AIR POLLUTION AND SOCIO-ECONOMIC IMPACT OF GAS FLARING IN NIGER DELTA

A

CASE STUDY OF UTOROGU GAS PLANT IN OTU-JEREMI DELTA STATE

BY

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DEDICATION

This project is dedicated to the Almighty God for His inspiration and grace, and also to all environmentalist whose major concern is to keep humanity and environment safe inspite of the global environmental degradation.

DECLARATION.

I hereby declare that this project was carried out by me and that information here is obtained from investigation and interpretations.

Omoru Emmanuel	Date

CERTIFICATION

This is to certify that this study was carried out by **Omoru E. Emmanuel** of the Postgraduate School, department of Geography, Environmental Management programme unit, School of Science and Science Education, Federal University of Technology, Minna.

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ABSTRACT

Petroleum exploration and exploitation has brought about gas exploration and production; and consequently flaring.

The contribution of petroleum exploration to our economic status cannot be over emphasized. Ironically, the areas where these economic resources are naturally located suffer evident deprivation and lag behind in development.

The study focuses on the evaluation of gas flaring on the atmosphere and the socio-economic life of the people around the area, the establishment of the principles for resolving negative environmental impact of the flaring in Niger Delta with specific references to Otu-Jeremi community in Delta State.

The study examined various impact of gas flaring on farming health, air and the standard of living of the inhabitants of the study area.

It was discovered that farming activities have been affected as farm produce are poorer, and more people take to other trade. Pollutants from the flares make the people vulnerable to sickness like eye irritation, skin rashes, malaria headache, as these are connected to oil prospecting exercise. Pollutants also cause early corrosion of roofing sheets due to acid rain formation. Job opportunity was not significant as one hundred percent respondents attest to this. The income of the people were more from trading, transportation and civil services. etc.

Relationship of the host community with the oil company was found to be average. It was also found that although the company carries out community development programme, the levels of poverty and deprivation of the people are still high. Some of the reasons from interview were found to be greed of some community representative to the oil company hence the taking over of youths.

The data collected from SPDC west shows that the air is unimpacted, this is likely due to the fact that Utorogu gas plant is a low pressure plant of production specifications with low emissions that are within FEPA standards.

The study concludes with the number of recommendation like the need for the utilization of flared gases, which will enhance industrialization and employment thereby increasing economic potentials, and also, the support and supervision of community development project which will enhance social welfare of the people in oil producing communities.

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CHAPTER ONE

1.0 INTRODUCTION

Nigeria is blessed with abundant oil and gas resources and is commonly regarded by petroleum experts as a gas province with little oil in it. The huge endowment in natural gas resources places Nigeria ninth (9^{th}) position in the world and second (2^{nd}) only to Algeria in the African continents.

Regrettably, since the discovery of petroleum in the late 50's oil has placed a prominent role in the Nigeria economy to the detriment of natural gas. The natural gas produced by the exploration and production companies in the cause of their exploration for oil has often been treated as a nuisance and therefore disposed of through flaring. Records of the total natural gas produced in the country and the percentages utilized and flared about seventy (70%) of the natural gas it produces.

Gas flaring is the disposal of natural gases to the atmosphere by burning in the oil field and refineries when no other use could be made from it as at that particular time.

The production of natural gas in Nigeria has so far been merely incidental to oil production. Since no specific drilling for natural gas has been undertaken, the gas has simply been escaping from wells drilled for oil. Thus the country was unprepared to utilized the immense volume of natural gas gushing out of many of its wells. The estimates of the nation proven natural gas reserves from various sources ranges from 3.40 to 4.00 trillion cubic metre (m^3) and Nigeria's cumulative production up to 1993, including flared and re-injected gas was approximately 529.4 billion cubic meter (m^3) (Chima, 1996). In the period of four years, (1996-1999), natural gas production has always exceeded 31 billion m^3 of gas, nearly all is associated with crude oil production, about 93 million m^3 of associated gas per day (equivalent of 54.700 barrel of oil was released or flared daily, which has represented a significant loss of earning for Nigeria (approximately 5.0 million dollars daily (Chima, 1996.).

Unfortunately, these gas so flared are associated gas which has the advantage of being exploited without having to make an investment for its extraction.

The explanation above reveals great economic loss to Nigeria, this is not only our concern as environmentalist, but the effect of these flared gases on the environment is the basic drive of this project.

The environment has been known to suffer from atmospheric pollution, the biosphere has been well affected as studies reveal that growth productivity and the yield of crops have reduced, changes in the morphology and biochemistry of animal, the total chlorophyll of leaves, soil chemistry et.c have also been found as effect of gas flaring in the environment.

The way of life of the people, precisely, their socioeconomic standards are definitely affected.

1.1 PROBLEM DEFINITION :

The environment is subject to natural and man –made changes, man made changes occur in attempt to gather resources to meet necessary demands. Man- made change are man –induce changes which refer to the action of man that cause either positive or negative environmental effects from the point of view of desirability. These activities of man have impact on all sphere of the environment, that is land , water , air, biological and socio- economic environment.

Socio- economic environment which is part of the area under consideration is a composite of numerous interrelated and non- related items descriptive of human relationships and interactions. In Nigeria more emphases on impact associated with projects have been the physical and biological environment with the neglect of such impact on the socio-economic environment and the atmosphere, part of the problem relates to the poor understanding of interrelationships of the socio-economical environment and the atmosphere in general.

The exploration and production of crude oil in Nigeria is connected to gas production and flaring. It has resulted in a number of socio-economic and environment impact which is negative to the welfare of the people and the environment in the Niger Delta Basin.

The Niger Delta basin with its very delicate riverine and mangrove ecology serve as an impact source of food particularly shrimps with an estimated yield of about 50,000 metric tons annually. The apparent impact on aquatic life, navigation, vegetation, aesthetic value or the health of humans have been substantial. The noticeable effect of pollution from gas

production and flaring for instance include the death or low yield of crops, economic trees and fruits, such as plantain, orange and coconut that used to grow in large quantities and large size in the area before while some trees continue to die.

Research on the Imo rivers spill in Oweza village discovered that certain discomfort from the heat vibration, noise and glows from the flares can cause serious problems.

It has also been reported in Imo River oil spill that flare has being the main cause of sudden termination of pregnancies among their women folk, sickness among their young, old and their inability to sleep at night (Ene- Ita, 1982).

In the light of the above, this project seeks to address the physical (air pollution) and socio- economic problems associated with gas flaring in Otu- Jeremi community where Utorogu gas plant is located.

1.2 AIMS & OBJECTIVE

The study aims at studying the physical (Air) and socio-economic impact of gas flaring in Otu-Jeremi, Delta State.

The specific objectives of the study include.

(a) To identify the various air pollutant associated with gas flaring and investigate their impact on the immediate environment.

(b) To examine the specific impact of oil production (gas flaring) on the socio-economics life of resident of the study area.

(c) Evaluation of the level variation among identified socio- economic impacts.

(d) To suggest ways of preventing and controlling gas flaring and improve the quality of life of the people in the study area.

1.3 JUSTIFICATION AND SIGNIFICANCE

For the purpose of study , utorogu field was selected, the justification for this selection was based on the following ground.

This community is one of the most peaceful location of the oil industries of the Niger Delta, thus, responses from the resident of this community would not be biased.

The peaceful state of the people does not imply they are not affected, thus the evaluation of the socio- economic impact .

This community is central to other gas flaring locations, located in Warri south and Isoko south.

The proximity of the location to the researcher encourages constant visit for adequate survey.

The significance of this study to environmental scientist is as follows:

It will enable them appreciate the socio – economic aspect of the environment as very relevant.

The atmosphere will equally been know to be affected as some environment agencies give priority to solid waste or other physical detected degradation.

The unveiling of economic and resources waste will be a reminder to the government to harnessed natural gas which will aid industrialization , employment and enhance standard of living.

1.4 SCOPE OF STUDY AND LIMITATION

The activities of oil industries constitute pollution to various aspects of the environment , but this project will focus on the atmosphere and socio- economic impact of gas flaring in Otu-Jeremi.

In carrying out this project the questionnaire were not easily accepted as member of the community were in a political era. However, one the enlightened member of a political group was used to reduced this non- receptivity.

Data from oil industry were not easily available and restrictions were encountered.

1.5 STRUCTURE OF WORK

Chapter 1	Deals with introduction, study area, problem definition aim objective, justification, scope and limitation of the research.
Chapter 2	Covers the literature review where economical, environmental impact of gas flaring were discovered from journals, textbook e.t.c
Chapter3	covers Research methodology, data collection and analyses techniques.
Chapter 4	contains Data analysis, finding and discussion.
Chapter 5	Summary, Conclusion and Recommendation.

1.6 STUDY AREA.

The Niger Delta extends from the Benin River in the west to the Bonny River in the east. On land it beings a few miles below the Village of Aboh at a point where the Niger fork into the Num and forcados rivers. Its is a low-lying region riddle with an intricate system of natural water channels through which the Niger finds its way into the sea. The Delta extends beyond the River Benin and Bonny in former times. It included the kingdoms of Bonny, Okrika, Kalabari and Nembe, but not the Efik State of Calabar

The Niger Delta region can be divided into two main geographical blocks, the Easter Niger Delta comprising of the kingdom of Bonny, Elem Kalabari, Okrika and Nembe; Other related people are the Andoni (Obolo), Ogoni (Khana), Ndoki, Abua, Oduai (Egene) and some parts of the riverine communities of Igbo land. The Ibibo of the present day Akwa Ibom state and the Efik State of Calabar (old calabar) in the present day cross River State on the cross River estuary lie further to the east.

The western Niger-Delta encompasses the bulk ethnically identical ljaw Sub-regions who from the present day Bayelse State and part of Delta, the Urhobos, Isokas, Ukwanis, the ltsekiri and part of some lgbo speaking riverine people of Delta State.

The llagies and Arogbo – ljaw in some of the riverine people of Ondo State and the Binis of some of the riverine part of Ovia local Government Area are also in thewestern Niger Delta.

The Delta covers an are of approximately 70,000 Square Kilometer and has a very fragile terrain

1.6.1 GEOGRAPHICAL LOCATION.

Otu-Jeremi, the Community where Utorogu gas plant in located, is approximately 5' 27' N of the Equator and 5' 25'E of the Greenwich Meridian. It is 20km SE of Warri, and it in located particularly at Ughelli South local Government Area of Delta State.

1.6.2 PHYSICAL CHARACTERISTICS

Otu- Jeremi has tropical climate marked by two distinctive Seasons, - the dry and rainy seasons, Annual rainfall is about 266.7cm Temperature is between 39^0c and 44^0c . The vegetation in the Community is perdominanlty mangrove swamp and trees like Obeche, walnuts and palm trees. Trees grow close together, Soil type include loamy, clay and sand.

The people's occupation including farming, fishing and trading, however some are employed by the government and the oil companies.

The culture is basically that of the Urhobo, which is manifested in religion worship, dance and dressing. The people are majority Christians.

1.6.3 ECONOMIC ACTIVTIES

Economic activities in Otu-Jeremi is well divided into formal and informal sector. In informal sector activities with low level modern organisation live petty trading, fishing. Farming, services in the form of transportation and favoring. While in the formal sector these is a higher level of organization found in banking oil séance activities.

1.6.4 REGIONAL SETTING

A functional region is said to be a system of settlements that are linked with functional road reworks. Assessment of regional settings provides opportunity to know the relationship between settlement degree of importance of any particular settlement under consideration.

Out-Jeremi is about 122km from Asaba which is the Delta State capital. It is also the headquarter of Ughelli-south local Government Area.

The regional setting arrangement implies that given a particular level of technology of transportation , more interaction shall take place between Otu – Jeremi and the hinder land.

1.6.5 THE UTOROGU GAS PLANT.

The Utorogu gas plant is a typical example of plant in which gas is being flared in Nigeria. The Utorogu Gas Development project was conceived in 1983 by the Nigerian National Petroleum (NNPC) for the supply of high quantity gas via the NNPC Warri – Lagos Gas pipeline to NEPA electrical generating thermal power station at Egbin near Lagos.

The project situated in the Utorogu oil field in NNPC / Shell oil mining lease number 34 was officially commissioned by the Ibrahim Babangida administration on January 17th 1989.

The project required the NNPC / SPDC (Shell Petroleum Development Company) joint

venture to construct gas facilities with a capacity of some 270 million standard cubic feet per day.

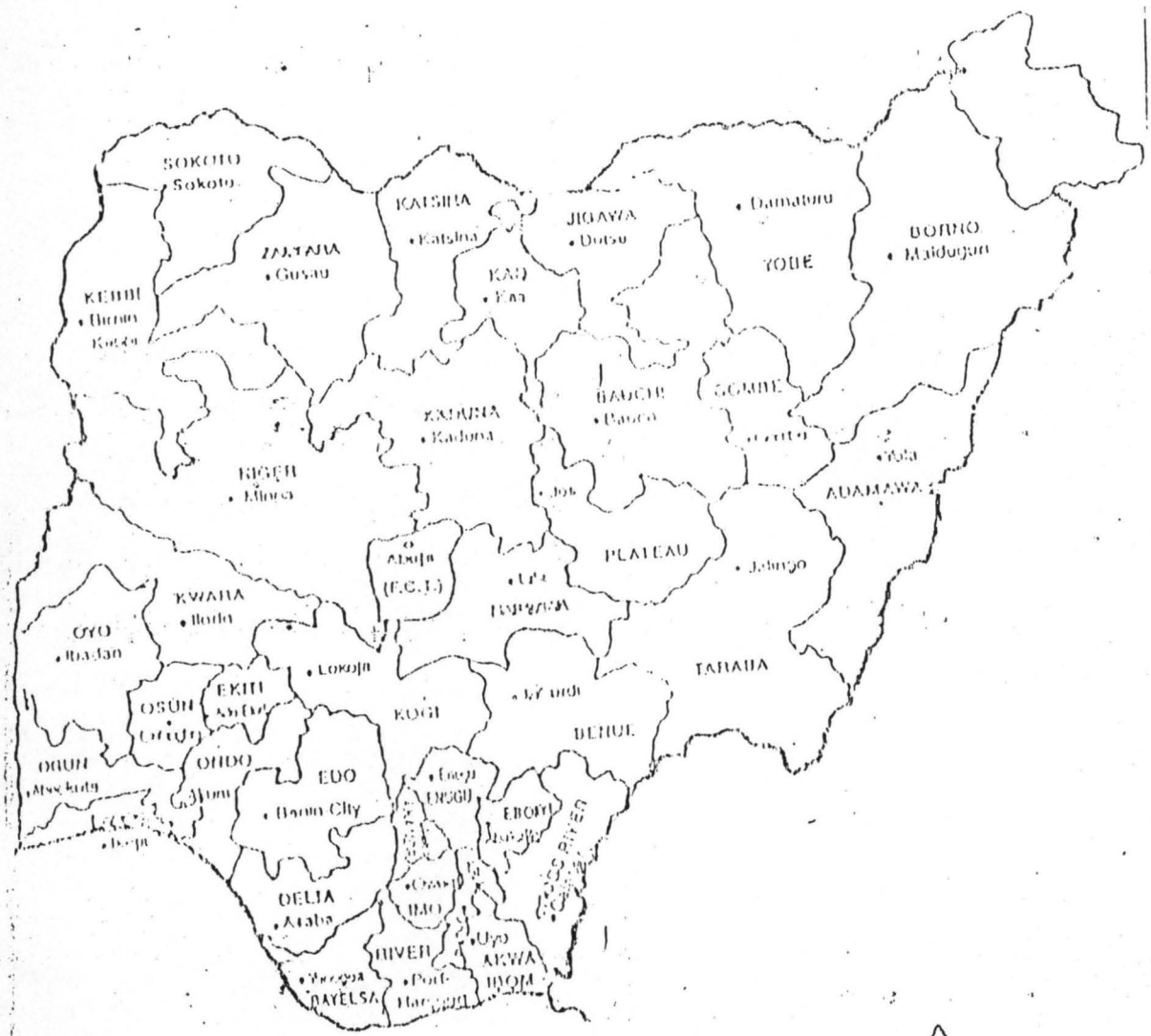
The gas facilities constructed on 44 Hectares of land consist of cluster of well, a gas treatment plant, heliport and full boarding facilities for 27 person.

And total of 11gas well will be tied into the gas treatment plant. The gas treatment plant which is of low temperature – Sepreated (LST) process type will deliver gas at an average cost of about 230 million Naira.

The gas from Utorogu is piped through 32km of 30 inch diameter pipeline to the NNPC refinery at Warri where it enters the Escravo-Lagos pipeline system (ELPS) from here a 36 inch pipeline deliver the gas to Egbin power plant.

FIG 1.1

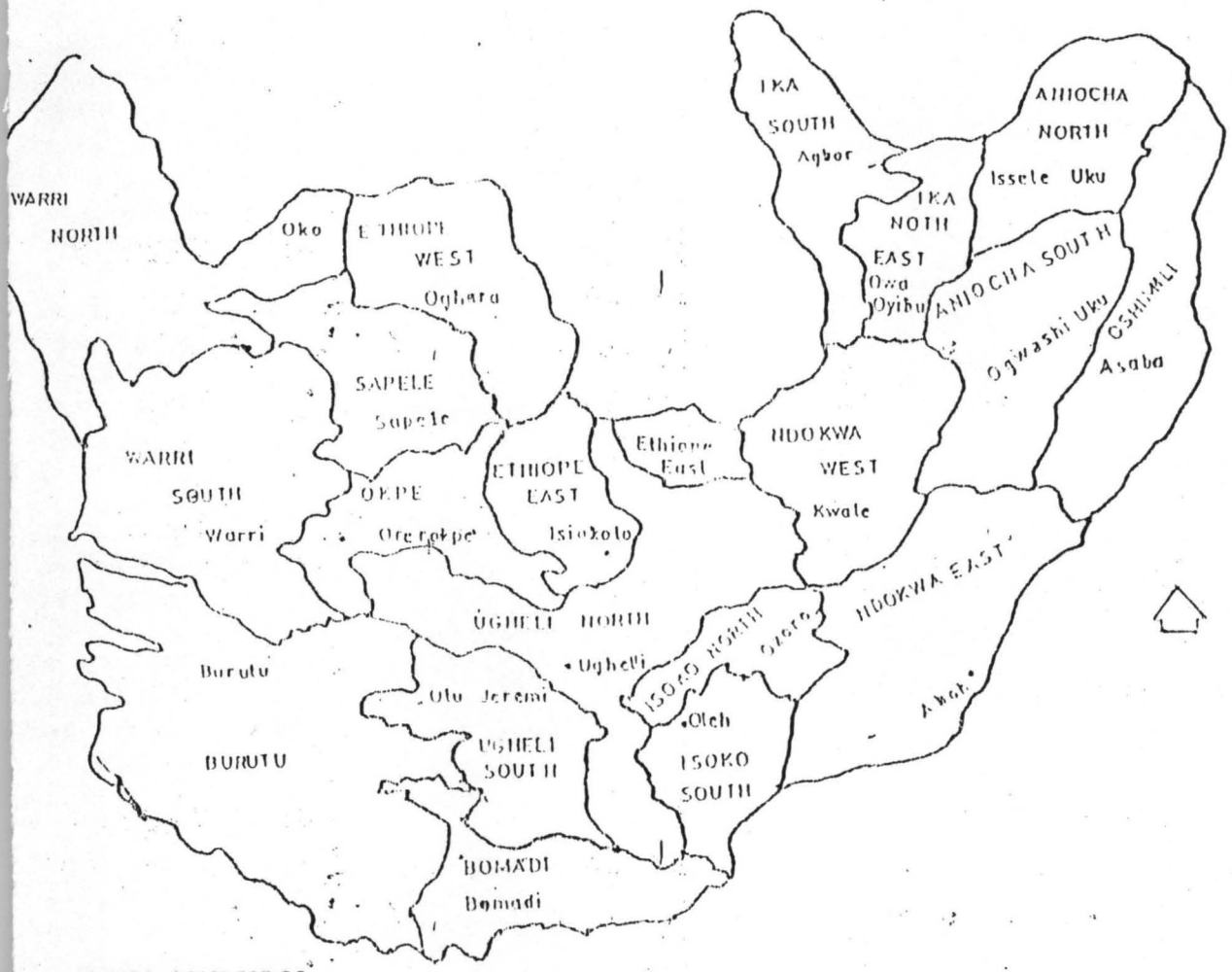
DELTA STATE IN THE NATIONAL SETTING



SOURCE: MONOGRAPHIC MAPS

FIG 1.2

DELTA STATE



. **OTU-JEREMI**

SOURCE:
WARRI SOUTH L.G.A.

CHAPTER TWO

LITERATURE REVIEW

2.0 DEFINITION OF NATURAL GAS

Natural gas is a mixture of hydrocarbon gases along with some impurities that are formed as a result of decomposed organic materials. The impurities found also include water vapour and heavier hydrocarbon. It also contains Hydrogen sulphide (H_2S) carbon dioxide (CO_2), mercoptas (RSH) and volatile sulphur.

When raw natural gas is withdrawn from the underground reservoirs to supply energy demands, these impurities are considered objectionable and are usually removed by various processing schemes. The hydrocarbon gases normally found in natural gas are methane, ethane, propane, butane, pentane and small amount of hexane, octane and the heavier gases.

Usually the propane and heavier fractions are removed for additional processing because of their market value as gasoline blending stock and chemical plant raw feedstock. What usually reaches the transmission line for sale as natural gas is mostly a mixture of methane and ethane with some small percentage of propane. Methane is usually predominant.

2.1 PRODUCTION AND PROCESSION OF NATURAL GAS.

Natural gas is produced from two main types of reservoirs the associated and non-associated gas reservoirs. In both gases well has to be drilled to the reservoirs, completed and prepared for handling oil or gas production. Once the necessary value and control equipment pipeline and surface treatment facilities have been installed the well can go into production.

The crude oil so obtained is passed through a separator to separate the gas from the oil. The gas is then further treaded to remove the heavier ends, gaseous impurities and water vapour before it is piped to consumers.

2.2 TYPES OF NATURAL GAS

Natural gas product from a reservoir that contains oil is called associated gas. The term applies to both free gas from a gas cap and to solution gas. In general the term casing-head gas is synonymous with associated gas since it commonly refers to gas production from oil well. Gas production from a reservoir that does not contain oil is referred to as non-associated

gas, on the basis that it is not directly associated with oil underground. In certain fields, these terms assume particular importance because regulatory and control measure applied to associated gas are directly towards a consideration of the effect of gas production upon oil production rates and ultimate recovery, where the production non-association does not involves such consideration.

In addition, to methane; natural gas sometimes contains liquid petroleum gas (LPGS) such as propane, butane and pentane. Where (LPGS) are present the gas is referred to as wet natural gas. Most of the natural gas currently produced in Nigeria is associated gas that is associated with oil. Associated is generally always wet.

Natural gas is also found as non-associated gas which arises in three ways.

1. Where the source rock is gas-prone, i.e. where it is made up of a high percentage of deposits derived from plant remains as organic matter that is biogenic.
2. Where the rock has been heated to above 150 degree centigrade so that all the oil has been cracked to become gas i.e thermogenic or
3. Where the gas has been able to migrate through permeable rock strata on it own. Non-associated gas is generally "dry" that is low in LPGS.

2.3 ENVIRONMENTAL IMPACT OF GAS FLARING

Exploration and production of oil whether carried out on land or offshore have a number of environmental oil impacts where the operations takes place on land, acquisition of the land result in relocation of villages. The clearing of land for the laying of pipelines may cause the distraction of agricultural lands, fish ponds e.t.c. these may changes completely the social and cultural life of the community.

Oil spillage is another adverse effect of oil extraction and operation on the environment. An investigation by the Nigeria Environmental Society (NES) in 1985 revealed that between 1970 and 1983 offshore and onshore oil spillage amounted to 1.7 billion barrels. Similarly between 1971 and 1975, there were 347 cases of oil spillage in which Warri and Port Harcourt and their environment have been seriously affected.

Also an observation made from field investigation carried out on the 5th and 6th of October 1977, on the Imo River Oil field as a result of a petition from the villagers of Oweza, Imo

state alleging gas flare damages to the villagers and that the gas being flared,

(a) Cause very high temperature with excessive noise and vibrations around the area.

(b) The excessive heat scorched or kill some vegetation particularly the palm trees.

(c) Air pollution from the incomplete combustion of the gas flare.

Isicher and Sanford, 1976, have explained that the activities connected with the flaring of natural gas, seismic surveys, drill cuttings, drilling mud and field used for stimulating production all produced fluid oil and water and that the chemical injected into them to control corrosion or assists the separation of oil from water and general industrial waste do damage the environment. More far reaching effect result from oil spillage, soil, plant, animal and water resources are adversely affected (usually because of the toxicity of oil).

Pollution as a result of oil industry activities and their socio-economic and environmental impact are further discussed below:

2.4 GAS FLARING

Gas flaring which has been defined as the disposal of natural gases to the atmosphere by burning in the oil field and refineries where no other use could be made from it at that particular time has a great effect on the socio-economic life of the inhabitants of the site of flaring. (Dansunmu, and Amadi, 1996).

Natural gas flares are thought to cause various degree of pollution. Because of the resultant variation in the air chemistry of the atmosphere, the meterological, biological, chemical parameters and soil conditions in the immediate environment are affected, local farmers have complained about retardation of growth and productivity of farm crop around gas flares, as well as scarcity of animals around the flared environment. (Donsunmu and Amadi, 1996).

When natural gas in flared or burnt a combustion reaction takes place. Thus.

$$C_nH_{2n+2} + {}^1/_2(3n+1)\,O_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots nCO_2 + (n+1)H_20.$$

where n = number of moles.

This is exothermic reaction for a complete reaction, carbon-dioxide and water vapour are

formed. However when the reaction is not complete carbon monoxide is formed and the product becomes carbon-dioxide, water vapour and carbon-monoxide. Depending on the location, impurities, such as Sulphur, Nitrogen and Hydrogen Sulphide are also found with natural gas. These gases undergo a combustion reaction to form acid gases such as Nitrogen oxides, Sulphur oxides and Hydrogen Sulphate ($N0_2$, $S0_2$, HSO_4)

Studies compiled by Donsumu and Amadi, 1996 shows the following.
The toxicological effects resulting from gas flaring could cause live damage and skin problems. It was also observed that gases compound when natural gas is burnt becomes acidic pollutant and are carried downward and are deposited in soils, stream and lakes and thereby increasing the P^H of the immediate environment.

A decrease in the chlorophyll and reduction in production of pistia plant subjected to condition of very high gas flaring was equally observed.

Ukegbu et al (1984) examined the effect of the flare on the general agriculture and found that the impact decrease as the distance increase from the flare.

Dosunmu and Amadi (1996) carried out experiment at IZOMBE flare station located in imo state on the effect of gas flare on the soil, crop, micro-organism and animals.

Sample were collected from IZOMBE flare station and experimental crops (maize and soya beans) were planted with this grid.

The animal of the experiment work was placed at distance of 100, 500 and 900 meters. The soil sample collected was corked and stored in a freezer for experimental analysis and the field temperature were respectively recorded at the field of varies time interval.

On analysis, the following results were obtained.
Crop Result: The result presented shows a depression in the growing of maize planted in the ground and in flare direction. The study also shows substantial reduction in the yield of soya-bean seed with decreasing distance to the flare. The morphology of the soya-bean crops cultivated about 100 meters from the flare showed

distorted growth with clustered nodes and little or no interposed. The leave were coiled and twisted.

Microbiology Evaluation from the experiment it was observed that microbial population increase in all direction as one moves further from the flare.

Morphological and Biological changes in the animal used.
The result showed edematous swelling and shortening of cilia on the Rabbit that was exposed at a distance of 100 metres away from the flare station using ordinary microscope and electronic microscope. At 900 metres, the Rabbit showed a faint endemotous swelling and shortening of cilia after a repeated and intensive examination with electronic microscope.

Based on these experimented works, the following conclusions were drawn:
When the animals were continously exposed to concentration of nitrogen dioxides and the distance decreased from 100 meter to 0 meter to the flare, morphological changes and biological changes were noticed in the respiratory organs of the experimental animal. These changes include the proliferation of the bronchiolar and alveola epithelium degeneration and obliteration of micros membrane showing that the oxide have the ability to set up biochemical reaction in the lungs. This biochemical reaction also causes the decrease in the weight of the animal.

The reduction in the productivity of the crops could be attributed to the high dehydration process which takes place in the plant system as the result of high radiation of the environment. Therefore too much waters comes out from the plants to the atmosphere. For productivity to the optimal, photosynthetic process in the plant has to be efficient. Plant has to absorb water and carbon dioxide in order to manufacture its food. The yield of Soyabean and Maize also increase as one moves away from the flare station showing that the radiation tends to reduce as are moves away from the flare.

2.5 THE ADVERSE SOCIO-ECONOMIC, AND ENVIROMENTAL IMPLICATION OF GAS FLARING.

A review of a number of existing post impact assessment reports in the Niger Delta Shows range of impact on the predominant mangrove system. The impact range from localised effects on the Flora and Fauna, (usually considered as minor to major impact, such as a high

mortality rate of the mangrove trees and ecological species they support as witnessed after the Faniwa – 5 blow out (Ekekwe 1981; Baker 1983). Fishery losses have been linked to oil spills (Eniola, et al, 1983; Oteri 1981)

Furthermore effect or gas flares on vegetation health and micro-climate are equally seeing. The free disposal of gas through flaring demonstrates the marginality of the interest of the oil producing communities in particular and Nigeria in general. Apart from the deafening howl of the raging fire at gas flares site, the thick smoke which bellow into the sky fall back as acid rain which has poisoned most rivers and lakes in the Niger Delta. Acid rain coupled with constant oil spills have adversely affected community ponds and which were once ripping sources of community protein, Aghalino (1991), Ikporukpo (1983).

Ikelegbe (1993) has shown that gas flares sites around the Western Delta generate tremendous heat which is felt over an average radius of 0.5 kilometers thereby causing thermal pollution. Similar findings were observed by Alakpodia (1989). He stressed that in a gas flare sites in Isoko land, at an average distance of 43.8 meters from gas flare sites, temperature was as high as 40^0E. indeed, the general appearance of the vegetation around the sites are pointer to the fact that the gas flares have had adverse effects on the vegetation and the vegetation cover appear pale and malnourished. This has affected the mangrove and rain forest vegetation with its associated loss of economic and medicinal plants. Traditional healer must now search further into the forest for herbs, bark and roots of tress for treatment of minor ailment (NEST 1991). A world Bank (1995) study estimates that as much as 76 percent of all the natural gas from petroleum production in Nigeria is flared. In deed in 1994, Nigeria emitted 35 tones of methane into the air.

The adverse socio-economic and environmental effect of gas flaring can be summarized as follows:

2.5.1 ECOLOGICAL DEVASTATION:

Natural gas flares are thought to cause various degree of pollution. There is the atmospheric pollution by combustion contaminants and thermal pollution of air land and water.

2.5.2 GREEN HOUSE EFFECT.

The green house is simply a glass house and inside it are plants. Everything the plant needs in order to do well in right inside except the presence of heat which plant uses

during photosynthesis. Light from the sum passes through the glass and gets to the plant. As the light enter the radiant energy or heat from the sunlight goes along with it but find it difficult to escape through the glass. This heat is then made use by plant when the temperature is low.

In a nutshell, just like the atmosphere, the glass house allows the free passage of heat from the sunlight but hinders it from escaping, its function is simply to trap heat. This glass can be used to compare the effect that occur from the combination of carbondioxide (CO_2) and water in the atmosphere. With additional water vapour and carbondioxide poured into the atmosphere from the gas flares, the effect would be that of adding a blanket that hinders the escape of heat the more and so the earth would heat up. This blanket in the essence of the green house effect. The green house effect takes its name from the warmth of the green house. The glass panes act in much the same way as the atmosphere which allows the free passage of in coming radiation but interfere with out-going radiant energy.

2.5.3 DESTRUCTION OF AQUATIC LIVES AND FOREST:

Gas flaring causes heat stress, acid rain and the precipitation have induced destruction of fresh water fishes and forest.

2.5.4 ACID RAINS:

As it has been known that when gas is flared, there is always emission of large oxide of Nitrogen, Hydrogen Sulphide (H_2S) depending on the composition of the gas.

These gases present in natural react with rain droplets in the air and fall as acid rain. They can be represented with the following equations

$CO_2 + H_2O$	H_2CO
	Trioxocarborate (IV) acid
$SO_2 + H_2O$	H_2SO_3
	Trioxosulphate (IV) Acid
$NO_2 + H_2O$	HNO_3 Trioxo
	Trioxontrate (IV) Acid

These acids when fall as acid rain result to the corrosion of corrugated iron sheet. This is observed in the community where gas is being flared.

If carbondioxide dissolved in water it form trioxocarbonate (iv) acid which decreases the P^H of the water and increase its tendency of been corrosive.

Hydrogen Sulphide is very soluble in water and when dissolved behaves as a weak acid and usually causes pitting. The corrosion caused by Hydrogen Sulphide is known as 'Sour Corrosion'.

As a result of gas being flared in the host communities, many who are fishermen have lost their job because the fishes have been killed and the ones that are not killed left the environment for another conducive environment. Also there is destruction of economic crop and trees in this communities the economical implication of this is that the values of agricultural product have been diminished apart from that the farmers have poor agricultural productivity.

2.5.5 LIGHTING UP OF HOST COMMUNITIES:

In the communities where gas is flared, there is continous lighting up. This affects the people psychologically and scare away animals from that environment and certain species of aquatic life.

The economic implication of this continous lighting up is that those who take hunting as their job becomes jobless because there will be no animal to hurt for their income.

As a result of this in one of the creek village near Brass in River State the local fishermen complained that certain species of shrimps that were caught in the post at night, were no longer existing. It was inferred that the continous bright lights from the flares probably disturb their mating habit or scare them away.

Also in Ogoni Land, the leaders have always argued that the perpetual lighting up of their communities by unrestricted gas flaring among other industrial activities is unacceptable to them. The same thing happens in the environment very close to Utorogu gas plant.

2.5.6 HEAT STRESS

During combustion of natural gas (when flared) there is release of heat energy to the surrounding. The heat so generated has adverse effect on man, animals and plant

within the region.

A typical example of this effect is at Erhoike in Kokori field, where high temperature are recorded at 300 meters from flare site. The vegetation present there are dead at less then 500 meters distance from the flare.

2.5.7 VISIBILITY REDUCTION:

This is one of the things that are observable in the areas where natural gas is being flared. This reduced visibility is produced and caused by the scattering of light from the surface of air-bore particle, thickness of the affected air-mass and certain more subtle physical factors.

2.5.8 LOSS OF REVENUE BY THE GOVERNMENT:

The government of Nigeria is loosing a lot from the Natural gas being flared every year. This would have been a constant source of revenue if utilized rather than flared. The revenue would been generated from the operating companies.

Apart from this, the nation is loosing foreign earnings, which can be derived from the natural gas.

2.5.9 WASTE OF ENERGY

The gas reserve of Nigeria appears inexhaustible. It is sad to note that no care is taken to preserve energy resource for today's use and for future generations. The gas flared in Nigeria is estimated to be equivalent to 257,000 barrel of oil per day, this gas flares daily is said to be sufficient to meet the energy requirement of whole West African Countries. If it is so, it means that Nigeria is wasting energy, which are supposed to be utilized.

2.5.9.1 WASTE OF NATURAL RESOURCES

Natural gas is a valuable, non-renewable natural resource. During flaring this is being wasted and there is no way to replace it and renew it. This means a great loss of natural resource to the nation.

2.6.0 REASONS FOR FLARING

The oil producing companies that flare natural gas are quite aware of its great potentials, yet for obvious reasons, some of which are listed below, they cannot but flare the bulk of natural gas produced by them. Some of the reasons why flaring is being done are:-

1. Gas consuming industries are far from gas wells: There are not enough gas consuming industries with economic distances to the source of gas (oil well) so as to utilize the gas.
2. Lack of Storage Facilities: There are no available large storage facilities such as depleted hydrocarbon reservoir or other sub-surface geological features to store the unused natural gas.
3. Lack of Adequate Gas Gathering and Transmission Facilities: In Nigeria's gas well are scattered all over the Niger Delta reign, with no adequate gas gathering facilities to link all the wells.
4. High Cost of Gathering and Transmission Facilities: The high cost involve in acquiring and installing gas gathering and transmission facilities, discourages the exploration and producing companies from installing such facilities in all their gas wells.

2.7.0 METHODS OF GAS FLARING IN NIGERIA

Two methods of gas flaring are generally known: they are Horizontal and Vertical Methods.

2.7.1 HORIZONTAL GAS FLARING

In this method, the flare stack is positioned in a horizontal manner, its advantage are as follows:

It is preferable for flaring sour gases and poses less environmental risk less soot deposit, does not light up environment when compared with vertical flaring.

It is good for flaring gases at low pressure and situations where small volume of gases flared. This is what occurs in Utorogu gas plant.

2.7.2 VERTICAL GAS FLARING

In this method of gas flaring, the flaring stacks is erected vertically. The

flares are usually visible from great distance. This method is preferable in swampy and offshore location. The reason for this is that there is a less danger of fire outbreak resulting from "carry over". A carry over is observed when crude oil goes along into the flare system when the liquid level rises in the process vessels Crude oil floats on the water surface and may ignite if the horizontal flare system is employed.

Moreover, the vertical flare system is preferable for flaring gases at high pressure. As well it is easier and safer to light and can handle larger volume of gas to be flared.

2.8.0 THE FLARE STACK

The method of flare system, which is to be employed, is put into consideration for designing flare stack. The horizontal flare stack is of smaller diameter and shorter length than the vertical type. The dimension also depends on the design capacity of the plant.

The material for construction of the flare stack is high carbon steel or rich steel alloy. The pressure level of the system is important in choosing the type of flare stack to use, horizontal flare stacks are preferable for low pressure while vertical for high pressure.

CHAPTER THREE

RESEARCH METHODOGY

3.0 INTRODUCTION

This chapter discusses the method for the study, the various methods employed in the collection of data for the study and the techniques used for data analysis. For the purpose of acquiring the needed data for a research of this nature, both the primary and secondary data sources were visited.

3.1 TYPES OF INFORMATION AND DATA NEEDED FOR THE STUDY.

For this study, the use of primary and secondary information and data were used in the form of fieldwork and previously published work.

3.1.1 PRIMARY SOURCES

This involves the process of acquiring information from the natural setting. In this study, primary sources were fieldwork, personal observation and questionnaires.

3.1.2 QUESTIONNAIRES

This involves the use of structural questions, which were distributed to the sampled population in the study area. The questionnaire were given to residents of the area to fill and return to the researcher. They were the objective type questions each of the questionnaire contains thirty-three (33) questions.

3.2. STUDY SAMPLE

The study sample consist of male and female in Otujeremi in Ughelli South Local Government Area of Delta State were Utorogu field is located. The ages of those involved were between 15 and 60 years and a total of seventy-five (75) representative samples were used for the study.

3.3. SYSTEMATIC OBSERVATION

Here, the researcher has to go to the study area to have a first hand view of Utorogu field, the site of the gas flare, community development projects and farmland of the area interview were also conducted.

3.4 PHYSICAL SURVEY

This involves physical inspection and analysis of the physical environment, some selected interview were conducted to observe injuriously affected and endangered] components of physical environment like farmland and atmosphere.

Moreso, relevant agencies like Local Government Authorities and petroleum Training Institute, shell Petroleum Company (SPDC) were consulted for relevant materials like journals maps, reports and seminar paper.

3.5 SOCIO-ECONOMIC SURVEY

This aspect of the research was with the acid of questionnaire with socio-economic variables. The questionnaire was divided into two sections A and B. Section A covers the socio-economic characteristics of the respondents while section B covered the oil industry (gas flaring) impact.

3.6 DATA COLLECTION AND ANALYSIS TECHNIQUES

The data were collected with the aid of questionnaire which were administered as an interview. The analysis of physical data collected were done through selected photographic processing.

For the purpose of analysing the data collected from the field, the use of simple statistic measures like percentage, frequency distribution, bar and pie chart etc.

Simple percentage (%). In this techniques data were summarized in tabular form and calculations made to bring out clear numerical and statistical interpretations.

Barcharts/piecharts were used to interpret the analysis of the data collected from the field.

AIR QUALITY METHODOLOGY

AIR QUALITY ASSESSMENT FOR UTOROGU FIELD

In-Situ air quality measurement were carried out in Ten locations using the modern USA Gas Guard 2 while suspended particulate matter was monitored by means of a Digital dust indicator, Model P-5, 1-2, Gaseous parameters measured include CO, $N0_2$, SO_2, CH_4, H_2S, and VOC. The eight locations were selected using such criteria as Accessibility, meteorological considerations of upward and downward direction of the flare point and good open space with suitable site configuration for equipment monitoring.

3.7 RESEARCH QUESTIONS

The research addressed the following questions, which will aid the researcher to draw significant inferences.

(a) Does gas flaring pollutes the atmosphere? What are the air pollutants associated with gas flaring and to what concentrations are these?

(b) Do poor agricultural yield and poor health have any relationship with gas flaring? The flaring of gas, has it any impact on agricultural productivity and how vulnerable are the people in the gas flaring community to illness?

(c) Does the poverty of the community have any connection with the activities of the gas operator. Are there job opportunities from the oil industries, the income per month of the people, is it influenced by the activity of the oil industry?

(d) Does the community benefit in any way from the oil industry operating in the area? Are there community development projects like school, hospital, roads, pipe borne water? Are there agricultural support to the community by the oil industry and to what extent does this get to the grass root?

CHAPTER FOUR

DATA ANALYSIS

4.0 INTRODUCTION

This chapter addresses the analysis of the data collected from the field.

The questionnaire is divided into two groups, which are:

- The socio-economic characteristics of the respondents and
- Gas flaring study in the area.

4.1 SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENT

Analysis of the characteristics of the people of Otu-Jeremi provides an insight into their lives. Variables such as sex, occupation, age, marital status, literacy level, income per month and number of persons per household are considered in this section.

These variable are expected to be indices for assessing standard of living, social values and aspiration of the respondents and economic and social order in the study area.

4.1.1 SEX DISTRIBUTION

In the survey 73.3% of the 75 representative sample were male while 26.7% were female. This indicated that there are more male than female respondent. This situation explains the nature of the socio-economic characteristics of the community.

4.1.2 MARITAL STATUS

Table 4.1 Marital status distribution

Marital Status	Frequency	Percentage %
Single	50	66.7
Married	20	26.7
Widow	Nil	-
Divorced	5	6.6
Total	75	100

Source: field survey 2001

From the sample study 66.7% were single, 26.9% were married, and 6.6% of the responded were Divorcees.

4.1.3 OCCUPATIONAL DISTRIBUTION

Table 4.2. Occupational Distribution

Occupation	Frequency	Percentage %
Student	30	40
Farmer	5	6.7
Fisherman	5	6.7
Trader	15	20
Civil Servant	20	26.6
Total	75	100.00

Source: Field Survey, 2001

This is the distribution of people into various jobs according to their function and the level of trading and skills they have received. From the study area 33.4% of the respondents were unskilled workers and this include people in jobs like farming, trading and fishing, 26.6% were skilled workers while 40% were students.

The implication could be that flaring has affected farming and fishing activities, thus a larger percentage are given to trading and engage themselves in civil services.

4.1.4 INCOME PER MONTH

Table 4.3 Income Distribution

Amount (N)	Frequency	Percentage %
Below 1000	20	26.6
1001-2000	10	13.3
2001-3000	5	6.7
3001-4000	5	6.7
5000 and above	35	46.6
Total	75	100.0

Source: Field Survey, 2001

The sample survey shows 26.6% of the respondents earn below N1000, 14.3% earn

between N1001-2000, 6.7% earn between N2001-3000 earn above N3000 while 46.6% earn N5000 and above.

This could mean the income is likely generated from trading and other services and may not due to oil prospecting exercises.

4.1.5 LITERACY LEVEL

Table 4.4 Literacy Level

Education Level	Frequency	Percentage %
Primary Level	15	20.0
Secondary Level	30	40.0
Tertiary Level	25	33.3
Vocational Studies	5	6.7
Total	75	100

Source: Field Survey, 2001

The sample survey reveals 93.3% of the respondents (20% Primary, 40% Secondary ,33.3% Tertiary) have basic education at background while 6.7% have no basic education.

4.1.6 DISTRIBUTION OF PERSONS PER HOUSEHOLD

Table 4.5 Distribution of persons per household

Number per household	Frequency	Percentage %
1-4	35	49.7
5-8	25	33.3
9-12	15	20.0
Total	75	100.0

Source: Field Survey

From the sample survey, 46.7% of the respondent have 1-4 persons per household, this could be because a higher percentage of the respondent were not married 33.3% have 5-8 persons per household while 20.0% have 9-12 per household.

4.1.7 AGE DISTRIBUTION

Table 4.6 Age distribution

AGE range	Frequency	Percentage (%)
0-15	-	
16-30	35	46.6
31-45	35	46.6
45-60	5	6.8
Total	75	100

Source: Field survey 2001

The age of the respondents from the table above disclose that 46.6% are of the ages of 16.30 years and 31-45% respectively while 6-8% were between 45-60 years.

This implies that the respondents were matured people who can give meaningful answers to the questionnaires. By implication most of the working age have left for greener pasture.

4.1.8 DURATION OF STAY

Table 4.7 Duration of Stay Distribution

Years	Frequency	Percentage %
0-5	10	13.3
6-10	25	33.3
11-15	5	6.7
16-20	10	13.3
20 and above	15	20.0
no responds	10	13.3
Total	75	100.0

Source: Field survey 2001

From the table above 40% have stayed before the establishment of the gas plant, they are eye witnesses with reasonable answers. 13.3% decline to responds. 33.3% have stayed within the period of the establishment of gas plant while 13.3% declares 0-5 years of stay. This small percentage may have come with the development from oil prospective exercises.

4.2 OIL INDUSTRY STUDY ANALYSIS

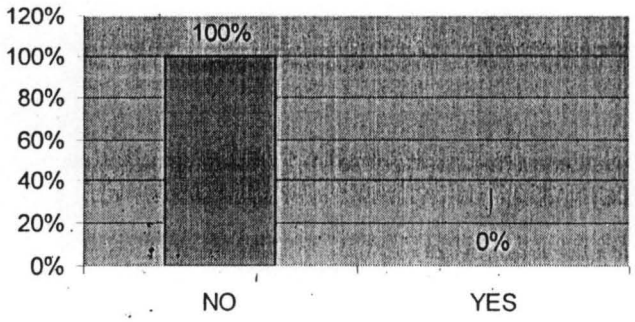
The analysis under this attempts to assess the impact of gas flaring on the welfare of the host community.

4.2.1 GAS FLARING IMPACT AND EMPLOYMENT

Employment remains one of the most important needs of any community. It can be reasonably assumed that any negative impact on employment opportunities shall disrupt the welfare of this community.

The implication of any negative impact on employment can be better appreciated on account of the higher number of sampled respondent who depend on other kind of jobs like the civil service and trading since the farming or fishing is not too favourable.

Fig. 4.1

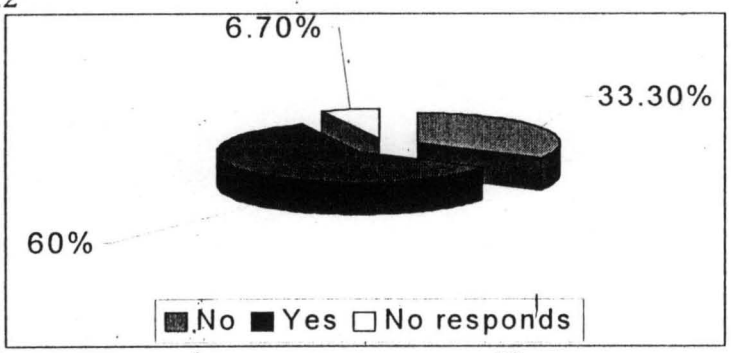


The analysis unveils 100% of the respondent not employed by the company this is quite amazing, but quite unrealistic since about 33% of the respondents have tertiary education. The implication could be because of low level of un-satisfaction of the employment rate expressed by the respondents. Ekakpamre a 12km neighbouring village admit 15% of employment and 82% of non-employment also for 75 respondents.- Balogun (2000).

Personal interview reveals that some of the indigenes employed were employed as Security, Cleaner, etc. It must be made clear that Shell gives priority to high level, skilled staff and training programmes are regularly conducted to enhance the skill of staff and ensure safety of Life, property and environment.

4.2.2. DISTRIBUTION OF ACID RAIN

Fig. 4.2



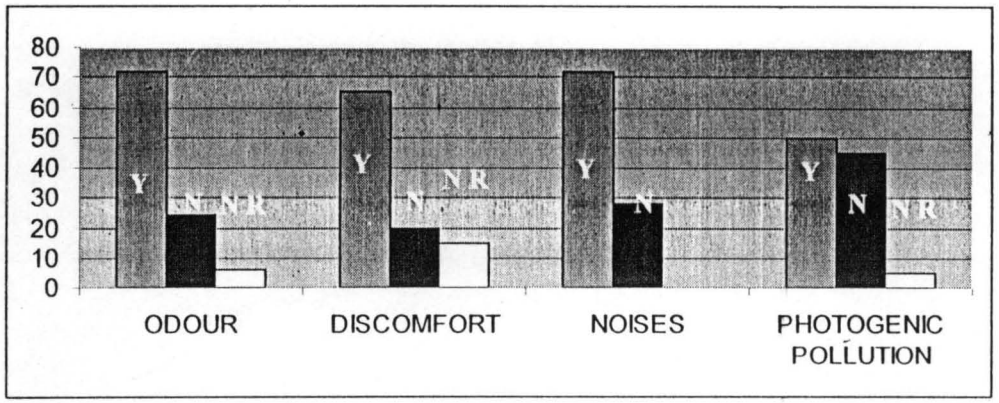
60% claims they have experienced acid rain, 33.3% admits they have not, while 6.7% declined to responds. The emission of combustion gases (Sox, Nox HC) from flaring could also lead to acid rain that directly affects vegetation. The roofing sheet of the study area are corroded which confirms this.

It was found that high specific emission in Utorogu field exacerbated by contributions from other industries within 20km radius yielded rainfall that was generally acidic, the P^H being slightly lower than those of rainfall from non-SPDC location.

4.2.3 DISTRIBUTION OF DISTURBANCE

(Comprising Odour, Discomfort, Noise and Photogenic Pollution, from flare site)

Fig. 4.3



For Odour, 72% claimed yes, 24% claimed no, while 4% declined to response.

For discomfort, 65% admitted yes, 20% claimed no while 15% declined to response.

For noise, 72% claimed yes, 28% claimed no.

For photogenic pollution, 50% claims yes, 45% claimed no, while 5% declined to response.

The result above implies atmospheric pollution.

4.2.4. FLARING IMPACT AND INFRASTRUCTURES

Physical infrastructure like housing, water supply, electricity supply and transportation determined the level of warfare development.

Any undesirable effect on these infrastructures does not guarantee good community welfare.

4.2.4.1 DISTRIBUTION OF SOURCE OF WATER

Table 4.8 Distribution of Source of Water

Source	Frequency	Percentage
Tap	35	46.7
Well	10	13.3
Borehole	10	13.3
Tap/well	5	6.7
Tap/Well/River/Borehole	5	6.7
No response	10	13.3
Total	75	100

Field Survey, 2001

60.0% of the respondents depends on taps and borehole for their source of water. 13.4% have access to more than one source of water, 13.3% declined to responds, 13.3% depend on well directly. Person observations of some of the tap show that there are not functional, on interview with some members of the community, the contractors were criticized for poorly done job. If more were depending on well or river, they would be more vulnerable to polluted water.

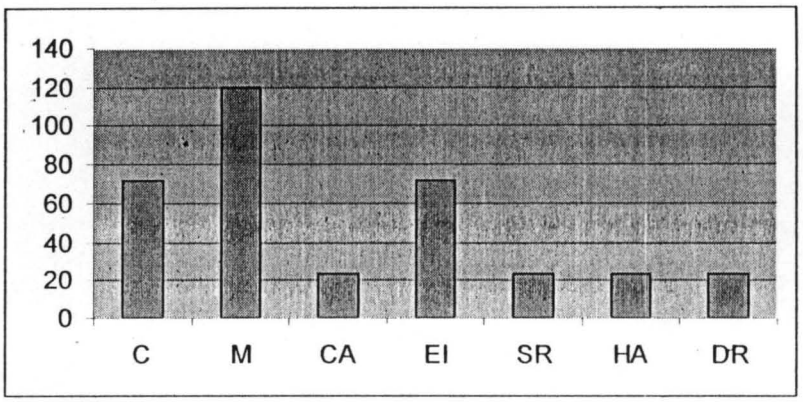
4.2.5 FLARING IMPACT AND PERSONAL HEALTH ANALYSIS

Science has established a link between health deterioration and compounds and elements like carbon monoxide (CO), Chloroflorocarbon, carbon dioxide (CO_2) and sulphur (S). All these elements and compounds are associated with oil activities. Therefore the implication of their presence in the study area in undesirable proportion suggest a danger for health of the inhabitants of the study area and therefore reducing the level of welfare.

4.2.6 DISTRIBUTION OF SICKNESS

The Fig. Below shows the degree to which the respondent are exposed to health hazards,

Fig 4.4



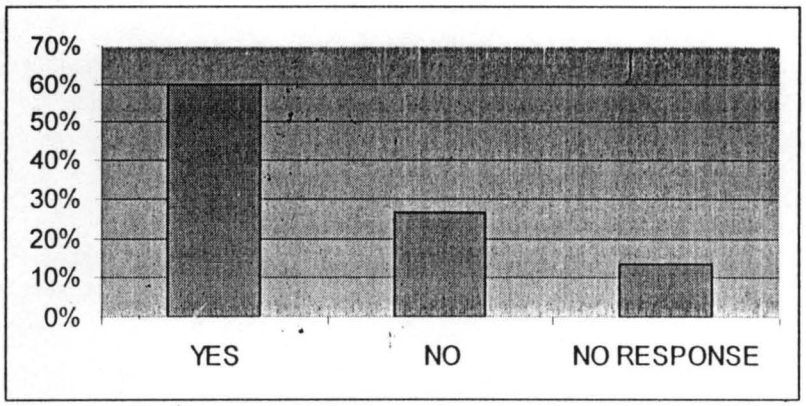
C – Cough
M – Malaria
CA – Catarrh
EI – Eye Irritation
SR – Skin Rashes
HA – Headache
DR - Diarrhea

CA
EI
SR

The result shows the people are exposed to atmospheric pollution as eye irritation, coughing, catarrh etc. are a function of the presence of SO_2, H_2S and suspended particle (Obajimi, 1998) while malaria could be as a result of the presence of numerous breeding points put in place or created due to petroleum prospecting exercise (Jimoh and Fabiyi, 2000).

4.2.7 CROP YIELD COMPARISONS WITH OTHER VILLAGES

Fig. 4.5



From the above 60% of the respondent admit that yields from other villages are better 26.7% do not agree while 13.3 declined to responds. Personal interview with some members of the community attested to the fact that yield from other villages are better.

Of the 60% of the respondent (i.e 45 respondents), 5 respondents claim that others villages farm yield 100% better, 35 respondents admit 75% better while 5 accept 25%.

The above implies a reduction in agricultural productivity.

4.2.8 PUBLIC RELATION WITH HOST COMMUNITY

Table 4.9 Relationship with Host Community by Public Participation

Responds	Frequency	Percentage %
YES	40	53.3
NO	15	20.0
No responds	20	26.7
Total	75	100.0

Source: Field Survey, 2001

The table shows ½ of the respondent (53.3%) admits that there is public participation while 26% declined to responds, 20% disagrees that there is public participation.

4.29 LEVELS OF PARTICIPATION

Table 4.10 Distribution of level of participation

Level of Involvement	Frequency	Percentage %
Satisfactory	10	25.0
Good	10	25.0
Fair	15	37.5
Poor	5	12.5
Total	40	100

The table reveals that the level of involvement is fair, thus, the company community relationship average as half of the respondent (50%)accepted appreciable involvement. While the other 50% claims below average, personal interview likened this to greed of some of the community representative to the oil industry.

However the company embarks upon a host of community development programmes. These programmes are as follows:

HEALTH FACULTIES:

The company completed the construction of a cottage hospital, it was equipped by the company while the government, in partnership with the company provide staff for it smooth running and operation.

EDUCATION:

Building of Six Block Class-room for Otu-Jeremi Grammar School in 1986 and 1995, donation of science equipment in 1991.

Scholarship award was given to 30 Post Primary School Student and 2 University Student.

AGRICULTURAL ASSISTANCE:

Agricultural assistance by extension officers are provided, also agricultural materials like cassava cuttings, pineapple suckers, oil palm seedlings plantain suckers, yam settees and fish fingerlings. However grassroots distribution remain the complain of the people.

4.3 AIR QUALITY ANALYSIS

Activities/actions that can impact air include oil water separation, flow metering and associate gas flaring, operation of gas-fired utilities, pumps and valves.

Values of air pollutants measured at some remote environment from the study area are used as basis for evaluating impact on air quality.

As show on table (4.11) below Ekakpamre and Okwagbe (within a 20km radius of Utorogu field), and Shell Housing Estate, Edjeba have mean concentration of Nox as 53.91, 52.2 and 1279 ppb respectively.

The SO_2 concentration in air quality of the six remote location also vary between 21.1 and. 148 ppm. Co values are 3.1 ppm (Ughelli, along the main road) 1.4ppm (Ekakpamre), 0.02 ppm (Okwagbe,) and 0.04 ppm (Shell Housing Estate Edjeba)

4.3.1 MEASURED VALUES OF AIR POLLUTANTS (MG/L PPM) IN SOME REMOTE TOWN/VILLAGE

Table 4.11 Measured values of Air Pollutants (Mg/1Ppm) in some remote Town/Village

LOCATION	NO_X	SO_2	CO	CO_2
Warri, Airport Rd Effurun	0.2	0.03		
Ughelli Market Place	0.2	0.15		
Ughelli (along the main Rd.	-	0.04	3.1	$383.1x10^{-3}$
Ekakpamre	0.05	0.02	1.4	$307.4x10^{-3}$
Okwagbe	0.05	0.02	0.02	
Shell resident Edjeba	0.13	0.03	0.04	

Source: SPDC – West, EIA Report.

Table shows the magnitude of air pollution of some locations within the Utorogu field. The results show that suspended particulate within the field are within that FEPA ambient air quality standard of $250ug/m^3$.

Table 4.12 Measured Values of Air Pollutants at Utorogu Field (Production Site Average)

Sampling Locations at Utorogu Field	Mg/1						
Gas Plant, Generator exhaust area	NO_X	SO_X	O_3	NH_3	CO_2	CO	VOC
	$23x10^{-3}$	$7x10^{-3}$	ND	$27x10^{-3}$	$760x10^{-3}$	$296x10^{-5}$	$21x10^{-5}$
Gas plant, flare site	$21x10^{-3}$	$7x10^{-3}$	ND	$25x10^{-3}$	$770x10^{-3}$	$263x10^{-5}$	$13x10^{-5}$
Gas plant, Processing module	$17x10^{-3}$	$56x10^{-3}$	ND	$31x10^{-3}$	$650x10^{-3}$	$192x10^{-5}$	$25x10^{-5}$
Flow-station, process area	$19x10^{-3}$	$51x10^{-3}$	ND	$25x10^{-3}$	$725x10^{-3}$	$213x10^{-5}$	$17x10^{-5}$
Flow-station, flare site	$24x10^{-3}$	$67x10^{-3}$	ND	$23x10^{-3}$	$804x10^{-3}$	$313x10^{-5}$	$33x10^{-5}$
Mean	$21x10^{-3}$	$38x10^{-3}$	ND	$26x10^{-3}$	$700x10^{-3}$	$256x10^{-5}$	$22x10^{-5}$

Source: SPDC – West, EIA Report.

The air quality also remained unimpacted as discerned from the level of total suspended particle that was generally within FEPA standards.

Despite this claim, some vegetation around the Utorogu field does not do too well. Therefore, there is a high probability of contribution from other emission sources as Delta Glass Ughelli (25km NE of Gas Plant, NEPA PLC. Thermal power station, Ughelli (25km NE of Gas plant,) Ughelli Urban air pollution source.

The results of the air quality assessment for Utorogu field are shown below

Table 4.13 Air Quality result.

S/N	LOCATION & CODE	SPM Ug/m^3	SOX Ug/m^3	CO Ug/m^3	H_2S Ppm	NO_2 ppm	CH4 ppm	VOC ppm
1.	UTAQ 1 Generator house	100	<0.1	<1.0	1.0	<0.1	<1.0	<1.0
2.	UTAQ 2 Inlet Manifold	<50	<0.1	<1.0	<0.1	<0.1	<1.0	<1.0
3.	UTAQ 3 Flare site downward	210	<0.1	2.0	1.0	<0.1	<1.0	<1.0
4.	UTAQ 4 Flare site (upwind)	140	<0.1	2.0	1.0	<0.1	<1.0	<1.0
5.	UTAQ 5 Gas well head (downward)	200	<0.1	<1.0	<0.1	0.3	<1.0	<1.0
6.	UTAQ 6 Gas well head upwind	200	<0.1	<1.0	<0.1	0.1	<1.0	<1.0
7.	UTAQ 7 Glycol regeneration unit	100	<0.1	<1.0	1.0	0.3	<1.0	<1.0
8.	UTAQ 8 Iwheka community	400	<0.1	<1.0	1.0	0.2	<1.0	<1.0
9.	UTAQ 9 Oto-Udu community	300	<0.1	<1.0	<0.1	<0.1	<1.0	<1.0
10.	UTAQ 10 Out-Jeremi	300	N.D	N.D	N.D	N.D	N.D	N.D
	FEPA/DPR Standard	250	0.01ppm 26.0ug/m^3	10.20ppm 11.4-22.8ug/m^3	N S	0.04 0.06	N S	N S
	WHO Standards	150-230	0.04-06 ppm	10ppm	N S	0.08	N S	N S

Source: SPDC – West, EIA Report. June 2000

* Flare site
* Chemical injection plant
* Saver pit
* Gas well-head 31
* Power generators
* Vapor venting Outlets
* Glycol Generation unit

The major air pollutant in Utorogu Gas field is suspended particulate Matter (SPM). Average values recorded for each of the ten locations range between 50 and 400ug/m^3. These values exceeded the national limit in 3 location viz Iwehrekan, community, Otu-Udu Primary School and Otu-Jeremi. CO_2 was detected only around the flare site probably due to the incomplete combustion and carry over of oil to the flare. The recorded values are however, below the stipulated limit. The concentration of H_2S was also low, ranging from zero to 1.0 ppm while the average values for both CH_4 and VOC were less than 1.0 ppm

NO_2 concentration was high and above the national limit in four of the location most especially around Gas well heads and the Glycol generation unit. This is probably due to the leakage of monoethonol amine which may have the amino group (NH_2) converted to NO_2 on Oxidation at high temperature.

The result shows pollution is still minimal, the reason is likely due to the fact that Utorogu is a low-pressure plant whose production specification maintains or meets FEPA standards and likely because, flaring is horizontal.

4.4 DISCUSSION

The study discloses that gas flaring has an adverse impact on the socio-economic life on the residents in the study area. This can be seen in the general yield of their farm produce around flare and the percentage that are still giving to farming.

Moreso, the people complained that apart from the heat, vibrations noise and glows from the flares, they are faced with health problems like catarrh, headache cough, eye irritation, skin-rashes and this account for over 50% of the respondents.
It was also discovered that the level of relationship between the host communities and the company in very minimal 50% of the respondent believed it is fair while the other 50% believe it is good this implies that the relationship between to community and company is yet minimal.

However oral interview reveals that some of the reasons of not being employed by the Company is the non-technicality of the people to be employed.
Moreso, greed and personal interest by some members of the community have led to the inadequate utilization of some funds for community development.

This study reveals that the activities of the gas plant (oil industry) has not been too favourable as derived from the questionnaire analysis. Agricultural products have been found to be reduced, this no doubt has led to the drifting from farming to other occupation such as trading..

The inhabitants of the oil field area (study area) are relatively vulnerable, eye initiation, skin rashes etc. which are a function of pollution in an area, are evidences in the locality.

The income of the people of the community is quite encouraging, but such contribution is not due to the impact of the oil industry as job opportunity is not significant as derived from the questionnaire.

Community development projects which are suppose to be benefits is still minimal and needs adequate update and standards.

Politics in the implementation of programmes have done great harms to our development from local, to national levels, this was also found to be a barrier between the oil industry, community heads and members of the community, justice, equity and transparency in reports should be the priority of organization if sustainable development is our vision.

Although reports from SPDC – Environment impact report shows the atmosphere is unimpacted, it must be known that the atmosphere is not localized and so where pollutant concentration are higher in one area it is believed that this can be transferred. However, the atmosphere disperses pollutant.

The peace or calmness of this community does not imply that they are satisfied, they rather believed that riot or destruction of gas plant would not do them good either, as lives, property and the environment would also be affected.

However, the case of the Ogoni people could be a threat to other communities in Niger Delta.

The need to face fact in Niger Delta with respect to environmental sustainability and socio-economic elevation should be the priority of the oil producing company.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 SUMMARY

The study was carried out on the environmental impact of gas flaring in Niger Delta with specific emphases on the Otu-Jeremi Community in Delta State

The study aimed at examining the specific impact of flaring on the socio-economic life of the residents of the study area and ways of controlling gas flaring to improve the quality of life of the people. It is also aimed at examine the atmospheric pollution associated with gas flaring.

The collection of data for this study was through primary and secondary methods. The primary method include the administration of questionnaire while secondary data involved the use of literatures, information from journals, articles and newspapers.

Gas flaring and oil exploration has a serious implication on the immediate environment as it impoverish both ecological and socio-economic environments causing land dereliction, deforestation, water and air pollution. The socio-economic impact from the study is seen to be negative.

5.2 CONCLUSION

The project work has shown that flaring of natural gas constitute both economic waste, environmental pollution and ecological devastation in the nation especially in area where gas in being flared (Utorogu field)

The only true way by which the flares could be put off is through the increase in utilization of natural gas.

Important, other benefit to be derived when gas reserves is fully exploited are:

* Increase revenue generation by the government
* Job opportunity
* Elimination of environmental pollution and attendant health risk
* Promotion of local industrial development since industrial fuel, chemical and metallurgical industry use gas in one or more processes

* Increased foreign earnings.

5.3 RECOMMENDATIONS

While it is obvious that the gas plant cannot be shut down for now, because of its economic importance, the well being of the people around the area should be taken into considerations. Community development programmes should be supervised to grassroots at it involves the members of the community. More scholarship should be giving to a greater number of students in the community, agricultural support programme should be increased, health services should be more encouraging, (if possible free drugs and treatment).

Importantly, flared gas can be utilized as suggested below.

1. There should be the provision of large enough storage facilities for the unused natural gas.
2. The high cost of gathering and transmission facilities should be reduced in order to encourage the producing companies to install such facilities in their gas well.
3. In order to enhance national interest and rapid industrialization, there should be constancy from one government regime to another on gas project.
4. Small industries should be encouraged to be involved in the extraction of liquefied petroleum (LPG) from national gas shames.
5. To ensure consistency, environmental monitoring organizations (FEPA, and SEPA) should also carry out their own monitoring research along side with Environmental Impact Assessment of oil producing industries or other industries.

REFERENCES

Aghalino, S.O. (1998) Oil and Gas Exploration and production in the Isoko Urhobo Areas of the Western Delta, Nigeria, 1958-1959'' (Ph. D.Thesis in progress).

Alakpodia, I.J. (1980): The Effects of gas flaring on the Micro-climate and adjacent vegetation in Isoko Area of Bendel State (Unpublished M.Sc. Thesis, University of Ibadan)

ANNE ENE-ITA: "The need for Environmental Impact Assessment (EIA) in a Developing Economy" Federal Ministry of works and Housing.

BAKER, J. N. (1987) "Impact of the Petroleum industry on Mangrove Ecology" in the Petroleum industry and Nigerian Environment (Lagos: NNPC)

BALOGUN O.A. (2000) Environment Impact of oil pollution in Niger Delta, case study of Ubegi and Ekakprame Communities B. Sc. Thesis, Obafemi Awolowo University, Ife –Ife, Niger.

CHIMA E. I. (1996): Progress and prospect for Nigerians Liquefied Natural Gas in proceedings of Twentieth Annual International Conference of the Society of Petroleum Engineers (Nigeria Cormal) pp. 124.

DOSUNMU, A and AMADI B.C. (1996): Evaluation of the Effects of Gas flares on the Environment in proceedings of Twentieth Annual International Conference of the Society of Petroleum Engineers (Nigeria Council) pp. 43-52.

EKEKWE, E. (1981) The Faniwa – 5 Blow out in the Petroleum Industry and Nigerian Environment (Warri, NNPC).

ENIOLA, O. A. et al (1981): " Environmental and Socio-economic Impact of oil spillage in the River Areas" in the Petroleum Riverine and the Nigerian Environment. (Lagos: NNPC), FEPA Decree No. 58, 1988.

Environmental Protection and Pollution Control Directorate (EPCCD) 1995. Development and Environmental Management Strategies in Ompadec.

FRIENDS of the Earth (Benin) P. O. Box 10577, Benin City. The Environmental impact of the oil industry on the Niger Delta.

IKELEGBE, O. O. (1993): "Pollution in Nigeria: Causes, Effects and Control. The case of Delta State". "Paper presented at the 20th Annual Conference of the Nigerian Geographical Association, (Minna, April 18-22).

IKPORUKPO. C. O. (1983): "Environmental Deterioration and Policy in Nigeria" Applied Geography, 3

ISICHEL, O. O. and SANFORD, M.W. (1980) The effect of waste gas flares on the surrounding vegetation in South Eastern Nigeria.

JIMOH H. I. and IFABIYI (2000): Contemporary issue in Environmental Studies. Haytes press and publishing Co. Ltd.

Nigeria Council of Society of Petroleum Engineers, 19th Annual Intentional Conference, the society of petroleum engineers, Nigeria Council (1995) pg. 255, 256, 257.

Nigeria's Threatened Environment: A National Profile by the Nigeria Environmental Study/Action Team (NEST) 1991 pp 44.

OBAJIMI M. O. (1998) Air Pollution – A threat to the healthy living in Nigeria Rural Towns. A clinico-Radiological perspective Ibd. Pp 49-59

OLUWATINMILEHIM, J. O. (1981): "The ecological impact of the oil industry in the Niger Delta Area of Nigeria Msc. Thesis, University of Ife, Ife.

OTERI, A. (1981) "A study of the effect of oil spills on ground water in the petroleum industry and the Nigerian Environment.

ORHUWERU, A. P. (1997): Methods of Utilization of Natural Gas as an alternative to flaring. HND Thesis, Petroleum processing Department Petroleum Training of Natural Gas 3rd Edition, Pg. 1, 2, 5, 6.

RICHARD A. Prospect for Natural Gas Development and Utilization in 21st century Current legal issues for Gas Production and utilization in Nigeria. Seminar delivered at the institute of directors, 1997 seminar on petroleum and Gas metropolitan club, V. I. Lagos.

SHELL DEVELOPMENT: Shell Petroleum, Development Company – West (SPDC WEST), Environmental Impact Assessment Report (EIA) June, 2000.

UKEGBU and Okegi (1984): The effect of the flare on general agriculture crops paper 19th Annual International Conference the Society of Petroleum Engineers, Nigeria. (1995).

World Bank (1995): Defining and Environmental Strategy for the Niger Delta.

APPENDIX 1

FEDERAL UNIVERSITY OF TECHNOLOGY,

MINNA, NIGER STATE.

POST GRADUATE SCHOOL

SCHOOL OF SCIENCE & SCIENCE EDUCATION

DEPARTMENT OF GEOGRAPHY.

ENVIRONMENTAL MANAGEMENT PROGRAMME.

1. Name of Town _____
2. Name of Street _____
3. Sex (a) Male ( ) (b) Female ( )
4. Marital Status: (a) Single ( ) (b) Married ( ) (c) Widow (d) Divorced.
5. Age (a) 0 - 15 ( ) (b) 16 – 30 ( ) (c) 31 – 45 ( ) (d) 45-60 ( ) (e) 50 years and above.
6. Occupation: (a) Student ( ) (b) Farmer ( ) (c) Fisherman ( ) (d) Trader ( ) (e) Civil Servant ( )
7. Income per month (a) Less than N1,000 ( ) (b) N1,000 – N2,000 (c) N2, 100 – N3,000 (d) N 3, 100 – N000 ( ) (e) N5,000 and above
8. Literacy level (a) Primary School ( ) (b) Secondary level ( ) (c) Tertiary level ( ) (d) Vocational Studies ( )
9. Number of persons per household (a) 1- 4 ( ) (b) 5 – 8 ( ) (c) 9- 12 ( ) (d) 9 and above.

Section B

10. Names of Oil companies operation in this community

(a)

(b)

(c)

(d)

11. Do you work in any of these companies? (a) yes ( ) (b) No ( )
12. Have you being affected by the gas flaring before ? (a) Yes ( ) (b) No
13. If yes were you compensated for the damage ? (a) Yes ( ) (b) No ( )
14. If yes what was the level of satisfaction of compensation What is the worth of compensation in percentage (a) 100 % ( ) (b) 75% ( ) (c) 50% ( ) (d) 25% ( ) (e) 0% ( )
15. Did the oil Company operate out any cleaning – up (a) yes ( ) (b) No ( )
16. What is the time interval between the incident and remedy (a) 0 – 4 weeks (b) 5-9 weeks (c) 10-14 weeks (d)15-19 weeks (e) 20 weeks and above
17. What type of sickness listed below have you suffered from (a) cough (b) malaria-fever (c)skin rashes (d) headache ( ) (e) eye irritation (f) diarrhea (g) catarrh ( ) (h)animal ( ) (f) Anemia ( )
18. How is the general crop yield harvest in your area around flaring (a) 100% ( ) (b) 75% ( ) (c) 50 % ( ) (d) 25% ( ) (e) 6% ( )
19. Do people from the other villages have better yield (a) yes (b) No
20. In what quantity is their yield better in percentage (a) 100% ( ) (b) 75% ( ) (c) 50% ( ) (d) 25% ( ) (e)0 % ( )
21. Have you stop farming of fishing because of the gas flare (a) Yes ( ) (b) No ( ).
22. If yes, what do you do now?
23. Have you experienced acid rain in your area as a result your building or any other structures were damage (a) yes ( ) (b) No ( )
24. Is there any attentive odor from the gas flaring site? (a) Yes ( ) (b) No ( )
25. If yes, is this odour causing discomfort to you and your family (a) Yes ( ) (b) No ( ).
26. Are you being disturbed by the noise from gas flaring (a) Yes ( ) (b) No ( )
27. If yes, what do you do during this period
28. Does the light glare (Photogenic pollution) from the gas flaring site constitute nuisance to you and your family (a) yes ( ) (b) No. ( ),
29. What is the source of water to the Community (a) Tap ( ) (b) Well ( ) (c) River ( ) (d)Borehole (e) Stream.

Where do you or your children use these facilities ?

Family	Location	Distance	Amount to travel	Travel time	Road condition
Primary School Secondary School Hospital Bank Postal Agency Water Market					

31. Is there anything like public participation in the decision making process by the company when it involves the people of the community.

32. If yes what is the level of involvement (a) Very Satisfactory (b) Good ( ) (d) fair ( ) (e) Poor.

33. How long have you stayed in this Town (a) 0 – 5yrs ( ) (b) 6 – 10 yrs ( ) (c) 11 – 15yrs ( ) (d) 16 – 20 yrs ( )

For community Leader

Facility	Year	Donor	Amount	State
Primary School Secondary School Electricity Water Hospital Bank Police Station Postal Agency Town Hall Road Market				

APPENDIX II

ABBREVIATION

CM	-	Centigrade
^{o}C	-	degree centigrade
NEPA	-	National Electrical Power Authority
NNPC	-	Nigerian National Petroleum Corporation
SPDC	-	Shell Petroleum Development Company
^{o}E	-	degree East
NEST	-	Nigerian Environmental Study/Action Team
SO_X	-	Oxide of Sulphur
NO_X	-	Oxide of Nitrogen
HC	-	Hydro Carbon
PPM	-	Part Per Million
PPB	-	Part Per Billion
FEPA	-	Federal Environmental Protection Agency
NE	-	North East
KM	-	Kilometre
VOC	-	Volatile Organic Compound
UTAQ	-	Utorogu Air Quality
SEPA	-	State Environmental Protection
FIG	-	Figure
TAB	-	Table
ND	-	Not Detected.