

Full Length Research Paper

Oil and gas exploitation in the Ghanaian context: The balance of benefits and challenges

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This study investigated the benefits and challenges associated with oil and gas exploitation from the Ghanaian perspective. A case study design that embraced both quantitative and qualitative methodologies was adopted for the study. Communities close to the oil and gas production area (that is, the Jubilee Oil Field) were specifically targeted as the study population. The population covered three communities; 547,368 residents of Shama, Newtown and Takoradi in the Western region of Ghana of which a sample of 400 was accessed. Both probability and non-probability sampling frames guided the study. Questionnaire was the main tool for assessment of the perspectives of people in communities near the Jubilee Oil Field. Descriptive statistics, relative importance index and significance testing using one-sample t-test was applied for the analysis and discussion of the study results. The study identified five main environmental impacts of oil and gas exploitation in nearby communities; low fish catch, loss of jobs and livelihoods, increase in accommodation cost, environmental degradation or pollution and cultural change. Major benefits of oil and gas development were evident in activities such as the development of social amenities and appreciation of income levels for people living near oil and gas development sites. The research recommended the need to address the adverse effects of the oil and gas exploitation through the reinforcement of strict rules and regulations regarding oil and gas exploitation activities in Ghana.

Key words: Oil and gas, exploitation, benefits, challenges, impacts.

INTRODUCTION

Oil and gas exploitation continue to attract massive attention in many countries partly due to the high premium placed on oil revenue mobilization as well as

the critical uses that oil and gas could be put to in the aviation and automobile industries, worldwide (Eder et al., 2017; Al-Naser and Al-Habib, 2019). Datasheets on

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oil and gas development show a total of 3666×10^8 t (oil) and 301×10^{12} m³ (gas) discovered reserves worldwide with 1474×10^8 t (oil) and 1187×10^{12} m³ (gas) prospective resources (Longxin and Zhieng, 2019). The trend in oil and gas exploration differs less in other developing economies, including Africa where discoveries versus prospecting is 311×10^8 t (oil) and 26×10^{12} m³ (gas), 184×10^8 t (oil) and 17×10^{12} m³ (gas), respectively. The drive to oil and gas exploitation worldwide is accompanied by various systemic development challenges including the discharge of complex moisture of different organic and inorganic compounds (Purified Water) into the environment (Nasiri et al., 2017); water management challenges associated with unconventional oil and gas exploration (Smith et al., 2017); and poor management of other poisonous substances that impact the health of people in nearby communities (Enyoghasim et al., 2019). Ghana, one of Africa's developing economies commenced oil and gas commercial exploitation in inland Tano bowl (Western area) in 1896 (Gyasi, 2017). Later, in 2010, Ghana joined the league of oil delivering nations by declaring the year 2010 as the 'Business generation of hydrocarbon assets' with a production level of 85,000 barrels per day at the Jubilee Field under Tullow Ghana Limited (Nyemah, 2016).

Oil and gas exploration has improved the economy of Ghana through revenue generation (Abokoma, 2012; Tanoh, 2017). In contrast, Siakwah (2017) has argued that the benefits of oil and gas exploration have been hyped since oil has only diversified Ghana's dependency on natural resources without structurally changing the national economy. Consequently, it is contested that the development and expansion of the oil fields in Ghana is froth with several challenges, many of which have been unresolved but rather left to damage the supposed gains from oil exploration (Abokoma, 2012). A key example is a specialized product such as oil and gas activity that served as a leading cause of expansion in the nearby populace.

The adverse impacts of oil and gas exploitation in Ghana have included destruction to the integrity of biological and ecological resources within the mining zones where communities such as Ahanta West, Shama, Nzema East/West, Jomoro, Elembelle and Sekondi-Takoradi is located (Amoasah, 2010; Sakyi et al., 2012, 2017). In these situation, Boohene and Pephrah (2011) argued that some of the adverse impacts of oil and gas production companies have been angling, a fundamental tool adopted by these oil and gas companies to control the population in oil and gas production sites. This development has been a recipe for conflict since fishermen in oil-bearing networks had to stay off the stamped span of the oil rigs, peculiarly the 500-m no-angling zone if they intend to avoid the potential impacts of oil and gas production activity on their environment (Badgley, 2012; Quist and Nygren, 2015). Oil and gas exploitation activities impacting the environment and its

resources have also included pollution due to the use of some harmful chemical substances, unintended spills, drill cuttings, emissions into the atmosphere, noise, and to some extent, the location of installations and pipelines on the sea bed (Sakyi et al., 2012). In other cases, the production of oil and gas have destroyed crops such as coconuts plantation found nearby the sea as these crops are plausible to be influenced by assimilation of dangerous materials that may affect the cycle of photosynthesis (Amarfio, 2010). The situation of these impacts has worsened the livelihoods of people living nearby these oil and gas production sites as a comparison of their earnings fall short of the daily minimum wage of GH¢11.82 (US\$ 2.16) (Vinorkor, 2019), although incomes alone do not justify the standard of living of people living nearby the Jubilee Oil Field. Similar studies have also identified oil and gas exploitation activities such as the inadvertent release of synthetic substances, raw petroleum, polycyclic fragrant hydrocarbons, alkyl phenols and overwhelming metals to have adverse implications for marine conditions in the exploitation operational zones (Purdy et al., 2019). Generally, only a few works of literature have compared the benefits and challenges of oil and gas exploitation with particular reference to communities along the western coast of Ghana.

The excesses of the oil and gas industry have received some attention; several measures have been recommended in an attempt to address the challenges associated with oil and gas mining activities in Ghana. The balance of benefits and challenges of oil and gas exploration is unclear and shrouded in several contestations. This study, therefore, explores how to investigate the environmental benefits and impacts of oil and gas production in Ghana.

The study is guided by the following objectives:

- (1) To investigate the environmental impacts of oil and gas production in Ghana.
- (2) To examine the benefits of oil and gas production in Ghana.

MATERIALS AND METHODS

The case study design was utilized for the collection of information. A case study methodology provides tools for researchers to study complex phenomena within their context (Baxter and Jack, 2008); by extension, mixed-method embracing qualitative and quantitative approaches was adopted to allow for a better review and analysis of the benefit and challenges of oil and gas exploitation in Ghana (Terrell, 2012). The quantitative approach was useful in providing the statistical foundation for the research and the qualitative approach gave inputs to the values behind the statistics.

Communities nearby the oil and gas production area (that is, the Jubilee Oil Field) were specifically targeted. According to Fowler (2013), a population is a group of individuals that have one or more characteristics in common that are of interest to the researcher. The population covered three communities; 547,368 residents of

Shama, Newtown and Takoradi in the Western region of Ghana. This distribution of respondents for the nearby communities was 36% for Shama, 30% for Newtown and 34% representing respondents from Takoradi. The study coverage in terms of location, was Shama, New Town and Takoradi in the Western region of Ghana. The respondents were fairly distributed since the number of respondents from each ranged from 30 to 36%. Thus, there were 36% from Shama, 34% from Takoradi and 30% from New Town.

These communities were targeted because of their proximity to the Jubilee fields as well as having been beneficiaries of the benefits and challenges of oil production in the Jubilee Oil Fields. The sample size for the study was determined as 400 respondents based on Krejcie and Morgan (1970)'s formulae for establishing the sample size of research. The sample frame consisted of people who resided in the communities before commencement and after the oil and gas production in the Jubilee Oil Field. The respondents for the study were people who have stayed in such communities for periods of not less than 5 years.

Both probability and non-probability sampling techniques were applied to the quantitative aspect of the study. A 2-stage cluster sampling was adopted as a result of unavailability of the list of households. This was based on the communities (households) closer to the Jubilee Oil Field. A convenience sampling of a non-probabilistic method was used to select the respondents. Both theoretical and empirical sources of data were used for the study.

The main tools of data collection were the questionnaire that explored quantitatively (close-ended) and qualitative inputs (open-ended). The questionnaire was structured into sections; section one dealt with the demographic information of respondents; the second section on the environmental impacts associated with oil and gas production; and the third section dealt with measures that have been taken to curb the environmental effects of the oil and gas industries.

Data gathered through the questionnaires from the field was entered into excel spreadsheet and imported into IBM Statistical Product and Service Solutions (SPSS) statistic version 23. The analytical tools used for the analysis were descriptive statistics, relative importance index and significance testing using a one-sample t-test. Results were presented in tables and graphs (figures). Themes relating to the objectives of the study guided the analysis of data.

RESULTS AND DISCUSSION

Background of respondents

Results on respondents' educational level recorded 15% with some level of university education, 23% secondary education, 35% primary education and 27% with no educational background. There was a fair distribution of the educational levels of respondents, except for the challenge of those with no education being underprivileged in their attempt to secure employment with the oil and gas production firms (Abokoma, 2012).

The dominant profession of the respondents was fishing (43%), a key risk associated profession due to the potential challenge of angling exercises, an endangered position potentially destructive to their fishing profession, and also have the capacity to influence the occupations of the overall populace of the impacted nearby communities. Unfortunately, the few available employment opportunities within the qualification of the

nearby communities are centred around being ranchers, unimportant dealers, craftsman labourers, angle mongers and galamsay (unregulated mining). These findings affirmed the exploration of Boohene and Peprah (2011) which identified angling as the fundamental control of the employment options available to the general population in oil and gas production sites.

Incomes accruing to the respondents from their fishing activities were varied; 51% (majority) with monthly income ranging from GH¢200.00 to GH¢400.00, but a few received between GH¢401.00 and GH¢800.00 per month. There were a number of the respondents who also received less than GH¢200.00 to nothing as monthly incomes. Comparing their earnings to the daily minimum wage of GH¢11.82 (US\$ 2.16). It is sad to note that such incomes are unable to provide subsistence livelihoods for the populace near the exploitation sites. The results into constant pressure on the oil and gas exploiting companies to provide support, including alternative livelihoods opportunities for the affected communities (Vinorkor, 2019). It is, therefore, evident that the majority of the respondents in the nearby oil and gas exploitation communities earn less than the minimum wage even though income alone does not justify the standard of living of people living nearby the Jubilee Oil Field.

Environmental impacts of oil and gas production in Ghana

An investigation of the environmental impacts associated with oil and gas production in Ghana involved the use of the descriptive statistics (mean and standard deviation), Relative Importance Index (RII) and one sample t-test with a test value of 3.4 statistical analysis (Table 1). The study used a 5-point Likert scale ranging from 1 for strongly disagrees, 2=disagree, 3=neutral, 4=agree to 5=strongly agree. Mean scores approximated to any of these scales averagely showed levels of agreement for each of the indicators. The rankings in descending order helped to arrange the indicators from the highest impact to the least impact.

The five fundamental effects of the oil and gas exploitation on the adjacent communities ranged between 4.06 and 4.69 demonstrating that the respondents averagely consented to the natural effects of oil and gas activities on nearby communities. The initial five positioned ecological effects of oil and gas production was a low fish catch, loss of occupation, increase in accommodation cost, natural debasement/contamination and social change.

Table 1 further shows that the worst variable impacted by oil and gas production was low fish catch (mean=4.69, S.D.=0.465) and the least being legal issues against offenders caught for entering prohibited zone of the oil and gas fields (mean=2.9, S.D.= 1.208). Generally, only two variables could not meet the mean test value of 3.4. Informants agreed that the exploitation activity has limited

Table 1. Environmental impacts associated with oil and gas production in Ghana.

Variable	N	Mean	Std. Dev.	RII	Index Ranking
Low fish catch	150	4.69	0.465	93.7	1
Loss of job	150	4.49	0.502	89.9	2
Increase in accommodation cost	150	4.25	0.991	85.1	3
Environmental degradation /pollution	150	4.19	0.878	83.7	4
Cultural change	150	4.06	0.921	81.2	5
Bad state of the road and the movement of heavy vehicles	150	3.95	1.128	78.9	6
Low level of income	150	3.67	1.224	73.3	7
Harassment by naval officials	150	3.55	1.144	71.1	8
Unable to fish at all	150	3.28	1.396	65.6	9
Legal issues against offenders	150	2.9	1.208	58.0	10

Table 2. Significance test for environmental impacts associated with oil and gas production in Ghana.

Variable	Test statistic	p-value	Hypothesis	Sig. level	Decision
Low fish catch	33.860	0.000	True mean \leq 3.4	Significant	Reject
Loss of job	26.694	0.000	True mean \leq 3.4	Significant	Reject
Low level of income	2.668	0.004	True mean \leq 3.4	Significant	Reject
Legal issues against offenders	-5.069	1.000	True mean \leq 3.4	Not Significant	Accept
Increase in accommodation cost	10.545	0.000	True mean \leq 3.4	Significant	Reject
Unable to fish at all	-1.053	0.853	True mean \leq 3.4	Not Significant	Accept
Bad state of road and heavy vehicles	5.936	0.000	True mean \leq 3.4	Significant	Reject
Environmental degradation/pollution	10.978	0.000	True mean \leq 3.4	Significant	Reject
Harassment by naval officials	1.641	0.051	True mean \leq 3.4	Not Significant	Accept
Cultural change	8.774	0.000	True mean \leq 3.4	Significant	Reject

$p < 0.05$ is significant.

the area of the previously available fishing ground for the fishers, because fishing was now prohibited in areas closer to the oil rigs.

Table 2 also depicted scores for significance testing for the effects of environmental impacts of oil and gas production on several variables. Test scores for impacts of oil and gas production on the environment was significant under low fish catch, loss of job, low level of income, increase in accommodation cost, bad state of road and activity of heavy vehicles, environmental degradation/pollution, and cultural change. These results are quite critical as they underscored the harmful effects of oil and gas production on the environment of the nearby communities.

The outcome upheld the submission of Quist and Nygren (2015) that argued that fishermen whined about the misfortune of reduced fish catch, because of prohibitions from fishing in places around the oil and gas fields. In other cases, limiting fishing expeditions around the rigs influenced the growth of seaweed and consequently diminished the quantity of fish available to the fishermen and other fish-related activities. The results also affirmed the conclusion of Badgley (2011) that posited the need for fishermen in oil-bearing networks to stay off the stamped span of the oil rigs, particularly the

500-m no-angling zone around the Jubilee Field because of the potential impacts of the production activity on the nearby environment.

Further concerns from the interview results suggested that establishing oil and gas enterprises in nearby communities had fundamentally contributed to the loss of occupations in the study area. Individuals who were cultivating or undertaking other economic activities in 200 angling zones have lost vocations and livelihoods because of the oil and gas industry. The affected fishermen are compelled to change professions to rather explore opportunities in the oil and gas production industry, but in most cases they became disappointed from gaining employment into the oil and gas industry. This scenario affirmed the fact that oil and gas activities could result in work-related misfortunes as well as some benefits that leads to both deliberate and automatic movement as well as livelihood changes (Boohene and Peparah, 2011).

Another challenge of oil and gas production identified by the study was the relocation of non-natives into the networks, an action which tended to increase the typical cost of basic items with attendant combined low pay/income of the normal labourer in the network. This corroborated UNEP (2009)'s argument on specialized

Table 3. Benefits of oil and gas production in Ghana.

Variable	N	Mean	Std. Dev.	RII	Index ranking
Development of social amenities (schools, roads, lights, etc.)	150	4.04	0.926	80.8	1
High level of income	150	2.86	1.386	57.2	2
Increase in job prospects within the community	150	2.85	1.134	56.9	3
Improvement in social life with an influx of people	150	2.84	1.366	56.8	4
Increase in fish catch	150	2.81	1.255	56.3	5

Table 4. Benefits of oil and gas production in Ghana.

Variable	Test statistic	p-value	Hypothesis	Sig. level	Decision
Increase in job prospects within the community	-5.978	1.000	True mean \leq 3.4	Not Significant	Accept
Improvement in social life with an influx of people	-5.020	1.000	True mean \leq 3.4	Not Significant	Accept
Development of social amenities (schools, roads, lights, etc.)	8.465	0.000	True mean \leq 3.4	Significant	Reject
High level of income	-4.773	1.000	True mean \leq 3.4	Not Significant	Accept
Increase in fish catch	-5.724	1.000	True mean \leq 3.4	Not Significant	Accept

$p < 0.05$ is significant.

production as a leading cause of expansion in nearby populace levels.

Ecological debasement/contamination remains a key effect of oil and gas production on environmental resources in nearby communities of oil and gas production sites, identified by the study. For example, the land, water and air at these production sites were largely vulnerable to contamination because of the excesses of the oil and gas exploitation activity. The consequent toxins have caused synthetic poisoning of community water bodies, air and clamour, although crops such as coconuts plantation found nearby the sea are at risk of assimilation of dangerous materials that may affect the cycle of photosynthesis (Amarfio, 2010; Boohene and Peparah, 2011).

Benefits of oil and gas industries in Ghana

The descriptive statistics (mean and standard deviation), relative importance index (RII) and one sample t-test with a test value of 3.4 was the statistical techniques used to establish the benefits of the oil and gas industries in Ghana. The study used a 5-points Likert scale where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree. Mean scores approximated to any of these scales showed the level of agreement for each of the indicators, averagely. The rankings in descending order helped to arrange the indicators from the highest to the lowest benefit of the oil and gas industries (Table 3).

Mean score rankings showed that the best performing benefits of oil and gas development were the development of social amenities followed by high levels of income. Meanwhile, the worst-performing variable was an increase in fish catch, which incidentally was one of

the key livelihoods of people living in communities nearby the oil and gas production fields.

The study identified the development of social amenities (such as schools, roads, lights) as one of the main benefits of oil and gas production to the nearby communities. The test score for contribution to the development of social amenities (mean= 4.04, S.D.= 0.926, p-value < 0.01 and index of 80.8%) showed that majority of the respondents agreed to the development of some social amenities as key benefits derived from the oil and gas production. It was further observed from the interviews, that oil and gas exploitation have benefited communities nearby the Jubilee Fields since the state of social amenities and infrastructure have received some facelift. Unfortunately, these improvements are unable to replace the livelihood opportunities of the nearby communities lost to the oil and gas exploitation activities.

The respondents were uncertain about the contribution of oil and gas production to high level of income, increase in job prospects within the community and improvement in social life with an influx of people and increase in fish catch and as a result, did not register any significant relationships. The study had already established these factors to have significant adverse impacts of oil and gas production on the environment (Table 2). Key informants were of the view that the adverse impacts of the oil and gas exploitation far outweigh the benefits, hence the inability of the respondents to identify any significant benefits of the activity. The outcome of the research confirms (UNEP, 2009) report which stated that, availability of and access to social amenities such as schools, roads, hospitals in key benefits of oil and gas production on communities nearby the production sites, but also these benefits are usually absorbed by the adverse implications of the production (Table 4).

Conclusions

The study identified five main environmental impacts related to oil and gas production in nearby communities; low fish catch, loss of jobs and livelihoods, increase in accommodation cost, environmental degradation/pollution and cultural change.

People living in communities nearby the oil and gas production sites of Shama, Takoradi and New Town is mainly fishermen who are prone to the adverse impacts of waste effluents from the oil and gas activities that are discharged into the ocean. These harmful substances ultimately pollute the seawater and undermine aquatic life.

Oil and gas exploitation and production do not necessarily improve unemployment situation for the nearby communities since many of the people in such communities continued to engage in fishing expeditions for their sources of livelihood. This situation is worsened by the fact that the majority of the people living nearby such communities are unable to apply for the few vacancies that occasionally become available in the oil companies, primarily because the category of prospective employees in such communities do not have the requisite qualifications and experience for the advertised positions.

Major benefits of oil and gas development were evident on activities such as the development of social amenities and appreciation of income levels for people living nearby these oil and gas development sites. Least among such benefits was the absence of key changes in the fish catch for fishermen who conduct their fishing activities nearby areas of oil and gas development.

Key directions for addressing the adverse effects of the oil and gas development were needed for governments to reinforce strict rules and regulations regarding oil and gas production activities. The need to ratify critical international conventions as well as localize application guidelines to promote better deals for communities nearby oil and gas production sites should be actively pursued by the government of Ghana.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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