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HUMAN HEALTH AND SOCIOECONOMIC IMPACTS OF OIL AND GAS ACTIVITIES IN SELECTED COMMUNITIES IN RIVERS STATE

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Abstract
This study was carried out to assess the human health and socioeconomic impacts of oil and gas activities in selected Rivers State communities. Primary data were collected from questionnaire responses from respondents living within close proximity to the selected flare locations. The results revealed that 25.8% of the total respondents strongly agreed that gas flaring had significant impacts on air pollution in their community of residence, 64.1% of the total respondents agreed, 2.5% were undecided, 6.3% disagreed and 1.3% strongly disagreed that gas flaring had significant impacts on air pollution in their community of residence. Furthermore, 31.6% of the total respondents strongly agreed that gas flaring is affecting their health or the health of members of their family, 50.1% of the total respondents agreed, 3.0% were undecided, 10.1% disagreed and 4.5% of the total respondents strongly disagreed that gas flaring is affecting their health or the health of members of their family. Similarly, 40.4% of the total respondents strongly agreed that gas flaring is causing respiratory diseases, 55.6% agreed, 2.3% were undecided, 1.3% disagreed and 0.5% strongly disagreed that gas flaring is causing respiratory diseases. Furthermore, results revealed that 32.3% of the total respondents strongly agreed that gas flaring led to loss of income and livelihood, 52.3% agreed, 7.6% were undecided, 4.0% disagreed and 3.8% strongly disagreed that gas flaring led to loss of income and livelihood. The prevalence of health disorders is stress disorder>Respiratory Problems>heart disease>Diabetes>Cancer. The study recommends that adequate health facilities should be established in communities close to flare locations to cater for the urgent health needs of residents.

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Introduction

Gas flaring which involves the combustion of associated gases produced with crude oil is a common practice in oil and gas operations. It is a high-temperature oxidation process used to burn combustible components, mostly hydrocarbons, of waste gases from industrial operations (Dienye *et al*., 2023).

Oil and gas operations in the Niger Delta region of Nigeria have developed gas flaring as an alternative to the release gas to the atmosphere, primarily for safety reasons. Gas flares are the disposal option for handling hydrocarbon gases because of their ability to burn efficiently (Ite & Ibok, 2013).

Gas flaring has generated numerous concerns considering its negative impact on the environment and human health. Although several calls by international bodies such as Global Gas Flaring Reduction (GGFR) have been made, the volume of gas flared globally seems to have been increasing. Research has shown an annual increase of 2 bcm in the volume of gas flared between 2010 and 2012. It is estimated that approximately 140 billion cubic meters of gas are flared annually across the oil-producing countries of the world (McGreevey & Whitaker, 2020). In Nigeria, approximately 7.4 billion cubic meters of gas was flared in 2018, whereas 425.9billion standard cubic feet of gas was flared in 2019, ranking among the top 10 gas-flare countries despite the practice being declared illegal since 1984 (Eboh, 2019).

Gas flaring negatively affects the environment. Gas flaring contributes significantly to global warming and climate change because of the emission of large quantities of carbon dioxide, nitrogen dioxide, sulfur dioxide, benzene, xylene and hydrogen sulfide (Nwachukwu *et al*., 2022). These toxic pollutants have a direct impact on human health and the livelihood of residents. In addition, the release of greenhouse gases is responsible for the increased heat wave intensity observed in present times. The resulting effects are the erosion of coastal shorelines, flooding, damage/ loss of agricultural crops which trigger outbreak of diseases, low crop yields, food insecurity and loss of income (Obi *et al*., 2021).

More worrisome is, that statistics have shown that oil and gas flaring is linked to $7.4 billion in health damages, contributing to more than 700 premature deaths and 73,000 asthma exacerbations among infants annually in the United States (Tran *et al*., 2024).

In Rivers State (the study location), gas flaring has also had direct impacts on the local environment and human health. Relatively, agricultural productivity has been severely hampered by gas flaring. The combustion process raises soil temperature, leading to a decline in crop yield and acid rains as its two major ripple effects. The smokes emitted from the flares also leads to black rainfall and water bodies, which affect aquatic and wildlife. It is also evident from previous studies that several pollutants emitted at flare locations cause insomnia, skin and eye irritations, bronchitis, asthma, and respiratory tract disorders (Ojukwu & Somerville, 2020).

In selected communities in Rivers State, associated gases have continued to be flared. This unstainable practice has remained unbated for decades, while health and socioeconomic losses have continued to increase. Unfortunately, residents live in close proximity to the flare locations. The study by Chen *et al*. (2021) showed that over 500,000 Americans living within 3 miles of a gas flare are at risk of adverse health effects. This revelation raises serious concerns as neighboring communities in Rivers State live in close proximity to flare locations. It has therefore become imperative to undertake a study of this nature to determine the human health and socioeconomic implications of oil and gas activities in selected locations in Rivers State.

Materials and Methods

The study area, Rivers State, is located between latitude $4^0 30^l$-$5^0 40^l$N and Longitude $6^0 40^l$-$7^0 20^l$E (Figure 1).

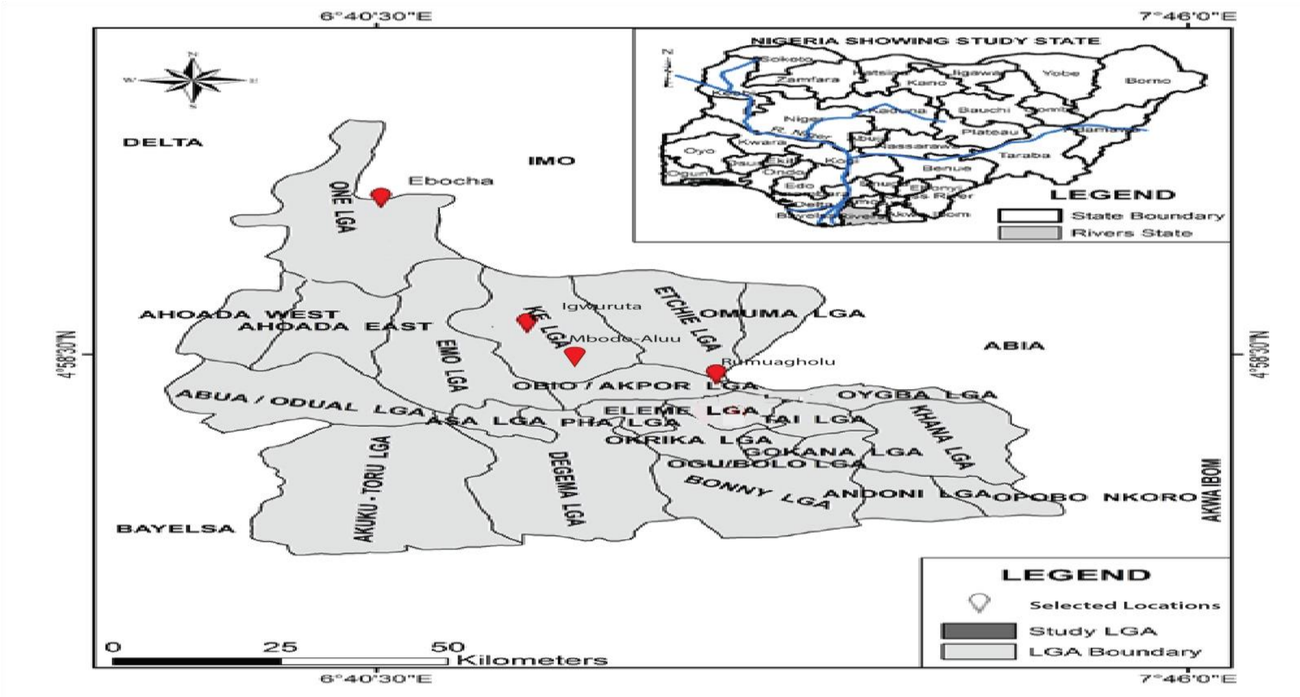

Figure 1: Map of rivers state showing the selected sampling locations
Source: *Cartography/GIS Laboratory, Department of Geography and Environmental Management, University of Port Harcourt.*

The state is located in the Niger Delta region of Nigeria and occupies an area approximately 11,077 km^2 of the delta described as constructive and fed mainly with sediments from the heavily laden (about 330,000 cm3 /annum) River Niger originating from Guinea through Mali, Niger, the Benin Republic and Northern Nigeria. The Delta also receives sediments from the Benue River, although to a lesser degree. The state is bounded to the South by the Atlantic Ocean, to the North by Imo, Abia, and Anambra, to the East by Akwa Ibom and to the West by Bayelsa and Delta States (Ofomata, 1979).

Climatically, the area falls within a subequatorial region due to its proximity to the equator. Its climate is hot (humid). The mean annual temperature of the area is 28^{o}C. It is predominantly under the influence of the monsoon winds and has a record of heavy rainfall of 2370.5mm (Wizor, 2012).

Rivers State has an upper soil layer of soft mud about 6 m thick having high organic materials in the delta area and also has a high-water table. An upper soil layer of silt and sand of the same thickness is found in the dry land. Because the soil type of Port Harcourt is a mix of silty clays and sand, it can be classified geologically as Benin formation.

The specific population of interest comprises communities in close proximity to the selected gas flaring locations in Rivers State, which includes Iguruta, Mbodo-Aluu and Ebocha. The population of the selected communities is shown in table 1 below.

Table 1: Population of the Selected Communities

S/No	Communities	1991 Census Population	1996 Projected Population	2023 Projected Population
1	Ebocha	2,882	3,411	8,554
2	Iguruta (Agbada II)	10,658	12,613	31,633
3	Mbodo-Aluu (Agbada I)	834	987	2,475
	Total	**14,374**	**17,011**	**42,662**

Source: National Population Commission (1991 Census)

From the population of the selected communities, a total population of 42,662 was obtained. Finally, to achieve a manageable sample size from the total population, the Taro Yamane (1967) formula was applied to obtain a cumulative sample size of 396 respondents for this study. The formula is expressed as:

$$n = \frac{N}{1 + N(e)^2}$$

Where;

n = sample size required

N = total population

1 = constant

e = $(0.05)^2$ error margin

$$n = \frac{42,662}{1 + 42,662\,(0.05)^2}$$

$$n = 396$$

To distribute questionnaires to the sample strata, the proportional allocation method was applied.

The purposive sampling technique was deployed to select sampling locations taking into consideration the ease of accessibility of the gas flare locations and adequate security in the communities studied. Moreover, the purposive sampling technique was also deployed in distributing the questionnaires to respondents who reside in the communities where gas flaring activities are taking place.

Information on the perceived health impacts of gas flaring on residents of the neighboring communities were collected using a well-structured questionnaire. The test-retest method was adopted to determine the reliability of the research instrument. The Cronbach's alpha reliability coefficient of 0.787 suggests that items have relatively high internal consistency and are therefore reliable.

Results

Socioeconomic characteristics of respondents

Table 2 shows the sociodemographic characteristics of the respondents. The distribution of sampled respondents from the questionnaires analyzed shows that 8.8% were within the ages of 18-28, 17.9% were within the ages of

29-39, 25.8% were within the ages of 40-50 while 47.5% were within the ages of 50 and above. Furthermore, the questionnaire analysis revealed that 48.7% of the respondents were male and 51.3% were female. In the analysis of the marital status of respondents, it was revealed that 34.8% were single and 53.3% were married. The percentages of divorced, widowed, and separated respondents were 1.3%, 14.1%, and 4.5% respectively. It was also revealed that 8.8% of the respondents were civil servants, 21.6% engaged in trading/business, 26.5% were self-employed and 31.1% of the total respondents were farmers. From the questionnaire analyzed, 8.1% of the respondents had no formal education, 23.5% had primary school education, 53% had secondary education and 15.4% had tertiary education.

Table 2: Sociodemographic characteristics of the respondents

Variables	**Frequency(n=396)**	**Percentage (%)**
Age(years)		
18-28	35	8.8
29-39	71	17.9
40-50	102	25.8
>50	188	47.5
Gender		
Male	193	48.7
Female	203	51.3
Marital Status		
Single	138	34.8
Married	211	53.3
Divorced	5	1.3
Widowed	24	14.1
Separated	18	4.5
Occupational Status		
Civil Servant	35	8.8
Trader/Business	125	21.6
Self employed	105	26.5
Farmers	131	31.1
Level of education		
No formal education	32	8.1
First school leaving certificate	93	23.5
O' level/SSCE	210	53
Bsc/higher degrees	61	15.4

Perception of the Health Impact of Gas Flaring

(i) Impact of gas flaring impacts on air pollution

Figure 2 presents the gas flaring impacts on air pollution at the selected flare locations. The results revealed that 102 respondents representing 25.8% of the total respondents strongly agreed that gas flaring had a significant impact on air pollution in their community of residence, 254 respondents representing 64.1% of the total respondents agreed, 10 respondents (2.5%) were undecided, 25 respondents (6.3%) disagreed and 5 respondents (1.3%) strongly disagreed that gas flaring had a significant impact on air pollution in their community of residence.

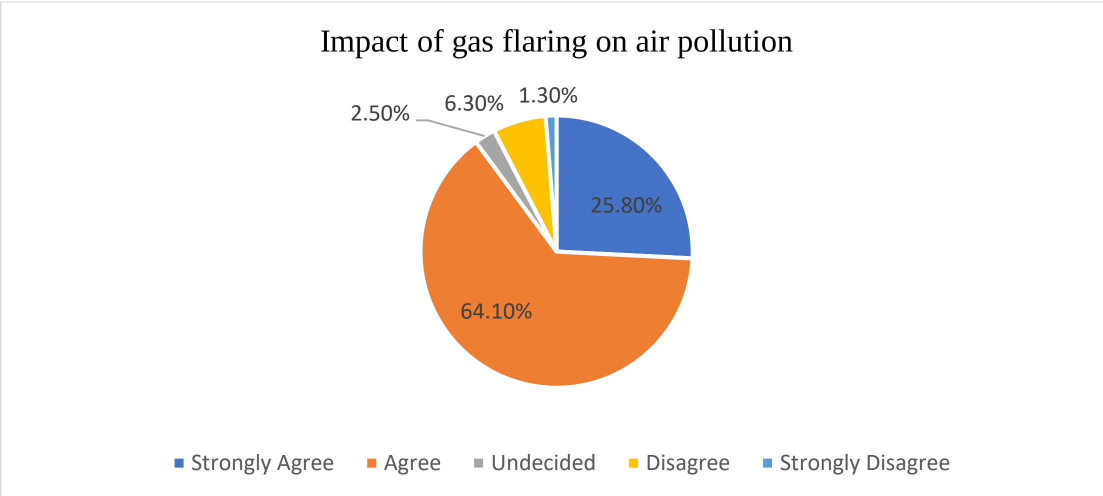

Figure 2: Impact of gas flaring impacts on air pollution

(ii) Harmful impacts of air pollutants on human health

Figure 3 presents the detrimental impacts of air pollution on human health at the selected flare locations. The results revealed that 159 respondents representing 40.1% of the total respondents strongly agreed that air pollutants had detrimental impacts on human health in their community of residence, 218 respondents representing 55.1% of the total respondents agreed, 10 respondents (2.5%) were undecided, 4 respondents (1.0%) disagreed, and 5 respondents (1.3%) strongly disagreed that air pollutants had detrimental impacts on human health in their community of residence.

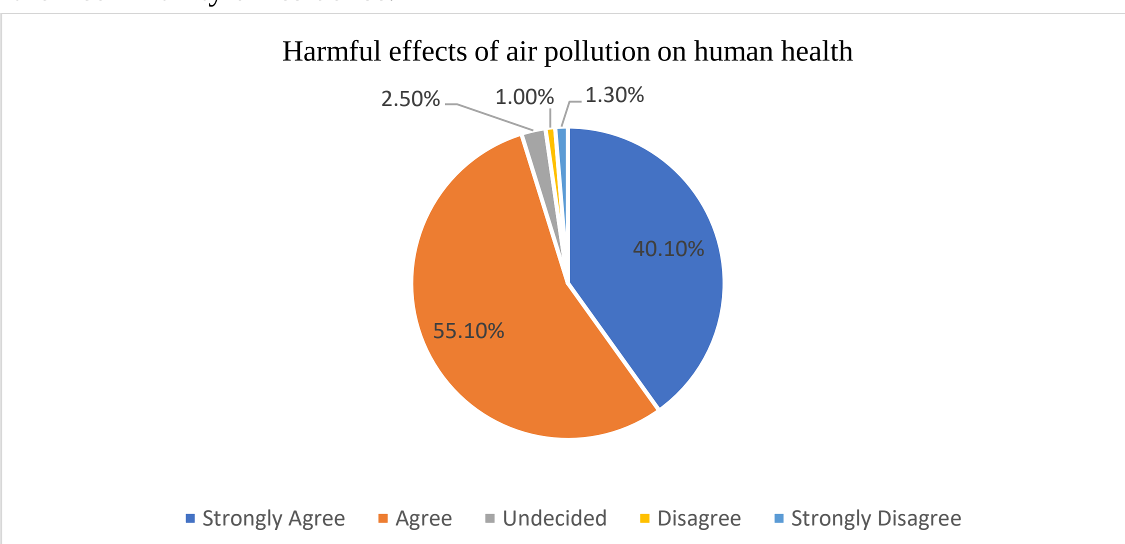

Figure 3: Harmful impacts of air pollutants on human health

(iii) Gas flaring affects my health and the health of members of my family

Figure 4 presents the perception of residents that gas flaring is affecting their health or the health of members of their family. The results revealed that 125 respondents representing 31.6% of the total respondents strongly agreed that gas flaring is affecting their health or the health of members of their family, 201 respondents representing 50.1% of the total respondents agreed, 12 respondents (3.0%) were undecided, 40 respondents (10.1%) disagreed and 18 respondents (4.5%) strongly disagreed that gas flaring is affecting their health or the health of members of their family.

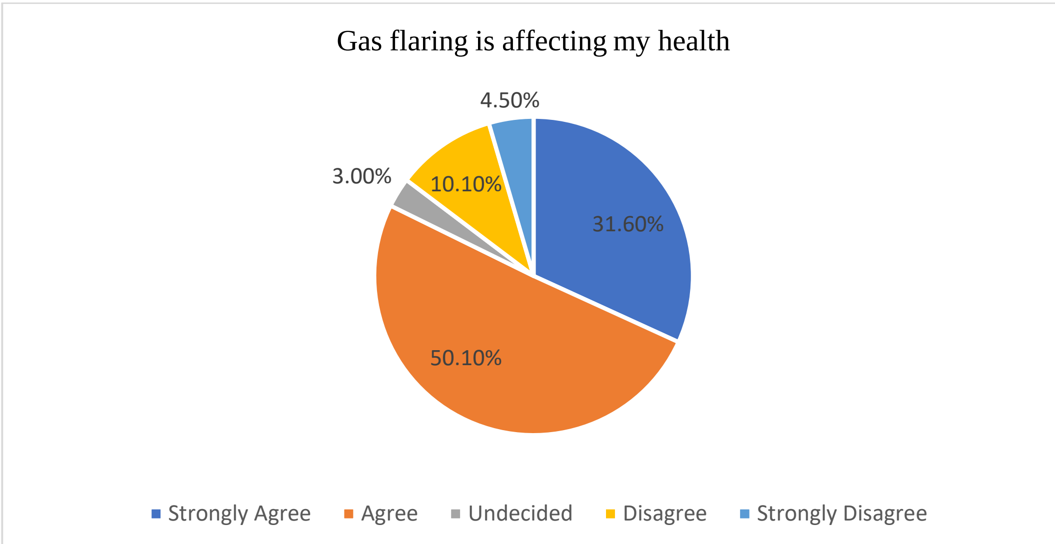

Figure 4: Gas flaring affects my health and the health of my family members

(iv) Gas flaring causes respiratory diseases

Figure 5 presents residents' perception of residents that gas flaring is causing respiratory diseases. The results revealed that 160 respondents, representing 40.4% of the total respondents, strongly agreed that gas flaring is causing respiratory diseases, 220 respondents representing ,55.6% of the total respondents agreed, 9 respondents (2.3%) were undecided, 5 respondents (1.3%) disagreed, and 2 respondents (0.5%) strongly disagreed that gas flaring is causing respiratory diseases.

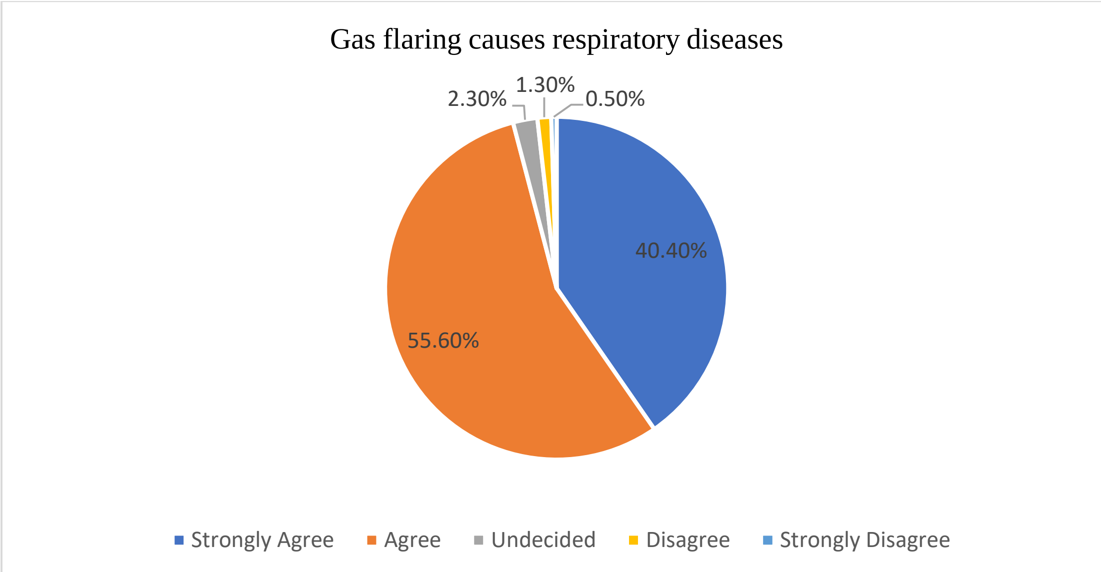

Figure 5: Gas flaring causes respiratory diseases

(v) Complaints related to eye and skin irritation by residents

Figure 6 presents eye and skin irritation complaints by residents in the selected flare locations. The results revealed that 118 respondents, representing 29.8% of the total respondents, strongly agreed that there were reported complaints of eye and skin irritation, 197 respondents, representing 49.7% of the total respondents agreed, 35 respondents (8.8%) were undecided, 30 respondents (7.6%) disagreed, and 16 respondents (4.0%) strongly disagreed that were reported complaints of eye and skin irritation.

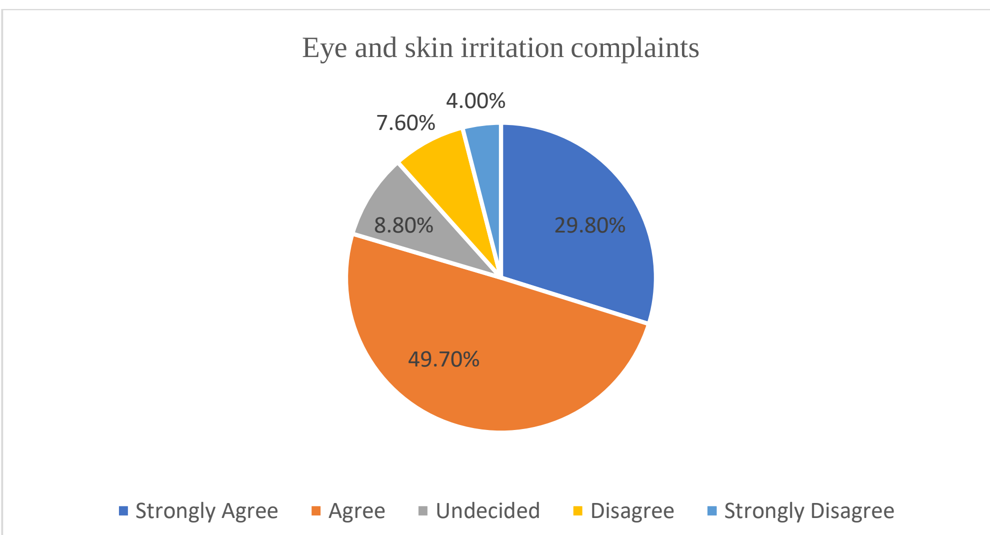

Figure 6: Eye and skin irritation complaints by residents

(vi) Cough and shortness of breath as reported by residents

Figure 7 presents cough and dyspnea cases as reported by residents in the selected flare locations. The results revealed that 120 respondents representing 30.3% of the total respondents strongly agreed that there were a prevalence of cases of cough and shortness of breath in residents, 199 respondents representing 50.3% of the total respondents agreed, 37 respondents (9.3) were undecided, 22 respondents (5.6%) disagreed, and 18 respondents (4.5%) strongly disagreed.

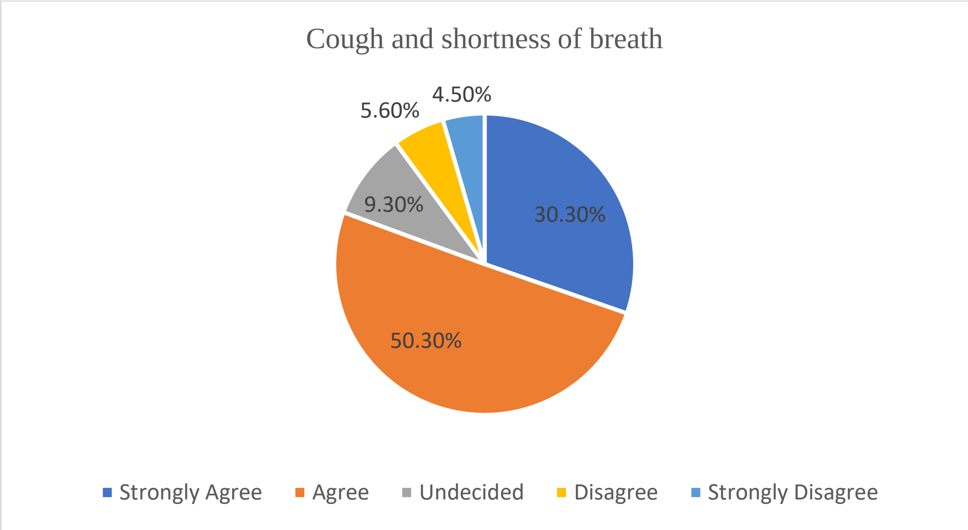

Figure 7: Cough and shortness of breath as reported by residents

(vii) Human health disorders suffered by residents living within close proximity to the flare location

Figure 8 presents the prevalence of human health disorders among residents living within close proximity to the flare location. The results revealed that 121 respondents suffered respiratory disorders, 182 suffered stress disorders, 48 suffered heart ailments, 35 suffered diabetes, and 10 suffered from cancer.

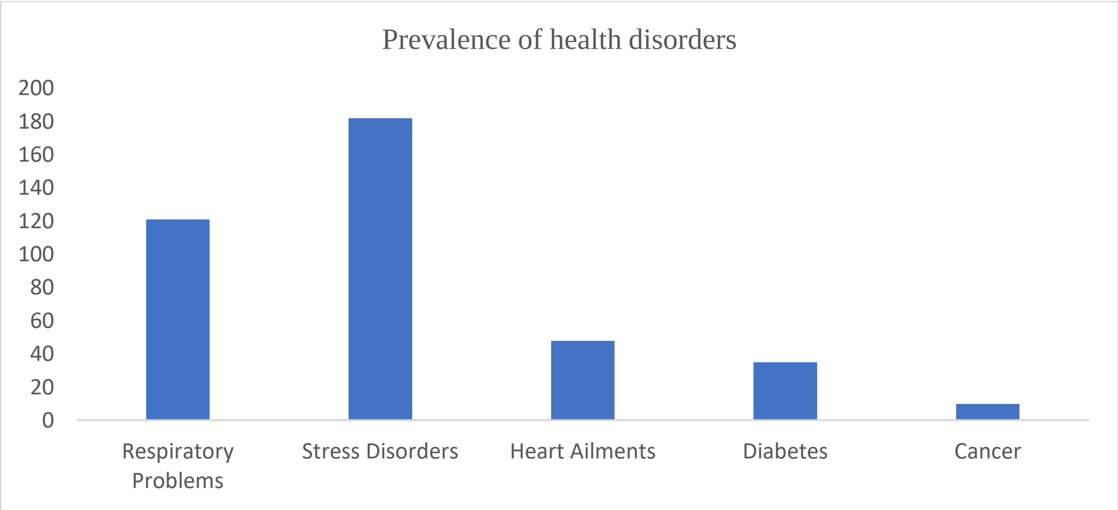

Figure 8: Prevalence of health disorders in the flare sites

Perception of the Socioeconomic Impact of Gas Flaring

(i) Loss of income and livelihood

Figure 9 presents loss of income as a perceived socioeconomic impact of gas flaring. The results revealed that 128 respondents representing 32.3% of the total respondents strongly agreed that gas flaring led to loss of income and livelihood, 207 respondents representing 52.3% of the total respondents agreed, 30 respondents (7.6%) were undecided, 16 respondents (4.0%) disagreed, and 15 respondents (3.8%) strongly disagreed that gas flaring led to loss of income and livelihood.

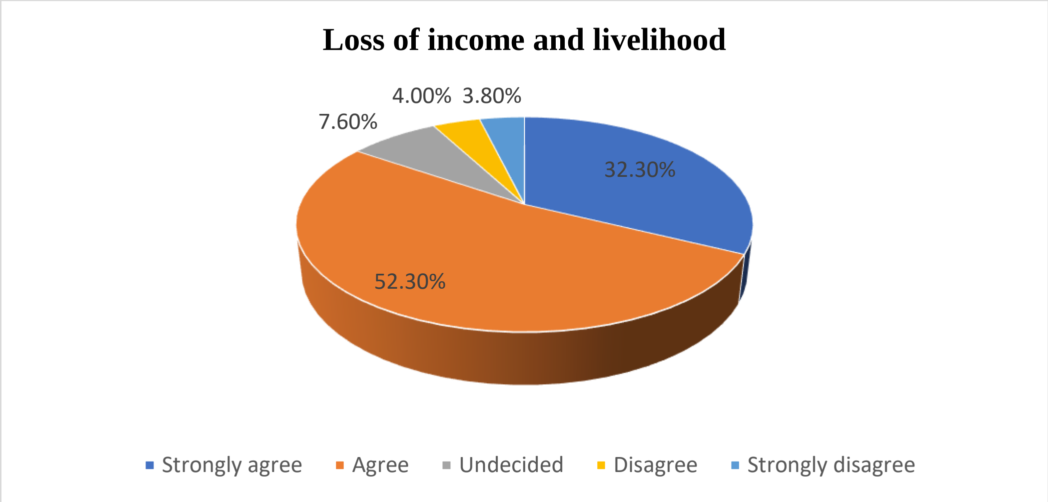

Figure 9: Gas flaring has led to loss of income and livelihood

(ii) Loss of arable land for agricultural purposes

Figure 10 present the loss of arable land for agricultural use as a perceived socioeconomic impact of gas flaring. The results revealed that 117 respondents representing 29.5% of the total respondents strongly agreed that gas flaring led to the loss of arable land for agricultural activities, 218 respondents representing 55.1% of the total respondents agreed, 40 respondents (10.1%) were undecided, 11 respondents (2.8%) disagreed, and 10 respondents (2.5%) strongly disagreed that gas flaring led to the loss of arable land for agricultural activities.

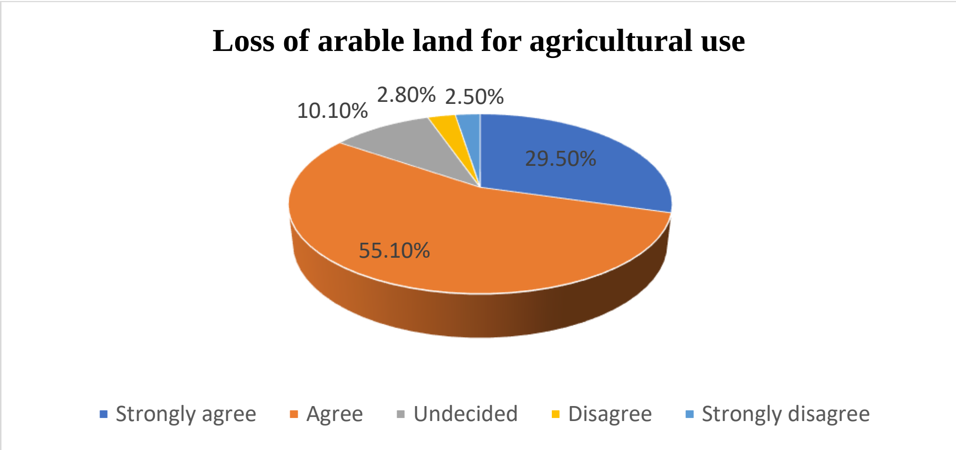

Figure 10: Gas flaring has led to the loss of arable land for agricultural use

(iii) Reductions in crop yields and agricultural productivity

Figure 11 presents the reduction in crop yield and agricultural productivity as a perceived socioeconomic impact of gas flaring. The results revealed that 106 respondents, representing 26.8% of the total respondents, strongly agreed that gas flaring led to a reduction in crop yield and agricultural productivity while 269 respondents, representing 67.9% of the total respondents agreed, 5 respondents (1.3%) were undecided, 10 respondents (2.5%) disagreed and 6 respondents (1.5%) strongly disagreed that gas flaring led to a reduction in crop yield and agricultural productivity.

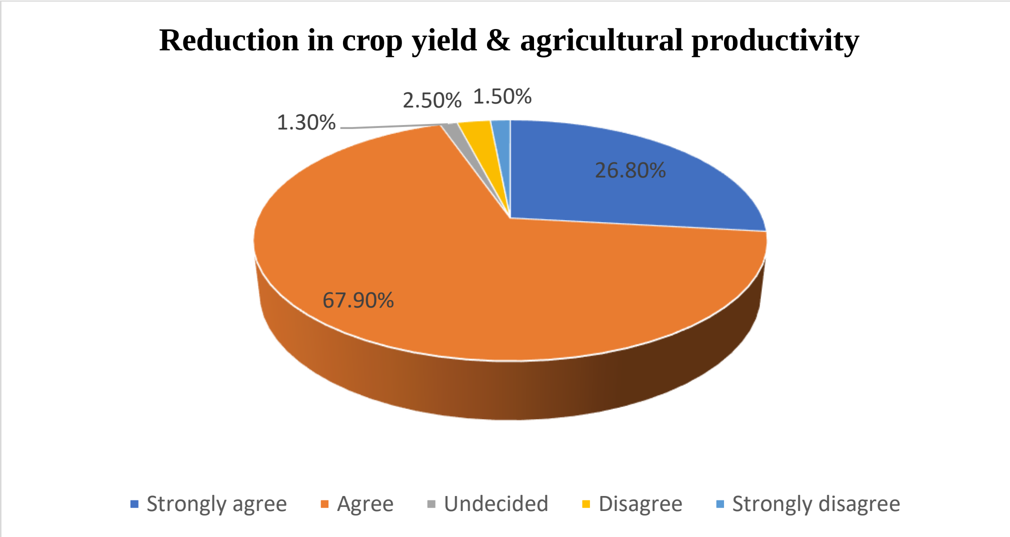

Figure 11: Gas flaring reduces crop yield and agricultural productivity

Discussion

The findings of this study revealed that most respondents agreed that gas flaring had a significant impact on air pollution in their community of residence. The study also revealed that gas flaring has had a significant impact on human health, as evident in the questionnaire responses of respondents living in close proximity to the flare sites. Nearly all respondents agreed that gas flaring had affected their health and that of their families. The findings of this study are in agreement with those of Nriagu (2018) and Nriagu *et al.* (2016), who in their separate study revealed that gas flaring significantly impacts the health of communities living in close proximity to flare sites.

The study also reported cases of cough, shortness of breath, eye and skin irritations, and respiratory disorders that can be attributed to the uncontrolled flaring in their communities. The prevalence of health disorders is as follows: stress disorder> respiratory problems>heart disease>diabetes>cancer. The findings of this research are synonymous with those of Ajugwo (2013); Ovuakporaye *et al*. (2012) and Gobo *et al.* (2009), who discovered in their study that cases of respiratory tract disorders and lung diseases were found in residents living within close proximity to flare locations.

The study revealed that majority of respondents were predominantly farmers. Consequently, gas flaring has led to the loss of income and livelihoods. This is evident in the loss of arable land for agricultural purposes, the decline in soil fertility, and land degradation occasioned by uncontrolled gas flaring in their communities. Moreover, most respondents agreed that gas flaring affected crop yield in their communities. These findings are in agreement with the findings of Uchegbulam *et al*. (2022), who discovered that gas flaring stunted growth and reduced the propensity to pollination, leading to dwindling agricultural productivity as well as diminishing wildlife and domestic biodiversity.

Conclusion

Oil and gas activities are among the leading contributors to air pollution in the Niger Delta region, in which the study area is located. Significantly, gas flaring has had a negative impact on the health status and socioeconomic dynamics of residents living in close proximity to the flare stacks. Agricultural productivity and crop yield within the region have steadily declined while the prevalence of health disorders is rising. It is recommended that adequate health facilities be installed in communities close to flare locations to cater for the urgent health needs of residents. Furthermore, if this ugly menace of uncontrolled gas flaring continues unbated, food shortages and mortality rates could increase.

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