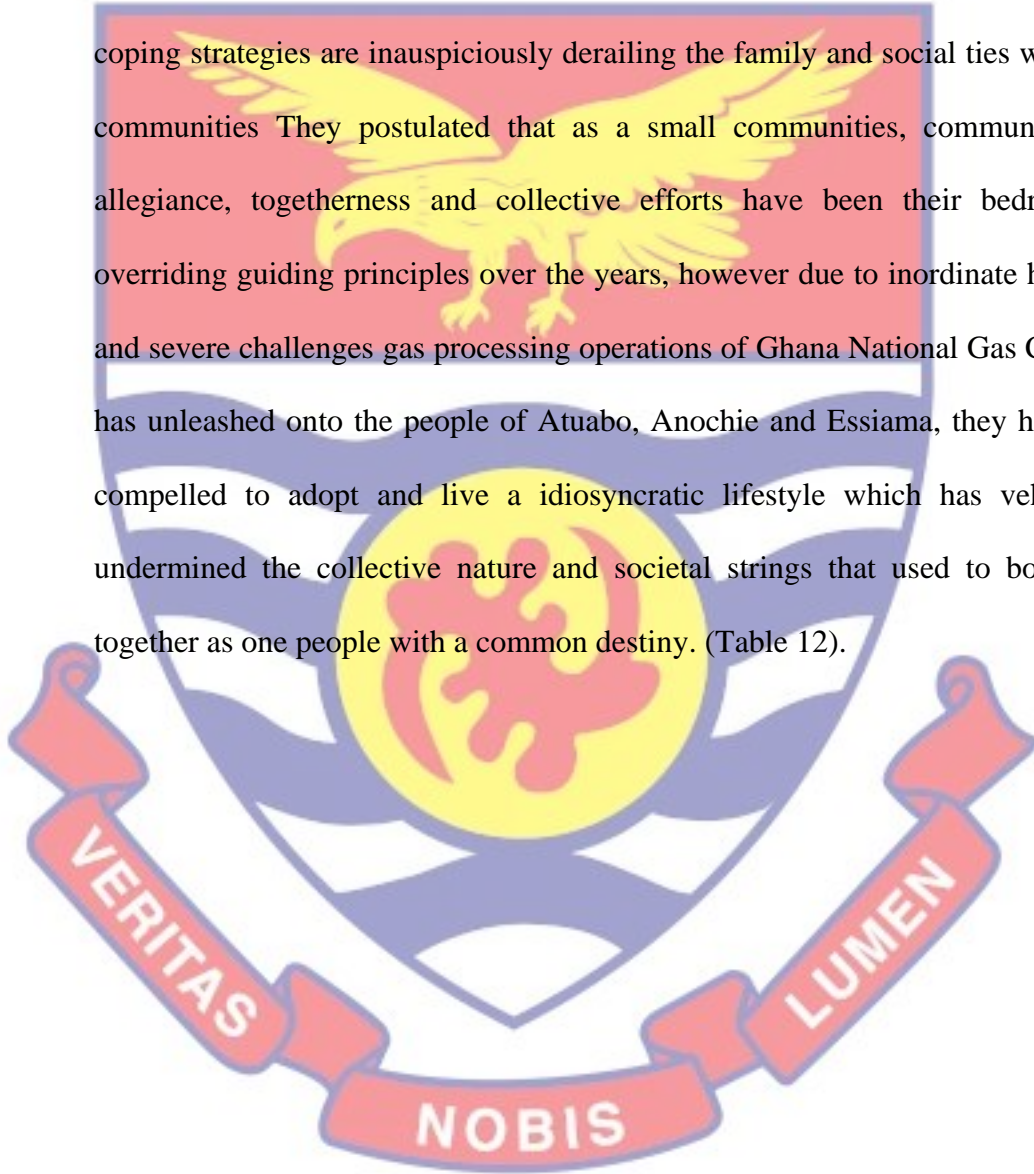
(\* ) = p is statistically significant *Source: Field Survey (2021)*

In this case, men were more regrettable about the coping strategy's effect of increase in stress whilst women were not happy with weaken of family ties that accompanies the coping strategy. A test of association did not show any link between age and negative effects ( $\chi^2 = 8.621$ ,  $df = 12$ ,  $p = 0.735$ ). Respondents' occupation had no association with their perception on effects of coping strategies

Respondents have a very strong conviction that their coping strategies they have adopted pose a significant level of economic, psychological and social distress with a high burdensome effects on them. Males were very critical with the towing stress and frustrations their coping strategies are unleashing on their very innocent lives. Due to the adverse effects of the operations of Ghana National Gas

Company the respondents are living at the mercy of a high mental strain and difficulties coupled with a grappling effect of intense level of economic and financial strain which is culminating into a throat cutting situation for them.

The females are also consciously worried of how their less-optional survival coping strategies are inauspiciously derailing the family and social ties within the communities. They postulated that as a small communities, communal spirit, allegiance, togetherness and collective efforts have been their bedrock and overriding guiding principles over the years, however due to inordinate hardships and severe challenges gas processing operations of Ghana National Gas Company has unleashed onto the people of Atuabo, Anochie and Essiama, they have been compelled to adopt and live a idiosyncratic lifestyle which has vehemently undermined the collective nature and societal strings that used to bond them together as one people with a common destiny. (Table 12).



## CHAPTER FIVE

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

#### Introduction

This chapter contains a synopsis of the results, conclusions, and suggestions.

#### Summary of findings

Gas production has impacted negatively on the vegetation and farmlands of Anochie, Atuabo and Essiama communities. Findings showed that the gas industry has accelerated conversion of agricultural lands to commercial activity (Ghana Gas production) which has threatened household food security and food basket within the district.

As a result of the gas emission the temperature of the sea has become uncondusive for the survival of aquatic animals. The research indicated that the major cause of dissatisfaction for fishermen has been the construction of secluded zones, which deny them the accessibility to fish harvesting areas. The restricted passage to fish gathering areas has had an invariable significant degree of economic harm and financial distress to the lives of fishermen and lowered the gross harvest yield in the areas.

The study respondents employed mitigating methods to maintain their mental well-being to withstand stress and shocks. Respondents coping strategies were classified into two, namely: positive coping strategies (hiring of farmlands, shifting to other occupations, and migration) and seeking social-support coping strategies (channelling grievances through traditional leaders, remittances, and borrowing).

## Conclusion

Agricultural lands have been rendered infertile because of gas flared in the various communities and its associated loss of farmlands. This act has affected the yields as farmers have to travel at a distance to undertake farming activities because all the fertile lands closer to them have been compulsorily acquired by Ghana Gas with little or no compensation.

Rise of sea temperature threatens the lives of fishes and home of other aquatic animals due to the gas flaring and this is causing drastic reduction in fish harvest. Fishermen are thus irritated, or their well-being is jeopardized because of the restriction on fishing within restricted areas in all member towns.

The respondents use a combination of strategies but that notwithstanding has brought no progress in dousing the tide and growing spate of the livelihood hardships. The most important outstanding issue appears to be the final payment for crop and loss of fishing grounds compensation and if addressed may scale down rising tension and stress and tension among farmers and fisher folks.

## Recommendations

Compensation negotiation committee must be set up by the chiefs to facilitate the unpaid, inadequate crop compensation to farmers and loss of fishing grounds compensation to fishermen. The committee must be tasked with the responsibility to negotiate on behalf of farmers and the fisher folks. That is, an all-inclusive standby compensation negotiation committee whose decisions would be broadly admitted ensuring that these communities are not adversely short-changed in their communities.

The Ghanaian government and Ghana Gas should guarantee that farm workers who have forfeited their lands are adequately paid, considering the compound interest. Houses near the Atuabo Gas Processing Plant and the Anochie Quantum Terminal should be evacuated because to the increasing temperature in the area.

On this point, the government must be trustworthy to guarantee the cooperation of host societies: this includes balancing the interests of diverse users while limiting their negative consequences on biodiversity and incomes.

To supplement the Environmental and Sanitation Inspectors, the government should create sub-EPA offices in all oil and gas-bearing District Assemblies. This will assist to develop and create capacity for continuous or regular monitoring and evaluation of oil and gas firms' activities in host communities to minimize oil spills, gas flares, and other pollutants.

Local officials should be heavily involved in resolving this unfairness. This would increase the likelihood of becoming aware of more practical coping techniques.

Option living standards must also be offered for fishing vessels because of the drastic decrease in fish produce and farm workers because of the loss of agricultural land. This can be accomplished using financial assistance to cushion them and widen their livelihood opportunities net.

#### **Further Research**

The inquiry in this study has revealed prospective research areas that may be investigated. Future scholars, for example, may conduct a study that looks at compulsory land acquisition in the Ellembelle District and its social impacts on project affected people.

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## APPENDICE

### APPENDIX A

#### QUESTIONNAIRE

Mr. Isaac Ntim is a Master of Business Administration (MBA) student in Oil and Gas Management with the Institute for Oil and Gas Studies, University of Cape Coast (UCC).

As part of the requirements for an MBA degree in Oil and Gas Management, Isaac is required to undertake an independent field research. The research problem is identified within “*Impact Assessment of Atuabo Gas Processing on Livelihood Activities and the Environment*”. When completed, the research, among other outcomes, is envisaged to provide in-depth knowledge on mitigation and empowerment measures for sustainable economic development.

This research questionnaire is, therefore, to solicit for relevant empirical data for the completion of this academic exercise on the subject “**Assessment of Atuabo gas processing plant on the environment and community livelihoods**”.

Interviewer’s code.....

House Number of Respondent .....

**Section 1: Basic Socio-demographic data**

1. Age of Respondent: 15-25  26-35  36-45  46-55

Above 56

2. Sex of respondent: Male  Female

3. Occupation of respondent: Farming  Fishing  other, please specify  
.....

4. How more period have you been harvesting fish and/or cultivating farming?

a. Fishing.....years

b. Farming.....years

5. What other activities are you engaged in to supplement your income?  
.....

6. For how long have you been staying in this town/village?  
.....

**Section 2: Effects of gas resource production on subsistence agriculture and on the physical environment.**

*Please kindly tick and appropriately write response where applicable.*

1. Do you have any idea about gas production activities in this town?

Yes [ ] No [ ]

2. What is/are the methods of operation by Ghana gas?
- a. Gas treatment
  - b. Transportation
  - c. Storage
  - d. Regasification
  - e. Odourisation
  - f. Reloading
  - g. Delivery

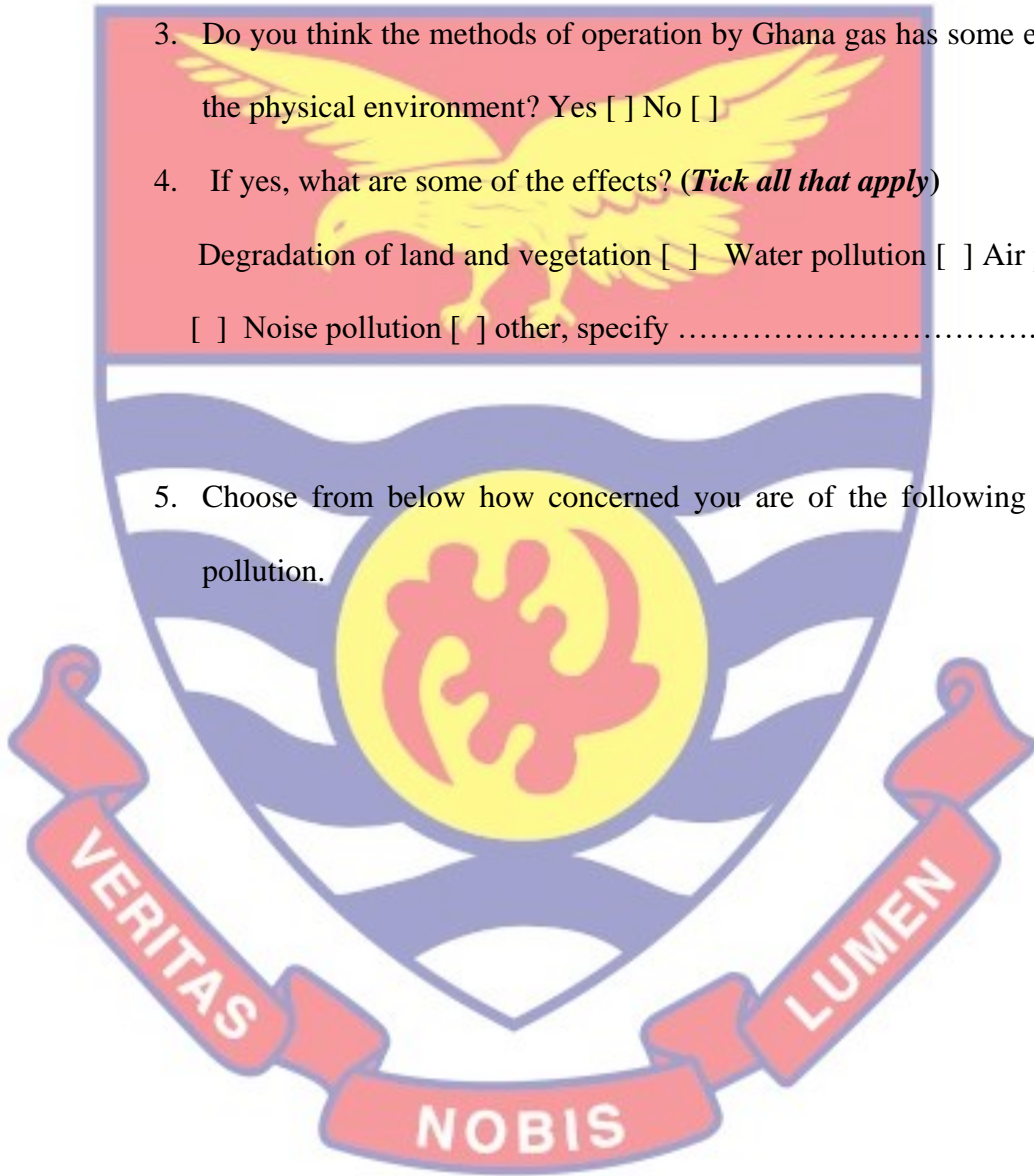
3. Do you think the methods of operation by Ghana gas has some effects on the physical environment? Yes  No

4. If yes, what are some of the effects? (*Tick all that apply*)

Degradation of land and vegetation  Water pollution  Air pollution

Noise pollution  other, specify .....

5. Choose from below how concerned you are of the following kinds of pollution.



	Extremely concerned	Very concerned	Moderately concerned	Slightly concerned	Not at all
Air pollution					
Water pollution					
Noise pollution					
Soil pollution					

6. How well are aware of the possible harmful impacts the oil and gas industry has on the environment?

Extremely knowledgeable [ ] Very knowledgeable [ ] moderately knowledgeable [ ] slightly knowledgeable [ ] No knowledge at all [ ]

7. Have you ever experienced gas flaring in your community before and now?

Yes [ ] No [ ]

8. As a community, have you had any oil spills or gas perforation before and now?

Yes [ ] No [ ]

9. Has oil and gas operations affected plants growth in any way in your community?

Yes [ ] No [ ]. If Yes explain.....

10. Have you or any family member lost farmland directly or indirectly because of the oil industry? Yes [ ] No [ ]

11. If yes to question 9, what size is the land you lost? .....

12. If yes to question 10, rank the significance of how loss of land has affected your yearly produce? Very significant [ ] Significant [ ] Slightly significant [ ] No significance [ ]

13. How much do you think, you lose Ghc .....per month or year Ghc.....?

14. Did you receive compensation for the loss? Yes [ ] No [ ]

15. If yes, are you satisfied? Poorly satisfied [ ] Satisfied [ ] well satisfied [ ]

**Section 3: Impacts of gas resource production on coastal and marine ecosystems**

1. Has the oil industry stopped you from going into areas where you used to fish? Yes [ ] No [ ]

2. If yes to question 1, rank the significance of how this has affected your catch?  
Very significant [ ] Significant [ ] slightly significant [ ]  
Not significant [ ]

3. Is gas flaring having an impact on the lives of fishes and other aquatic animals? Yes [ ] No [ ]

3a. If yes, how?.....

4. Is there any system in place you know of that compensates fishermen for loss of fishing zones? Yes [ ] No [ ]

5. If any compensation, would you describe the compensation you received as adequate?  
Yes [ ] No [ ]

**Section 4: Coping strategies adopted by residents in dealing with the environmental impact**

1. How are you/your household coping after losing or suffering after losing your livelihood?

Coping Strategy	Tick (Tick all that apply)
1. Resorted to other non-farming activities	
2. Resorted to other non-fishing activities	
3. Relied on remittances	
4. Resorted to borrowing	
5. Managing with the same source of livelihood	
6. Reduced household expenditure	
7. Managing the economic hardship	
8. Migration	
9. Shift to other occupation	

2. Other, please specify .....

3. What is the effect of the coping strategies on livelihoods?

Weaken family ties  Increase stress  Affect the level of development

Morbidity and mortality

4. Are you satisfied with the effect of the coping strategies? Yes  No

