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RESEARCH ARTICLE

Assessing the perceived impact of exploration and production of hydrocarbons on households perspective of environmental regulation in Ghana

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Abstract

This paper seeks to critically study the perceived impacts of the exploration of hydrocarbons in selected coastal communities in the Western region, the oil and gas industry benefits to local communities, and to determine whether hydrocarbon development is a means for sustainable development. The study uses both quantitative and qualitative approaches using a questionnaire survey, key informant interview, and focus group discussion tools to understand the impact of oil and gas exploration and production in selected affected communities along the coast of Ghana. The activities of oil production and exploration impact negatively on communities; it also leads to a sharp increase in food prices thereby increasing their costs of living. The activity has also caused a decline in fish catch levels which happens to be the main economic activity as a result of exclusion zones created by oil companies which limited the extent fishermen can go fishing. In terms of infrastructure, the three communities are lacking, 77% of respondents from Princess Town hold the view that there is no motorable road linking their community in the next town and 60% from Aketakyi also hold the same view. Infrastructure such as roads, schools, water provision, and clinics are woefully provided in these communities.

Keywords Hydrocarbons · Environmental regulation · Livelihoods · Sustainable impact · Exploration

Introduction

Globally, the dynamics of developing natural resources such as hydrocarbon resources for the economic transformation of resource-endowed countries are always faced with environmental, social, and governance issues. Hydrocarbons are seen as important resources for oiling and promoting modern industrialization, and it can also serve as an impetus to bring about sustainable economic growth in many developing countries like Ghana. In view of this, non-oil-producing countries have to find ways and means to develop and nurture mutually beneficial relationships with resource-endowed countries to leverage their resources for their economic development (Iqbal and Mohsin 2019; Anser et al. 2020). For instance,

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China as heavily industrialized nation needs energy to keep its industrialization drive going, but it does not produce enough to meet its demand domestically (Sun et al. 2020a; Mohsin et al. 2018b, 2020). It is the second largest economy in the world and consumes more petroleum next to the USA. Given these dynamics, it has to forge partnerships with other oil-rich states to meet its demands (Sun et al. 2019). The wind-generated renewable hydrogen can help to meet its demands (Mohsin et al. 2019a).

The USA despite opening more areas for exploration does not still meet its domestic demand and consumes about 25% of hydrocarbons produced in the world. Thus, for these big economies to sustain their economies and keep them on growth, trajectories are forging good relationships with oil-endowed countries to fuel their economies (Sun et al. 2020b). There have been a plethora of studies to back the assertion that a section of resource-endowed countries fails to prudently use their natural resource wealth to boost economic growth and development while others successfully do. Ghana's discovery of oil and gas was met with public jubilations and optimism about the resource changing the economic fortunes of Ghanaians. Environmental regulation of the oil and gas sector in developing countries has been often inadequate. When contracts are signed between transnational oil corporations and national governments, there is often little regard to the risks and impacts on the local communities where oil-drilling activities take place. This is more pronounced in emerging and developing economies (Sun et al. 2019). Part of the problem lies in the lack of control mechanisms to enforce compliance on the part of the oil companies, as to whether they are applying proper risk management and safety programs to prevent any grave catastrophe in developing countries. If a developed country like the USA was not sufficiently prepared for this unforeseen occurrence in the Gulf of Mexico in 2010, the question is how prepared Ghana is to handle these oil exploration–related problems.

Oil spills have catastrophic effects on the source of seafood, by usually taking a toll on flora and fauna, particularly, if the huge category of those fishes' eggs or larvae is exposed to the oil. The effects of hydrocarbon development are manifold, and according to the Niger delta environment survey final, the Niger delta is a world-acclaimed biodiversity concentrated area on earth, with a lot of freshwater species fish, in west Africa, could experience loss of 40% of its inhabitable terrain in the next 30 years because of extensive dam construction by oil explorers in the area (Akiyode 2010). However, the discovery of oil and gas at the coast does not only bring negative impact but also positive impact, access to certain goods and services—education, housing, healthcare, water, a commercial fuel, electricity, sewage disposal, and consumer goods imported into the region.

The overarching objective is to investigate the impact of oil and gas exploration and production on these communities. The study seeks to evaluate the category of people that benefit from exploration and production activities and to evaluate the impact of exploration and production of oil and gas on the livelihoods of the individual in the selected community. Our contribution also includes the quantitative analysis by taking Ghana as a case study. This study covers the development of hydrocarbons in the Western region of Ghana. The three communities were selected from the Ahanta West District of Ghana, Cape Three Points, Princess Aketakyi, and Prince Town. The oil fields of Jubilee are located about 60 km from these communities. The Takoradi Port is being expanded to have the space to handle huge cargo arriving in the region. Environmental Impact Assessment report identifies three possible effects on fishing. This is according to Ayifli et al. (2014) that fishing grounds being lost due to the presence of the floating production storage and offloading facility (FPSO), exclusion zones being created, and disturbance to fish and damage to fishing activities. Thus, this study will find out whether these assertions have an impact on the communities.

The rest of the paper is organized as follows: the "Background and literature review" section contains the background, the "Methodology" section contains methodology, and the "Results and discussion" section explains results and discussion while the "Conclusion and policy implications" section concludes the study.

Background and literature review

Oil exploration and production have impacted negatively on local communities due to the environmental, socio-economic impact challenges it passes to these communities over time, threatening subsistence peasant farming and biodiversity and eventually their entire social livelihoods and survival. Hydrocarbon development and its transportation and distribution have brought about the degradation of the land and aquatic mammals and deadly to flora and fauna in the Niger Delta (Adeyemo et al. 2009). Furthermore, oil spillage has diverse consequences on local communities on farming land, fishing, and water bodies for bathing at the communities' levels as water bodies are polluted which have effects on their health. Again, fishermen complain of the low catch during fishing as the creation of exclusion zones as a result of oil exploration and production. This ultimately affects their income levels and social livelihood.

According to an independent study carried out by ACORN International in Ghana, regarding the marine environmental conditions in Ghana, together with the EPA (Environmental Protection Agency, Ghana), there is no enough research in this area and asked for further studies in this area. The study draws a relationship between the socio-economic activities of communities along the coast due to oil and gas exploration such as fishing activity interference, damages, and impact to the

viability of fishing as a livelihood (Babanawo et al. 2016) Thus, fishermen in these communities always complain of low catches. As a result of these teething issues facing resource-endowed communities, the study seeks to find answers on the impacts of the development of hydrocarbons and eventually related problems facing these communities, and to offer necessary recommendations for enhanced mitigation measures on the socio-economic livelihood in these communities. Various other studies have been conducted to measure the renewable energy and environmental issue (Al Asbahi et al. 2019; Baloch et al. 2020).

The exploitation of the oil and gas has a regional, local, and national impact; from the view of the majority of the local population, the impact is most alarming. Rather than bringing prosperity to local communities, the contrary is the case. Localities, communities that are located very close to the rig, bear the brunt of hydrocarbon activities and suffer from reduced income levels and socio-economic problems compared with the rest of the country (Mohsin et al. 2020; Iqbal et al. 2020).

Economically, petroleum fails to offer long-term sustainable employment alternatives at the local level, but it can seriously disrupt pre-existing patterns of production. The promise of new jobs that new oil exploitation seems to offer typically attracts large numbers of migrants to an exploitation area (Mohsin et al. 2019a). The increasing migration of people to oil-producing communities due to higher attractive pay brings an increase in the costs of living in the communities. Economically, petroleum fails to offer long-term sustainable employment alternatives at the local level, but it can seriously disrupt pre-existing patterns of production. The promise of new jobs that new oil exploitation seems to offer typically attracts large numbers of migrants to an exploitation area. The increasing migration of people to oil-producing communities due to higher attractive pay brings an increase in the costs of living in the communities (Akinsemolu and Akinsemolu 2020). The effects of high costs of living are unevenly distributed in the communities (Mohsin et al. 2018a, 2019a, c). Thus, the study seeks to find empirical answers to these concerns and contribute to policymaking in the Ghanaian society.

This section examines the literature relating to issues of hydrocarbon development, the impact of such activity on human life and impact on economic activities of communities of the coast and the environment (Mohsin et al. 2018b, 2019b). There has been a tapestry of evidence of the effects of hydrocarbon extraction on the Niger Delta, as the negative effects have been accentuated there. Hydrocarbons' development and transportation come with environmental problems. Brown and Tari (2015) in their paper, evaluating the effects of oil and gas production in Ogoni land, Nigeria, say crude oil spills have socio-economic impacts on the environment and the livelihoods of the people. They find the effects of oil spills and pervasive when it happens on communities, and that there are no proper mechanisms for dealing with the situation by oil majors working in these communities. It is worthy to note that, while oil has brought untold socio-economic and environmental problems in these communities, some communities do see the benefits since Nigeria started commercial production in the 1950s.

National Bureau of Statistics (2019) says the gross domestic product of the country (GDP) was made up of 50% by the services sector, while oil still generates approximately 90% of the country's external revenue. In the first quarter of 2018, 87.7% of Nigeria's external revenue came from oil exports. Indeed, the oil industry in Nigeria has affected the economic aspect of the nation in various ways. It has led to the economic transformation of Nigeria in some aspects; however, on the flipside side, hydrocarbon development has had severe impacts on fishing and farming which are the mainstays of economic activities of oil-producing communities in the Niger Delta, Nigeria. If hydrocarbon development is viewed in Nigeria regarding the chunk of foreign exchange earnings, Nigerians cannot complain. On the other hand, when it is viewed on the lenses of the untold socio-economic difficulties oil-bearing communities face, it has left on its trail environmental destruction and social woes (Habiba 2018).

There exist five stages in the production of oil and gas called the "Production lifecycle." These steps describe how hydrocarbons are gotten, costs, and jobs involved at the various stages through to decommissioning. It also describes how the activities those go on at each stage of the life cycle and how they impact on local communities. The figure below describes the various stages in the product lifecycle.

Figure 1 shows prior to the exploration stage is the acquisition stage, where contracting and signing of documentation relevant to the exploration and development take place. This stage does not directly impact local communities but may indirectly through the contracts they sign with governments. Oil and gas exploration is the search for oil and gas by petroleum engineers, geophysicists under the earth's surface. It entails finding the hydrocarbon reservoir mainly using seismic surveys and drilling wells. Exploration has impacts on local communities like discharging substances and chemicals into the environment that pollute the environment. An interesting paper by Mohamoud (2018) on the prospects and challenges of Somaliland's oil and gas exploration first attempt identifies issues of environmental concerns during the prospecting stage such as the dumping of chemicals, which has long-term ecological effects and deprives livestock of grass to feed on since majority of the indigenes are nomads. For example, during exploration, drill cuttings, drill mud, and fluids are used for stimulating production.

If a company becomes successful in the exploration, drilling, and the discovery of oil and gas, the next stage is to appraise the well. This has ensured certainty about the size

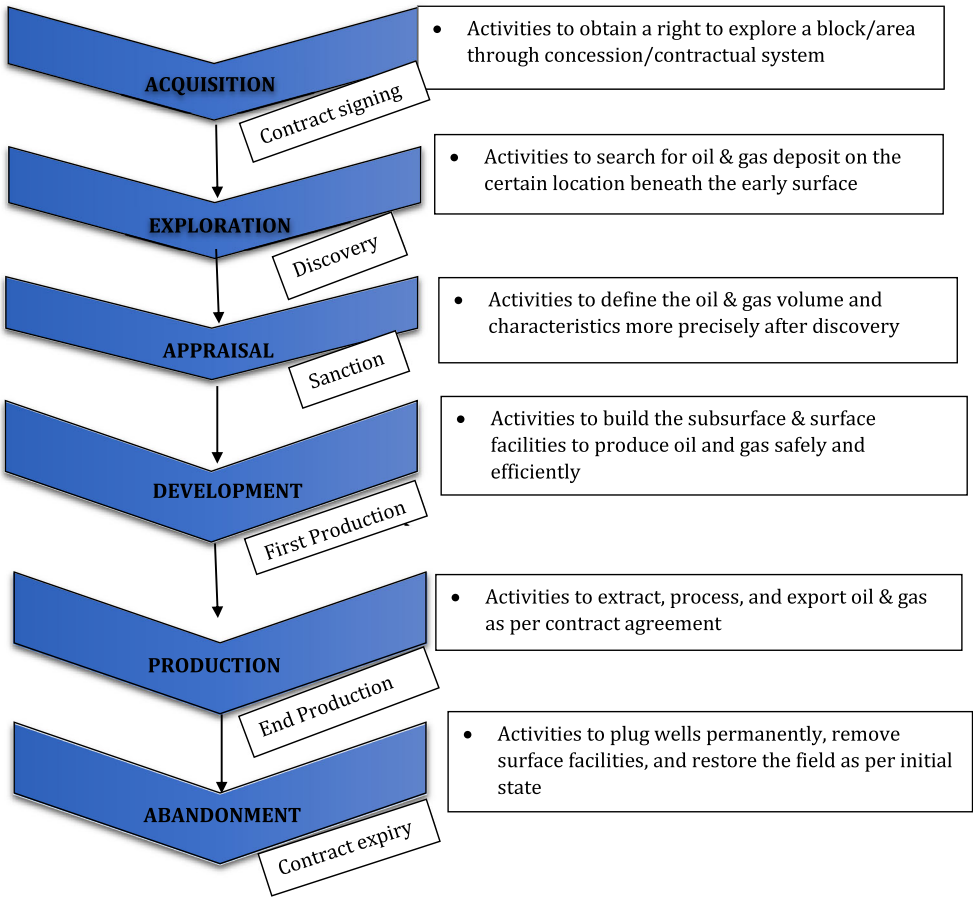

Fig. 1 The exploration and production lifecycle

and the properties of the well to be developed. During the appraisal stage, more wells are drilled to gather information and samples from the reservoir. A seismic survey may bring about the destruction of forest and loss of vegetation and biodiversity, lot of drill cuttings such as barite and bentonite could prevent grass from growing when they are disposed to the soil unless there is natural regeneration from the soil (Ibeawuchi 2016). According to Brown and Tari (2015), these materials disperse and sink, killing marine animals. This stage is the next stage after a successful appraisal before development and full-scale production. This stage also impacts local communities through the flaring of natural gas which has negative consequences on surrounding vegetation.

Production is the stage at which hydrocarbons are drilled and taken from the oil field. This is the commercial aspect of the activity when the first money is gotten from oil sold. After sometimes, revenue exceeds the company's expenses and the companies start making money and this is profit. Production takes quite a time and may last up to about four decades, depending on the size of the field and how costly is it to keep the well and production facilities running. In view of oil production and exploration, there could be a problem with oil spills. The problem of oil spills could arise due to transportation, marketing, and accidents involving road trucks and vandalism to pipelines and other emissions (Ikporukpo 1988) bringing serious consequences because the toxicity of the oil gravely affects flora and fauna. Also, the impact on local communities could be damming. Refinery wastes also contain very toxic chemicals, which pollute the environment. Ogbonna (2018) in his work, the application of biological methods in the remediation oil-polluted environment in Nigeria finds combining one or two approaches in remediation that breaks, degrades, and neutralizes the chemicals spilled or removes contaminants from the soil known as bioremediation, could be a panacea to removing the pollutants. This is a way to treat the soil from contaminated chemicals.

This would make the chemicals not harmful to the environment and brings the land to its state prior to the oil spillage. Decommissioning is the act of taking away production equipment and reclaiming the field which is no longer economical to operate. The practice is associated with offshore facilities. Drilling offshore requires huge structure and construction works thus when the field is not economical to operate, these facilities must be dismantled. Decommissioning does not only entail removing the platform but also any other electrical material. This is done to avoid any risk to marine life. Most at times, all facilities are taken away and the site returned to its old state before development. These facilities could be used

again in a different field. For example, tension leg platforms are used to create artificial reefs in the Gulf of Mexico. This important step may take many years to complete and involves a lot of money. All relevant stakeholders' views will be sought during decommissioning.

Environmental damages in oil- and gas-producing countries

The exploration and production of oil and gas go through some steps to get the crude which causes environmental challenges (Mohsin et al. 2019a). Oil spill accidents have become a central issue in the Nigerian industry, recording over 60,000 spills over the four decades of the lifespan of the Nigerian oil industry. It is about 150 spills per year (Ogbonna 2018). Oil spillage contaminates the soil and water bodies, making the water not good for drinking and renders the soil unproductive for farming. These incidents if not handled well lead to the harming of marine life, birds destroying beaches, and a decline in tourist activities. Some of the major spills which had a serious impact on the petroleum industry, in particular, have been a major concern because of recorded incidents like the Chasse (1978) which spilled 220,000 tons of oil, Bodkin et al. (2002) spilling 40,000 tons of oil, and the Yamada (2009) spilling 85,000 tons oil. All these had negative effects on mammals, fishes, and birds and the ecology in general. A fascinating study by Appel (2012) on foreign direct investment in the Equatorial Guinea oil industry finds that there is a huge disconnect between the country's resource base and infrastructure development in the country. The country lacks both "hard" infrastructures such as roads, schools, hospitals, electricity, and water provision and "soft" infrastructure in the forms of education, health care, and libraries, to meet the basic needs of the indigenes. The study equally discovers that whereas oil majors staff is living in palatial homes, the indigenes are living in mosquito-infested homes with no light and water (Appel 2012). According to Ayisi and Akabzaa (2010), improved standard of living may include jobs for the indigenous people, transfer of technical and commercial know-how, development of indigenous capacity, and better infrastructure. Various similar methodologies have been contributed in energy economic and environmental issues (Mohsin et al. 2018b; Iram et al. 2019; Baloch et al. 2020).

In a work that was done in the South Texas area by Tunstall (2015) close to the unconventional drilling of shale gas and oil discovers that these communities are faced with the crowding-out effects of labor, as most people would prefer to work for oil companies instead, due to higher incomes offered. This does not give room for diversification to other sectors to make local communities earn more and create more jobs. To avoid this situation, there is the need to sterilize revenues earned in the form of taxes, create stabilization funds at the local level, and have an investment policy to invest the revenues in infrastructure at the community level.

Oil and gas activities bring about loss of income and occupation which lead to voluntary and involuntary migration in communities where the activities are carried out. This brings to the fore the need to let the oil majors consider investing in these communities through corporate social responsibility to generate alternative incomes. Aaron (2012) working on corporate social responsibility in the Delta region of Nigeria finds the need to have a new paradigm in how corporate social responsibility is being done. He suggests the adoption and the implementation of the global memorandum of understandings (GMOU) as being used by Chevron and Shell is a departure from the old model of corporate social responsibility. This is more sustainable and very forward-looking during engagements with communities and oil majors. This, he believes, would solve the problems of absentee state, culture barriers to corporate social responsibility, and constraints put by corporations due to profit motives and the enormity of local communities' challenges. When oil majors undertake corporate social responsibility in the right context, they gain the confidence of the communities and therefore get the social license to operate, since they would not face resistance from these communities, because they know they are benefiting from the activities ((Baloch et al. 2020).

Research (Okoli and Orinya 2013) confirms that the Nigerian oil industry is faced with the two predicaments troubling the production of oil and gas, oil pipeline destruction and militancy. These issues are more pronounced in the Niger Delta after the Amnesty deal in 2009. This has brought financial losses to oil majors and increased risk for their investments and sends a bad signal to would-be investors to the country. Hydrocarbon activities have also led to social unrest, mismanagement of resources, and uneasiness among resource-rich communities and Nigeria lost about 10.9 billion dollars from 2009 to 2011 which resulted due to militants breaking pipelines and siphoning fuel (Okoli and Orinya 2013). The people at the grassroots feel disenchanted due to the "paradox of plenty" syndrome. The oil is taken from their region and yet they do not get any economic benefits from it. There is a big divide between the resource wealth in Nigeria and economic development. This does not promote inclusive growth and development.

There are two points of view regarding the extraction of natural resources being held by naturalists. The first group believes that developing natural resources is crucial for the socio-economic development uptake of a nation, as it will promote inclusive economic growth and development. Others also hold a divergent view regarding its exploitation by saying that it leads to economics underdevelopment and makes the natives worse off prior to the exploitation of the resources. This divergent view is contrary to the first group. They believe it brings the resource "curse." The views being

held by them are based on the fact that natural rich countries like Norway and Botswana have judiciously used their natural resources to stimulate sound economic growth and development. On the other hand, other countries that do not have natural resources have grown and developed without natural resources (Iqbal et al. 2020).

A final group of nations despite their many years of exploiting their natural resources have seen slowing growth trajectories and at times negative growth rates. Chambers and Conway (1992) define livelihood "means of gaining a living." These concepts of livelihood see oil production as important and how it contributes to sustaining households, social groups, and individuals. A livelihood is sustainable when it can cope with adversities in life and being able to get life to normal and not undermining the resource base.

Methodology

Research design

The study was modelled in line with the sustainable livelihood framework (SLA). Aspects of the framework relevant to the study were adapted for the formulation of questionnaire and only limited to the scope of study. This part of the paper gives insights into the procedure employed in analyzing the research. The questionnaires were very brief and straight to the issues in order not to spend much time on respondents. It covered all Ghanaians from all walks of life. It took about a month to conduct the survey and the success rate was 90%. Research design explains the practicable steps taken by a researcher to complete a study. In other words, it is the roadmap to accomplishing the research. The study design employs descriptive research design. Descriptive research makes room for a concise and precise description of objects, processes, and persons (Knupfer and McLellan 1996) and descriptive design uses tools like questionnaires and interviews to collate data relevant to the study to analyze the data. Descriptive research has the potential to provide unique characteristics of a group of people such as attitudes, behaviors, and naturally happening events. Descriptive studies are done to draw relationships among things in the world. This approach makes it possible for many sided to data collection.

Sampling method

Sampling method is a representative or a subset of a population that serves as a true representation of a population. It is the act of selecting a population to be studied from the total population. In other words, it is selecting a larger group and studying this group and making an inference of the total group based on the larger group studied. A convenient non-probability sampling approach was deployed during the research in these three communities along the coast. Convenient sampling was used to select the seventy-five respondents from the three communities. Convenient sampling was applied as a result of the readily availability of these respondents to answer the question. Non-probability sampling technique is one that makes use of population that is readily available to participate in a study. This approach essentially requires first-hand primary data to analyze without needing other conditions to its use. Because of the nature of the study, a quantitative approach was chosen. The reason for the choice was due to the ability of the method to enable me to show the results in descriptive ways such as figures, numbers, and tables pertaining to the work. This enriches the results of the study and gives a pictorial view of ideas and results.

Data collection method

The rationale behind the study was explained to the respondents and so they were at liberty to either answer the question or refuse to do so. I conducted 5 groups' informal interviews with the residents within a week. The apparatus that was used in gathering the data was a self-design questionnaire that was designed based on literature related to oil and gas exploration and in production in Ghana and Africa in general. Zhang et al. (2009) argued that a research instrument could be a survey, questionnaire, that is used to measure variables, characteristics, behavior, or information of interest. The merit of using a questionnaire is that it is relatively cheaper to use and brings higher sense of accuracy and objectivity than other approaches. The sampling technique for the study was a convenient sampling technique.

Data analysis and statistical tools

The data was analyzed purposefully through categorizing and coding the data. Stata was used in the analysis and Microsoft Excel 2007 equally was used in analyzing the data on perceived impact of the exploration and production activities on households in Ghana.

As a strategic tool, it helps in defining the needs of society in project development. It aims at balancing socio-economic and ecological issues in a coherent and policy important system to ensure that resources are used to achieve sustainable development. It can be an impetus that enables society to address the development and sustainable use of natural resources that lead to the elimination of poverty in communities (Fig. 2). Thus, it is very pertinent for oil majors to consider it for developing and formulating master plans for resource communities to meet their needs sustainably. The vulnerability context comes to play when the oil resource is discovered and can influence each of the capital assets and shapes the outcomes of individual lives or household as a whole. The first capital being the human capital entails the labor market,

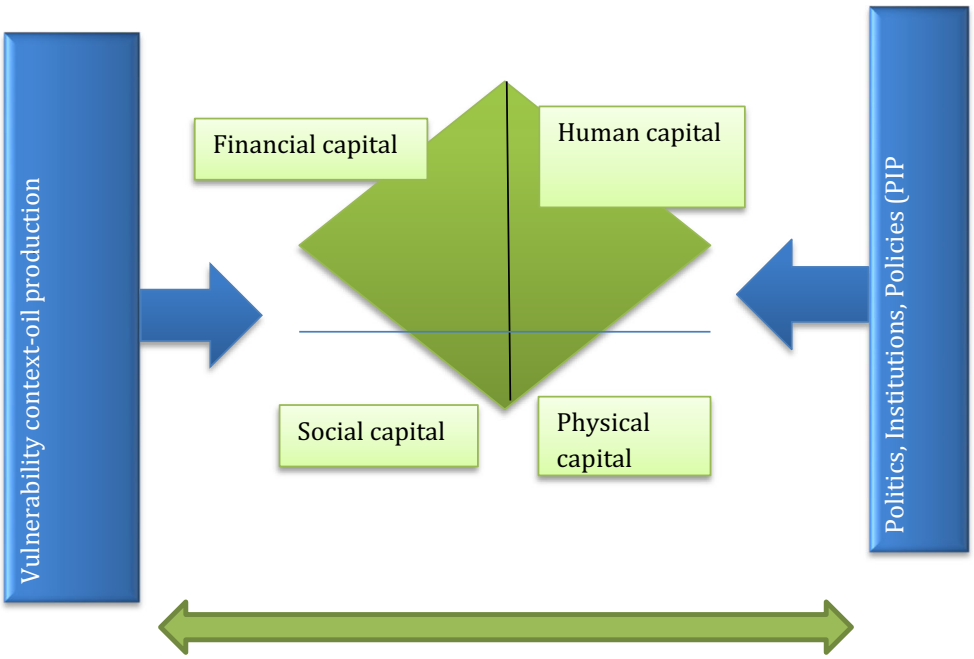

Fig. 2 Framework of sustainably livelihood analysis (Livelihoods et al. 2008), source: Erik Plänitz and Daniela Kuzu (2015)

quality of education, and the health environment. This will determine the economic status of an individual or a household. Without the necessary capital in the form of skills, one cannot be gainfully employed to earn a livelihood. More so, environmental issues from the extraction of the resources affect the human capital through pollution and distractions to fishing activities. In addition, the financial capital explains the ability of the individual to generate income to sustain oneself. The discovery of oil brings about the influx of foreigners to local communities, which might crowd out locals in the highly skilled oil and gas sector. This is very important as lack of jobs can cause social unrest in communities. The physical capital talks about the availability of infrastructure to cater to the needs of locals and affordable housing system. There is always high cost of housing due to people moving to these areas to seek better living conditions. Infrastructures like better roads are always in high demand to ensure people live comfortable lives. Migration has become a thorny issue in oil-producing communities and measures need to be put in place to curb the trend in order to curb population explosion, with its resultant crises like high costs of living, unemployment, and the like. When all these factors are considered in designing a livelihood framework for an oil community, it would give society-resilient adaption strategies that would lead to reduced vulnerability, better well-being, more sustainable use of natural resources, and increased income, as shown in the diagram above.

The analysis of data is in two distinct procedures. The first procedure is the binary logistic technique and the second is the ordered logit procedure. The distinction in the use of the two techniques is dependent on the nature of the dependent variables. The study estimates the model that identifies the category of people that are more likely to use logistic regression. The rationale for using a binary logistic procedure is because the dependent variable is binary [1, 0], which represents a response to the question of whether they have benefited from exploration activities or not. The general specification within the binary procedure takes the following form;

$$\ln\left[\frac{\Pr(\text{yes})}{1-\Pr(\text{yes})}\right] = \alpha_0 + \alpha_1 \text{AgeCat} + \alpha_2 \text{Gender} + \alpha_3 \text{EduSta} + \sum \alpha_i B_i$$

where AgeCat represents the age category and Edusta represents educational status. The α_s are the parameters of the various independent variables to be estimated. The right-hand side of the equation represents the probability of an individual within the study area benefiting from exploration activities. The other variables to be included are captured in B_i.

Results and discussion

Category of people that benefit from exploration and production activities

The coefficient estimates measure the values that maximize the log-likelihood function of an individual benefiting from oil exploration and production activities. The coefficients of the logit model and the marginal effects are reported in Table 1 and Table 2.

From Table 1, the Prob > $\text{chi}^2 = 0.0070$ reports a null hypothesis of a non-monotonic association between SHS attendance and the independent variables, and this shows that the

Table 1 Coefficient of the logit model

Log pseudo likelihood = − 98.425293						
Prob > chi^2 = 0.0070						
Wald chi^2 (31) = 23.59						
Dependent (benefit) (Yes = 1, no = 0)	Pseudo R^2 = 0.0956					
	Coef.	Std. Err.	*Z*	P>|z|	[95% Conf.	Interval]
Age Cat	0 .294	0.910	0.22	0.047	− 1.489	2.077
Young = 1, not young = 0						
Gender	− 0.267	0.998	− 0.27	0.789	− 2.224	1.689
Male = 1, female = 0						
Edu Sta	0.291	1.144	0.25	0.001	− 1.953	2.533
Edu = 1, not edu = 0						
Employ	0.277	1.133	0.24	0.017	− 1.943	2.498
Unemp = 1, others = 0						
Training	0.457	0.415	1.10	0.021	− 1.271	0.356
Tech = 1, voc = 0						
Cons	1.192	0.611	1.95	0.051	− 0.005	2.388

Source: researcher estimates from field data

F-test has a probability value of 0.0070. The value of the log-likelihood function of all coefficients is − 98.42529, which says the estimation of the log transformation variables is feasible in the model. The interpretation of the logit model gives credence to the direction of the impact of the coefficient estimates and marginal effects.

The logit model in Table 1 shows that the coefficient of age, educational status, employment, and training is positively correlated to benefiting from exploration, while gender is negatively related to the dependent variable. More so, the coefficient of age, educational status, employment, and training are statistically significant at a 5% level of significance. The coefficient of age for the young category is positive and significant at 5% level of significance. This means that young people within the selected communities are more likely to benefit from exploration activities than older people. The coefficient of educational status also is positive and significant at 5% level of significance. An individual with education is more likely to benefit from oil exploration and production activities than those with no education. The coefficient for employment is also a positive sign. Therefore, the people in the joblessness category are more likely to get jobs in oil exploration and production. Finally, the coefficient of training is also positive and significant at 5% level of significance. This means that people with technical training within the selected communities are more likely to benefit from exploration activities that those with vocational training.

The marginal effect explains the change in a variable that leads to a change in a response variable holding other values constant. The marginal effects have been estimated to determine how the factors that would explain individuals' chances of benefiting from oil production and exploration in the selected communities. From Table 2, the increase in the number of young people by 1% will probably cause a 0.016% increase in the likelihood of an individual benefiting from exploration activities. Again, an increase in the number of educated people by 1% will result in a 0.13% increase in the probability of an individual benefiting from exploration activities. Also, a 1% increase in the level of unemployment will probably cause a 0.198% increase in the likelihood of an individual benefiting from oil exploration activities. Finally, technical training will also more likely to increase the probability of an individual benefiting from exploration activities by 0.45%.

Table 2 Marginal effects

Marginal effects after logit							
Y = Pr(benefiting) (predict) = 0.7835							
Variable	dy/dx	Std. Err.	*Z*	P>|z|	95%	C.I.	X-bar
Age	0.0162	0.1507	0.11	0.014	− .279	0.312	0.133
Gender	0.047	0.141	0.34	0.735	− .228	0.324	0.235
EduSta	0.138	0.075	1.83	0.037	− .009	0.287	0.231
Employ	0.198	0.099	1.99	0.047	.003	0.393	0.472
Training	0.053	0.0943	0.57	0.016	− .131	0.238	0.144

dy/dx is for discrete change of dummy variable from 0 to 1

Impact of exploration and production of oil and gas on livelihood

Secondly, the objective of the study was to assess the impact of oil and gas exploration on the livelihood of selected communities. This objective considered the variations in the daily lives of respondents, due to the development of hydrocarbons.

From Fig. 3, it is revealed that 52.6% of the residents say that the costs of living in the communities have gone up in the last years; on the other hand, 39.5% of them say it has not. The remaining 7.9% say it has reduced considerably. Because the

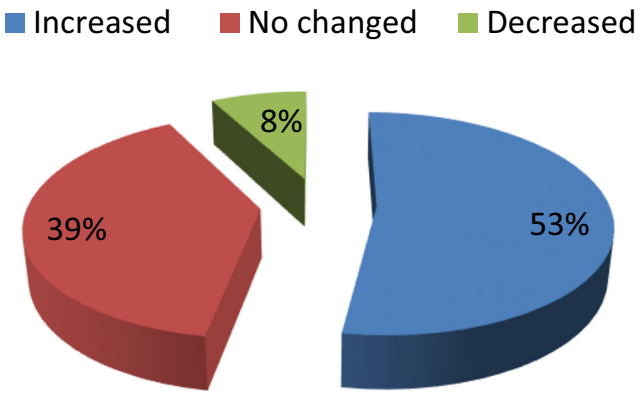

Fig. 3 Changes in the cost of living

study seeks to get a better understanding of the price variations, the prices of six foodstuffs between 2009 and 2014 are used. These are a loaf of bread, a bowl of tomatoes, a cup of rice, a bowl of onions, five pieces of fish, a cup of sugar, and a tuber of yam. The study relies on the price information the residents could easily recall, and this information is concurred by their peers. The study equally uses the basic foodstuff residents to consume daily so as to make it easier for price recall.

From Princess Town is said to have the biggest price hikes of 44.4 followed by both Cape Three Points and Princess Aketakyi of 28.5 and 28.5 respectively in the price of a cup of sugar. From Table 3, Princess Aketakyi has the biggest hikes in the prices of a bowl of maize of 66.6% between 2009 and 2014. The rates of increase in the other towns are Princess Town 45%, Cape Three Points 25%. The biggest hikes in Princess Aketakyi are attributed to high transport prices due to hikes in transport fares, which a rippling effect on other things consumed in the country. From Table 3, six pieces of fish are priced the highest in Cape Three Points (100%) and Princess Aketakyi (87.5%) between 2009 and 2014. Princess Town, however, has the minimum rate of price increase on the same commodity of 80%. Between 2009 and 2014, Cape Three Points have the barest rate of price growth in the bowl of onion at 44%. This is followed by both Princess Town and Princess Aketakyi that see the maximum rate of price growth the price of a bowl of pepper at 100%. Furthermore, Princess Aketakyi has the maximum amount of price growth of a bowl of gari at 50%, followed by Princess Town 33.3% and Cape Three Points 16.6%. Finally, Princess Aketakyi and Cape Three Points had the highest increment rate in the price of a tuber of yam of 50%, followed by Princess Town by 10.5%.

Impact on fishing: restricted zones

In general, respondents during the interviews alluded to the fact that the fishing industry has been greatly affected by the oil activities in their communities, and these effects have impacted negatively on their daily lives. The study found that fishermen now have restricted zones to fish at sea (a 500-m exclusion zone around drilling ships and a 1000-m exclusion zone around the Floating Processing Storage and Overload (FPSO Kwame Nkrumah). This is done to prevent fisher folks from going near the oil rig. This fisherfolk is not happy with this restriction. Participants stated that this restriction is causing a decline

Table 3 Commodity prices at the three communities

Commodity	Location	Average price 2009 (GH¢)	Average price 2014 (GH¢)	Increment between 2009 and 2014 in % (average)
Bowl of local rice	Cape Three Points	5.00	7.00	28.5
	Princess Aketakyi	4.50	6.50	44.4
	Princess Town	5.00	7.00	28.5
A bowl of maize	Cape Three Points	2.00	2.50	25.0
	Princess Aketakyi	1.80	3.00	66.6
	Princess Town	2.00	2.90	45.0
Six pieces of fish	Cape Three Points	10.00	20.00	100.0
	Princess Aketakyi	8.00	15.00	87.5
	Princess Town	10.00	18.00	80.0
Bowl of pepper	Cape Three Points	5.00	7.20	44.0
	Princess Aketakyi	5.00	10.00	100.0
	Princess Town	4.00	8.00	100.0
Three large sizes of tubers of yam	Cape Three Points	10.00	15.00	50.0
	Princess Aketakyi	8.00	12.00	50.0
	Princess Town	9.50	10.50	10.5

in fish catch and subsequently a decline in earnings. This is because the fish are attracted to the light surrounding the oil rig and as such have gravitated towards the restricted fishing area. The fisherfolks bemoaned this barrier to their occupation and their source of livelihood. Another serious issue that came up frequently during the interviews concerns the noise produced by the oil rig. Some participants indicated that the noise emitted from the oil rig coupled with the light intensity makes fishes swim away from the delineated fishing area towards the rigs. As already indicated, fishing close to the oil rig is prohibited, thus rendering small catches. This has resulted in a significant reduction in their income since the oil activities started. It is becoming extremely difficult to make a living from fishing in order to meet their household needs.

Underlying these concerns is the issue of whether fishermen actually fish close to the rig or not since this is prohibited. This issue is important to them because fishing too close to the rig could lead to arrest and prosecution. To this end, there were arguments among fishermen during the interviews, mostly to the effect that they never got too close to where the rigs are for the fear of being prosecuted. In Princess Town and Princess Aketakyi, some respondents stated that they have not been to where the rigs are. However, in Cape Tree Points, some confirmed that they do get to the rigs and beyond.

Most of the fishermen have become aware that they are gradually being kicked out of their occupation which is the source of their livelihood. This is because the authorities feel that oil exploitation is more important than fishing. The previous sections discuss the direct effects of oil exploration in areas such as occupation (fishing, farming, trading, etc.) among others. These sections present the results on other issues that the oil activities affect indirectly but remain essential to communities' daily lives. As the oil business expands, more people migrate to these areas to find work in the oil fields. These people certainly need accommodation and other related housing facilities. This has brought a lot of strain on the few available accommodation facilities. The result of this situation is an increase in rents, accommodation, hotels, rental of office space, etc. During the interviews, this issue features prominently among the concerns raised by respondents. Respondents indicate that they are not only facing high prices in basic rental facilities but they are also actually being pushed out of their communities since they cannot afford the high rent prices. According to the respondents, this issue has been exacerbated by property owners who have capitalized on this activity in these communities to make money. In the interview, participants state that landlords and property owners are taking US dollar equivalent as payment for rents. Secondly, rents have been hiked in excess of a 100% and more since exploration began. A farmer expresses his view about the accommodation hike: Things have become more difficult and renting a house has become more expensive because people prefer to rent out to the oil workers. It was GH¢60.00 per month then, but now it ranges from GH¢60 to GH¢100.00.

The benefit of oil and gas exploration and production on selected communities

This objective seeks to find how oil and gas exploration have benefited selected communities. The study seeks opinions from respondents about the current state of several basic social amenities of their communities.

From Table 4, majority of the respondents in all three communities Cape Three Points (62%), Prince-town (68%), and Princess Aketakyi (64%) do not consider the current education in these communities as proper. Though these communities had primary schools, most of the school buildings were dilapidated and lack basic facilities. From Table 4, all the respondents in Cape Three Points and Princess Town respond that there is electricity in these communities but in Princess Aketakyi, all the participants responded that there is no electricity in the community. In Cape Three Points, 77% of the participants responded "Yes" that they have a motorable road. In Princess Town, 60% claim there are motorable roads in the community and finally, in Princess Aketakyi, 72% of the respondents also say yes, there are motorable roads in the

Table 4 Infrastructure development in the communities

Infrastructure	Response	Cape Three Points		Princess Town		Princess Aketakyi	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Electricity	Yes	25	100	25	100	25	100
	No	0	0	0	0	0	0
Good education	Yes	10	38.5	8	32	9	36
	No	16	62	17	68	16	64
Motorable road	Yes	10	77.7	8	32	9	36
	No	16	60	17	72	16	64

Source: author's own calculation

community. In a further interview with the respondents, they say the road network leading to Cape Three Points and Princess Town and Princess Aketakyi are in a deplorable state. A journey from Takoradi to these communities which could be made in an average of an hour if the roads were to be in good state extends to about 3 to 4 h due to the nature of the road.

In an observation, there is a deteriorating situation on health care in these communities. The dangers of accidents on both land and sea and the breeding of mosquitoes pose health challenges while Princess Town has an ill-equipped health center without personnel to man it. Cape Three Points on the other hand lacks these facilities and Princess Aketakyi does not have a health post at all. Basic health care services have eluded members of these oil-rich communities who have to travel over 6 miles to neighboring communities for these essential services. Some informants recount numerous situations when some friends and family members lost their lives on the way to the hospital.

The study seeks to examine the impact of the activity on their livelihoods, 60% of the respondents agree that their costs of living have increased. In terms of prices of goods and services increasing, 80% of respondents in Cape Three Points say prices of goods have increased while 50% of Princess Town agree to the same assertion. Drastic increases in prices are everywhere across all the age brackets. Furthermore, the activity also affects fishing seriously as fishermen complain of low catch since the exploration and production of oil began. Fisherfolks, in the oil-bearing communities, have been asked to not fish close to the oil rigs, a case in point is the 500-m no-fishing zone around the Jubilee Field (Benkenstein 2016).

Conclusion and policy implications

Findings from the binary logit estimate showed that the category of people that are more likely to benefit from oil production and exploration within the selected communities are young people, individuals with education, those who are unemployed, and individuals with technical training. Again, the activity is impacting negatively on their livelihoods, which is evident in the drastic rise in food prices thereby increasing their cost of living. Equally, accommodation hikes in these communities, making life unbearable. Infrastructural development is the foundation of a sustainable economy (Mashatt et al. 2008). Providing basic services is critical to security, governance, economic development, and social well-being. In Nigeria, the infrastructure is inadequate and often manifested by the poor road network, especially in the oil resource-rich areas (Idumange 2011). Whereas there is a hardly electricity supply in many areas, healthcare is less than desirable while the schools are ill-equipped. These conditions, therefore, provide a fertile ground for social unrest, conflict, and instability (Idumange 2011).

The above findings are not different from what pertains in Ghanaian communities in the Western Regions. In terms of infrastructure, the three communities are lacking, 77% of respondents from Princess Town hold the view that there is no motorable road linking their community in the next town and 60% from Aketakyi also hold the same view. However, all the three communities have been hooked to the national grid and are therefore enjoying it. Rural electrification is essential for development as it enhances growth by encouraging industries to locate in remote communities and provide off-farm job opportunities. With the provision of affordable, readily available, and environmentally acceptable energy, the living conditions for the poor in rural areas can be improved (Zoomers 2011). The availability of this infrastructure has helped boost social life in these communities. The study lends credence to many studies in this direction (Zoomers 2011; Benkenstein 2016).

The overarching problem is the issue of low fishing, which is their main economic activity as a result of exclusion zones created by oil companies which limited the extent fishermen can go fishing. It was found that economic and social infrastructures which are very important in these communities are underprovided or do not exist at all. Road networks in these communities are in a very deplorable state, and there is no major road linking these communities to the District capital. The following recommendations are made:

1. Alternative livelihood skills be given to fishermen to cushion them due to low catch as a result of exclusion zone being created, as well as equip them with skills to participate in oil and gas activities.
2. A scholarship fund could be set up by the government to help in educating the children of these communities since most of them stopped schooling at the primary school level owning to lack of finances.
3. The women who are fishmongers could be given soft loans to do their businesses.
4. Also, conscious efforts should be made to provide an improved infrastructure in these communities to open them up.
5. The road network should be given serious attention since it can attract tourists to these communities which are tourist destinations.
6. Critical infrastructures such as schools and roads should be provided by oil majors.
7. There should be community engagement at the initial stages of exploration and production of resource.
8. The paper would recommend the adoption and the application of Global Memorandum of Understanding (GMOU) as being used by oil majors like Shell and

Chevron to undertake corporate social responsibility (CSR), which is more encompassing and comprehensively addresses all complex challenges in undertaking corporate social responsibility. The old model of undertaking CRS does not deliver desired results in undertaking CSR.

9. The issue of gender inequality has to be addressed to ensure parity of economic opportunities. Women are always left out, and they do not have equal access to entrepreneurial activities emerging from the oil sector. For instance, access to startups capital is limited for women who want to engage in petty trading or business of some sort. Business development support should be provided by oil majors and the government in the communities to women at all levels

Finally, the study would recommend the setting up of local community infrastructure and livelihood funds to cater to the needs of oil-producing communities, with seed funding from the oil majors operating in the area.

Author contribution David Ajene Alemzero: conceptualization, data curation, methodology, writing - original draft. Nadeem Iqbal: data curation, visualization. Sajid Iqbal: visualization, supervision, editing. Muhammad Mohsin: review and editing. Ngonadi Josiah Chukwuma: writing - review and editing and software. Burhan Ali Shah: writing - review and editing.

Data availability The data that support the findings of this study are openly available on request.

Compliance with ethical standards

Conflict interest The authors declare that they have no conflict of interest.

Ethical approval and consent to participate The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. We declared that we do not have human participants, human data, or human tissue.

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