



Nigerian Marginal Oil and Gas Field Development: A collaborative perspective

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Article information

ABSTRACT

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In spite of the potential of marginal oil and gas fields to increase the level of petroleum production in Nigeria, very few indigenous producers have made appreciable progress. The envisaged development of indigenous technological capabilities has also not been realised. This study examines the capability building linkages among the relevant actors in the sector. Primary data was gathered by questionnaire administration on a sample of 120 lecturers in oil and gas related disciplines in Federal and State universities across Nigeria, 150 staff from indigenous oil and gas firms, 42 credit analysts in 21 commercial banks and 20 members of staff in relevant government agencies. The survey shows that collaboration between the oil and gas firms with Financial Institutions (2.50), Government Agencies (2.43) and Universities (2.31) was low. Regression analysis revealed that engaging academic staff in Consultancy, Student internships and industry sponsored conferences may improve linkages with academia. The study further shows that project financing credit, invoice discounting facilities and bank guarantees may enhance linkages with financial institutions while Government financial support for technology innovation and training, policy directed towards marginal field development and R&D funding may facilitate linkages with government agencies. The study concludes with a framework that may foster sustainable collaboration among stakeholders in the sector.

Keywords:

Technological innovation; Marginal oil and gas fields; Sustainable development; Innovation systems

1.0. Introduction

There is a general consensus that there are considerable concerns for the future of the global oil and gas industry and Nigeria's petroleum sector is not exempt. This is partly due to the negative effect of carbon emissions from fossil fuels, the fast depletion of some oil fields, fluctuations of oil prices and the quest to harness alternative (renewable) energy sources amongst others. Despite the uncertainty of the future of oil and gas, the petroleum sector in Nigeria still holds a very strategic position in the economic growth of the country.

The Nigerian oil reserve is estimated to be 37.5 billion barrels, and the oil reserve to production ratio is 51.6 (BP statistical report, 2018). The contribution of petroleum sector to the country's foreign exchange earnings is approximately 92% (CBN, 2017). However, the largest share of the exploration and production activities are done by international oil companies (IOCs) and most of the refining activities are carried out abroad. This leaves very few production and refining activities for Nigerians. This provided so much income for the investors at the expense of environmental degradation and the dearth of indigenous human. Nigeria's government over the years have not found this absurd because they receive the resource rents so easily and cheaply and have treated this inflow as 'manna from heaven'. With rapid growth in population over the years and without any solid infrastructure to cater for this mostly unskilled growing population, the Nigerian government has realised the urgent need to equip this teeming population with requisite production skills. In order to increase the participation of the citizens in oil and gas activities, reduce unemployment and create more wealth in the economy, the Federal Government came up with some initiatives among which is the marginal oil and gas field development initiative.

Marginal fields are fields which cannot be produced through conventional methods or current technology. According to Kaiser (2010), marginal fields have different economics compared with large fields and hence require different recovery techniques. They are usually produced by smaller companies (mostly local), and although the production may still be at commercial quantities,

the conditions under which profit is generated tend to be more restricted than the larger fields. Marginal fields comprise the small and abandoned fields, which have remained undeveloped by the multinational oil companies (MOCs) in Nigeria (Ayodele and Frimpong, 2003; DPR, 1996). The fields contain reserves that are uneconomic when produced by the MOCs but might be profitable if operated by the indigenous entrepreneurs as a result of their low overhead and operating costs. The Nigerian Petroleum Act, 1969 provides that the President may cause the farm-out of a marginal field if the field has been left unattended for a period of not less than ten years from the date of first discovery. The development of such fields has become an important strategic issue to increase the level of petroleum production.

There is a reported huge reservoir of marginal oil fields in Nigeria. These fields are conservatively estimated to contain over 2.3 billion barrels of Stock Tank Oil Initially in Place (STOIP) strewn over 183 marginal fields (Onyeukwu, 2010). In 2003, the Federal Government handed over the operations of 24 marginal fields to 31 Nigerian companies. The government wanted to achieve the farm-out of marginal fields within the concessions of the MOCs to indigenous companies. Despite this laudable policy, the success of the incursion of indigenous players into marginal oil field development and production can be said to be 'insignificant'. Not many have made appreciable progress with their concessions. Few marginal field operators are producing presently and the limited production is not in tandem with the desired pace for local content development in the national oil sector (Adetoba, 2012; Akinwale and Akinbami, 2017). It is imperative to know what could be responsible for this unimpressive trend in marginal oil and gas field development by indigenous oil companies in the country.

Akinwale et al. (2018) showed that Nigeria's marginal oil firms' R&D, human and knowledge capital, acquisition of advanced machinery, size, age and staff training were all statistically significant in influencing the technology capabilities of the firms. Jegede et al. (2012) examined the factors influencing technological capabilities among the servicing firms in the Nigeria's oil industry, and reported that

qualifications and experience of the heads of technical departments and extensive staff training were the most important factors that accounted for technological capability. Few studies have examined the economic profitability of marginal oil fields in Nigeria using Monte Carlo simulations, discounted cash flow modelling and sensitivity analysis among others (Ayodele and Frimpong, 2003; Adamu et al., 2013; Akinwale and Akinbami, 2016). In spite of the attention given to the collaboration and interaction among the stakeholders in a particular system, there is scant research on the collaborative nature of the indigenous stakeholders operating marginal oil and gas fields. This study therefore seeks to provide information on the nature and extent of the institutional interactions in the development of Nigerian marginal oil and gas fields. It is hoped that the study will provide information that will aid policy formulation that would foster linkages, and enhance human capability that will aid the development of the sector.

2.0. Literature Review

Actor Network Theory (ANT) emphasizes that a network is a heterogeneous system of aligned interests which consists of people, organizations and standards (Shin, 2016). It is mainly concerned with how heterogeneous actors come together to form a network (Olaopa et al., 2018). It is involved with the development of innovation and technology by all the actors that influence actions and decision making in the development process thereby leading to system stabilisation. The system of innovation (SI) presents innovation as an interactive process among a wide variety of actors (Edquist, 1997; Akinwale, 2017; Akinwale and Surujlal, 2017). System of innovation could be referred to as the flow of technology, information and innovation among people, institutions and enterprises which is important for the technological progress of a country (Lall, 1992; Freeman, 2002; Ilori, 2006). The innovation and technological development of a nation are a result of a complex set of relationships among actors in the system. This concept emphasises the significance of the interactions or linkages among the various actors involved in technology development towards translating the inputs into outputs. System of innovation accentuates that there is no single firm that can innovate without the input or assistance of other

firms/actors. Innovation is a collective process whereby firms interact with other firms as well as with non-firm organisations (such as universities, research centres, government agencies, financial institutions and so on) in any sector of the economy (Malerba, 2005). The types and structures of relationships vary from one sectoral system to another as a consequence of the features of the knowledge base, the relevant learning processes, basic technologies, characteristics of demand, key links and dynamic complementarities (Malerba, 2005; Akinwale et al., 2017). Furthermore, Stakeholders are groups and individuals who benefit from or are harmed by, and whose rights are respected or violated, by corporate actions (Freeman, 2001). These groups and individuals are critical to the success or failure of corporations (Freeman and Reed, 1983). This means that the actions and inactions of each individual or group of firms can affect its goal. These theories are applicable to the collaborative perspectives of viewing technology innovation in marginal oil and gas field development. The economy achieves industrial maturity or technological puberty when many people learn and acquire skills in breadth and depth up to a point when each skill type begins to enjoy the support of others, and the relevant linkages which improve productivity become established (Ogbimi, 1999). This can be revealed by Ogbimi's theory of industrialization which postulated that technological growth is a learning process (Ogbimi, 2007). The author identified five variables critical to the economic strength of a nation. This includes the number of people involved in productive work in a nation; the level of education and training of those involved in productive activities in the economy; the linkages among the knowledge, skills, competences and sectors of the economy; the learning rate or intensity in the economy, especially that of workforce and the learning history of the society. The five variables are relevant and related to the learning –man and they are directly related to the strength of the economy, or sector as in the case of this study. The higher the value of these variables, the healthier is the economy or sector and vice versa (Ogbimi, 2013).

There are also some empirical studies that have been conducted regarding collaborations among the actors of a system, though not necessarily in the oil

sector. Börjesson and Löfsten (2012) investigated innovation capabilities and performance of 131 small high-tech firms and their collaborations with other stakeholders. The results showed that cooperation with universities and business planning and advisory firms are latent constructs that have a positive effect on innovation performance. Hinkkanen *et al.* (2012) examined the level of cooperation of 206 Russian firms with R&D firms to identify the link between increased R&D investments and collaborative actions taken by a firm. The results revealed that Russian firms use their R&D collaborations to a certain extent to gain knowledge absorption, and by so amend their own competencies and skills. Egbetokun *et al.* (2010) carried out a survey in cable and wire manufacturing sub-sector in Nigeria for factors promoting innovation, and their results indicated that collaboration and networking are more important than firm-related variables in promoting an innovation capability. Falode and Nebeife (2013) conducted a study on university-industry collaboration in the oil sector, and the results revealed a low level of collaboration between them. The authors suggested for the improvement of university-industry collaboration, the provision of improved laboratory facilities and other infrastructure, involvement of staff from industry in teaching and the encouragement of industry representation in university committees. Akinwale *et al.* (2018) could not establish any significant cooperation agreement among the indigenous oil firms in Nigeria.

3.0. Methodology

The data were obtained through primary data by administering questionnaire to the stakeholders. The stakeholders considered were financial institutions, the indigenous marginal oil field operators, universities and relevant government agencies. Multi-stage sampling technique was used for sample selection which comprises cluster sampling, purposive sampling and finally simple random sampling as the case may be for each of the stakeholders. Four sets of questionnaires were administered to four different stakeholders. The sample consists of 120 lecturers of federal and state universities in oil and gas related disciplines across Nigeria; 150 indigenous oil and gas firms at the upstream subsector; 42 credit analysts/management staff in 21 commercial banks; and 20 members of

staff in relevant government agencies. The data was analysed using descriptive method and logistic regression.

4.0. Results and Discussion

The average rate of response from respondents on the administration of the questionnaire was 80.18%. The data is presented and discussed from the perspectives of each stakeholder

4.1. Linkages with other stakeholders from the financial institutions perspective

Financial institutions within any economy are expected to provide financial support for industries in that economy. Table 1 shows the results of the questionnaire administration obtained from the commercial banks selected for the study. Majority (82.4%) of the respondents in this category claimed that their banks have not granted loans to Exploration and Production (E&P) oil firms to engage in marginal field development in the last five years. About 44.8% of them attributed this to failure of the oil firms to supply the required documents, 27.6% claimed that their capital base was too low for the nature of credit requested by the oil firms, and 13.8% claimed that the oil and gas E&P business is too risky and another 13.8% indicated that their bank policy does not support granting loans to E&P oil firms. Similarly, Table 1 also shows that 88.2% of the respondents claimed that their banks did not support any oil and gas related research activities in the University in the last 5 years. More so, 97.1% of the respondents asserted that there was no government policy in the financial sector which supported granting of credit to indigenous oil companies. All the respondents opined that they are not aware of any concession in granting loans for the Academia for patenting their inventions.

4.2. Linkages with other stakeholders from the university academia perspective

The diffusion of technology and knowledge is a salient feature in the recent literature on technology capability and innovation (Loof and Brostorm, 2006). Much attention has been given to the role of universities in modern industry (Akinwale, 2016). Table 2 shows the result of the factors that influence the extent of interaction between the University Academia and other stakeholders using a scale ranging from 1 (Very low extent) to 4 (High

Table 1: Linkages with other stakeholders from Financial Institution Perspective

Accessibility of credits/funds from financial institutions	%
Fund or credit granted to E&P oil firms in the last 5 years	
No	82.4
Yes	17.6
If No- Reasons for not granting credit/ fund to E&P firms	
The oil and gas E&P business is too risky	13.8
It is not in the bank policy to grant loan to E&P Oil Company	13.8
The capital base is too low for the kind of credit required	27.6
The E&P oil companies did not supply the required documents	44.8
Range of Credit/Loans granted (billion naira)	
1 – 5	16.7
5 – 10	33.3
> 10	50.0
Has your Financial institution supported any oil and gas related research activities in any university in the last 5 years	
No	88.2
Yes	11.8
Any government policy supporting credit to indigenous oil companies	
No	97.1
Yes	2.9
Any concessions in granting loans to the academics for patenting	
No	100
Yes	-

Table 2: Linkages with other stakeholders from University Academia perspective

Factors	Mean Rank
Academic papers prepared by the academia published and presented in oil and gas related conferences	3.32
Attendance of training program, workshops and conferences organised by the academia for other stakeholders	2.37
Consultancies	2.35
Prototypes developed by the academia that are relevant in the oil and gas upstream subsector	2.16
Technical Services/Joint research between University and Oil company	2.0
Use of University laboratory facilities	1.81
Cooperative R&D Agreement	1.73
Licensing arrangement between academia and oil company	1.63
Spin-off companies emanated from research activities	1.28
Patent granted to the academia invention in the area of oil and gas upstream subsector	1.22
Mean Ranking: 1 = Very low; 2 = Low; 3 = Medium; 4 = High	

extent). None of the factors listed in Table 2 indicates a high extent of University interacting with other stakeholders. Factors such as attendance at training program/workshops and conferences organised by the academia for other stakeholders, consultancies, prototypes developed by academia that are relevant in the oil and gas upstream subsector, technical services/joint research between university and oil firms, use of university laboratory facilities, cooperative R&D agreements and, licensing arrangements between academia and oil company were all rated low with mean ranks of 2.37, 2.35, 2.16, 2.0, 1.81, 1.73 and 1.63 respectively. Meanwhile, Spin-off companies emanating from research activities and Patents granted to the academia in the area of oil and gas upstream subsector were rated very low with mean ranking of 1.28 and 1.22 respectively.

Table 3 shows the nature of oil firms that the academia got R&D support from in the last 5 years. While majority (64.1%) of the responding academia claimed not to have gotten R&D support from any oil and gas firms, 31.1% and 4.8%

Table 3: Support for University R&D by Oil Firms

Oil firms support for R&D in the Universities	Freq.	%
Nature of Oil firms supporting R&D in Academic Departments		
Multinationals	32	31.1
Indigenous	5	4.8
None	66	64.1
Total	103	100
Forms of Oil firms' support		
Research Grant	10	27
Staff Exchange	6	16.2
Travel Fellowships, Workshops and Conferences	21	56.8
Total	37	100
Factors responsible for poor R&D support from the oil and gas firms		
The oil firms were not contacted	43	66.2
The oil firms were contacted but no response	16	24.6
The oil firms were contacted but declined	6	9.2
Total	65	100
Basis of Academia application decline		
They believe Nigerian Universities do not have the state-of-the-art facilities that will satisfy their research needs	4	66.7
Fear of possible loss of confidentiality on the research results	2	33.3
Total	6	100

indicated that they got R&D support from multinational and indigenous oil firms respectively. Consequently, travel fellowships, workshops and conferences dominated (56.8%) the nature of support that the academia received from the oil and gas firms. This was followed by research grants (27%) and staff exchange (16.2%). The study also showed the factors that could be responsible for the majority of the academia not to have obtained R&D support from oil and gas firms. The result revealed that majority (66.2%) of the responding academia did not contact the oil and gas firms for any oil related R&D support, while 24.6% of the respondents claimed to have contacted the oil firms but did not get any response. About 9% claimed to have contacted the oil firms but their requests were declined. Most of those that were declined opined that the oil and gas firms believed that Nigerian universities do not have the state-of-the-art facilities that would satisfy their research needs.

Similarly, Table 4 shows that most (91.3%) of the responding academia claimed not to have secured

Table 4: Access to Credit and Fund from Nigerian Financial Institutions on Oil and Gas related Research by the Academia

Accessibility of fund from financial institutions	Frequency	%
Fund or credit obtained from Nigerian financial institution		
No	94	91.3
Yes	9	8.7
Total	103	100
If No- Reasons for poor access to fund		
No application was made for assistance	64	68.1
Application was made but there was no response	16	17
Application was declined	14	14.9
Total	94	100

funds or credit from any Nigerian financial institution on oil and gas related research. While majority (68.1%) of them did not apply for any fund, 17% applied but did not get any response and 14.9% were declined.

4.3. Linkages with other stakeholders from the government agencies perspective

Table 5 shows that while 50% of the respondents in this category perceived that Government is not playing any role in linking university with oil industry, 37.5% perceived that Government is playing a role in this regard and 12.5% were not aware whether Government is playing any role or not in linking university with the oil industry. Also, majority (62.5%) of the respondents were not aware of any role played by government in supporting academics in patenting their oil and gas related inventions for the last 5 years. In addition to this, 75% of the respondents were not aware of any government policy that supports marginal oil and gas field development in Nigeria. While 56.2% asserted that their Ministries or Agencies had not provided any fund for R&D activities in oil and gas related research in Universities in the last 5 years, 43.8% claimed that their Ministries or Agencies had provided such funds in the last 5 years.

Perception of the respondents on the extent of training and development of indigenous human capabilities in the area of marginal oil and gas field development by the Nigerian government were also examined. Most (68.8%) of the respondents claimed that the efforts of government in

Table 5: Linkages with other Stakeholders from Government Agencies’ perspectives

Perception of the relevant Ministries, Departments and Agencies (MDA) on the role of government in oil and gas related research	%
Perception of the respondents on MDA playing any role in linking university with oil industry in the last 5 years	
Yes	37.5
No	50.0
Not Aware	12.5
Awareness of the respondents on the role of government supporting academics in patenting their oil and gas related inventions in the last 5 years	
Yes	37.5
No	62.5
Awareness of the respondents on any government policy supporting marginal oil field development	
Yes	25.0
No	75.0
Has your MDA provided any fund for R&D activities in oil and gas related research in universities in the last 5 years	
Yes	43.8
No	56.2
Perception of the extent at which Nigerian government has facilitated the training and development of indigenous human capabilities in the area of marginal oil field development	
Not at all	-
Low	68.8
High	25.0
Very High	6.2
Total	100

facilitating such training and development of indigenous human capabilities is low, while 25% and 6.2% claimed that it was high and very high respectively.

According to the National Bureau of Statistics (2012), a total number of 682 citizens have been granted petroleum technology development fund (PTDF) scholarship between 2002 and 2007 while 731 citizens have been given PTDF scholarship between 2007 and 2009. This scholarship was given to pursue postgraduate degrees in energy and oil and gas related courses both within Nigeria and Overseas. While this is recognised as a good development on the part of government, these numbers are very small when taking into consideration the entire population of approximately 190 million people in Nigeria. The governments of various countries have made several laws defining the framework of collaboration to encourage more Universities and industries create collaboration projects with one another (Kaymaz and Eryigit, 2011). It is necessary for the Nigerian government to also create such a

platform to foster collaboration among the stakeholders in the petroleum innovation system.

4.4. Linkages with other stakeholders from the oil and gas firms’ perspective

Table 6 shows the mean ranking of the extent of collaboration of the indigenous oil and gas firms with financial institutions, government agencies and universities with mean rank of 2.50, 2.43 and 2.31 respectively out of the total of 4, indicating a moderately low level of collaboration of the oil firms with other stakeholders.

Table 6: Extent of Linkages with other stakeholders from oil and gas firms’ perspectives

Elements of Petroleum Innovation System	Mean Rank
Financial Institutions	2.50
Government Agencies	2.43
Universities	2.31

Mean Ranking: 1 = Very low; 2 = Low; 3 = Medium; 4 = High

The nature of collaboration is further delineated by different variables as earlier presented in the work of Akinwale and Surujlal (2017). Table 7 revealed the factors that influence the extent of collaborations of oil firms with the universities. Factors such as engagement of academic staff in project/consultancy (X₁), Joint research with academics (X₂), student internship (X₅), and workshops and conferences organised by the oil firms (X₆) have significant impact on the level of collaboration with the university academia with probability values less than 10 percent (p<0.1); whereas using university laboratory facilities (X₃) and licensing of university held patents by the oil firms (X₄) did not have significant impact as their probability values are greater than 10 percent level of significance.

The positive coefficient indicates the likelihood of all the variables increasing the extent of collaboration of the oil firms with the universities except X₃ which is negative and indicated a lower likelihood to foster the firm-university collaboration. The negative coefficient of X₃ might be due to the poorly equipped level of university laboratory facilities. Pseudo R-squared of 0.57 showed that the model fits the data, and the Prob (LR-statistic) of 0.0002 implies that all the independent variables jointly influence the level of interaction with the universities.

Table 7: Factors influencing the extent of collaboration of oil firms with universities

Explanatory Variables	B	Std. Error	z-Statistic	Prob (p-value)
Engagement of academic staff in project/Consultancy (X ₁)	0.374	0.084	4.438	0.0000
Joint research with the academics (X ₂)	0.328	0.071	4.639	0.0000
Laboratory facilities (X ₃)	-0.110	0.083	-1.333	0.1867
Licensing of University held patents (X ₄)	0.079	0.075	1.053	0.2956
Student internship (X ₅)	0.215	0.065	3.282	0.0016
Training, workshops and conferences (X ₆)	0.197	0.062	3.180	0.0021
Constant	-0.001	0.247	-0.004	0.9965
Pseudo R-squared	0.575			
Prob(LR statistic)	0.0002			
Method	ML- Ordered Logit (Quadratic hill climbing)			

The factors influencing the extent of collaboration of indigenous oil firms with financial institutions are presented in Table 8. The result reveals that project financing credit (X₁), invoice discounting facility (X₃), interest rate concession (X₄) and bank guarantee (X₅) have significant impact on the extent of collaboration with the financial institutions in Nigeria at 10 percent (p<0.1) level of significance while Overdraft Facility (X₂) was not significant. All these variables were also positively

related to the extent of interaction with financial institutions except interest rate concession which was negatively related. Access to credit and funding has been recognised as an important factor driving linkages among the stakeholders in an innovation system. The negative coefficient of interest rate concession may be due to the low level of concessions given to the indigenous oil firms by the financial institutions.

Table 8: Factors influencing the extent of collaboration of oil firms with the financial institutions

Explanatory Variables	B	Std. Error	z-Statistic	Prob (p-value)
Project financing credit	0.160	0.062	2.567	0.0121
Overdraft facility	0.058	0.048	1.206	0.2313
Invoice discounting facility	0.190	0.055	3.450	0.0009
Interest rate concession	-0.063	0.036	-1.784	0.0783
Bank Guarantee	0.582	0.067	8.746	0.0000
Constant	0.173	0.101	1.716	0.0902
Pseudo R-squared	0.468	-	-	-
Prob(LR statistic)	0.00012	-	-	-
Method	ML- Ordered Logit (Quadratic hill climbing)			

Table 9 shows the factors influencing the extent of collaboration of the indigenous oil firms with relevant government agencies. The results signify that government financial support for technology innovation to develop marginal fields (X₁), government efforts in training people (X₂), government policy directed to marginal field development (X₃) and government research and development funding relating to marginal fields (X₄) are statistically significant in influencing the

extent of collaboration of oil firms with the relevant government agencies.

The level of collaboration among the indigenous stakeholders in the oil and gas sector has been revealed to be low, and it is well documented in the literature that low collaboration of actors in a system usually impairs technological capabilities and innovation. In order to foster sustainable collaboration among the stakeholders in this study, a framework is suggested.

Table 9: Factors influencing the extent of Collaboration of oil firms with the relevant government agencies

Explanatory Variables	B	Std. Error	z-Statistic	Prob (p-value)
Government financial support for technology innovation to develop marginal field (X ₁)	-0.291	0.090	-3.247	0.0017
Government effort in training people (X ₂)	0.367	0.086	4.290	0.0000
Government policy directed to marginal field development (X ₃)	0.368	0.096	3.851	0.0002
R&D funding relating to marginal field (X ₄)	0.512	0.095	5.377	0.0000
Constant	0.111	0.171	0.650	0.5174
Pseudo R-squared	0.676	-	-	-
Prob(LR statistic)	0.0000	-	-	-
Method	ML- Ordered Logit (Quadratic hill climbing)			

The suggested framework emphasises stronger linkages of the knowledge and financial institutions, government agencies and the indigenous oil and gas firms. While all the actions of each stakeholder are important to the success of the system, government policy and actions should play a central role in driving the techno-economic factors required to boost collaborations and accelerated development of marginal oil and gas fields in the country. This is shown in Figure 1. Policies aimed at localising the oil and gas supply chain and strengthening indigenous technology capabilities at various levels must be championed by the Nigerian government.

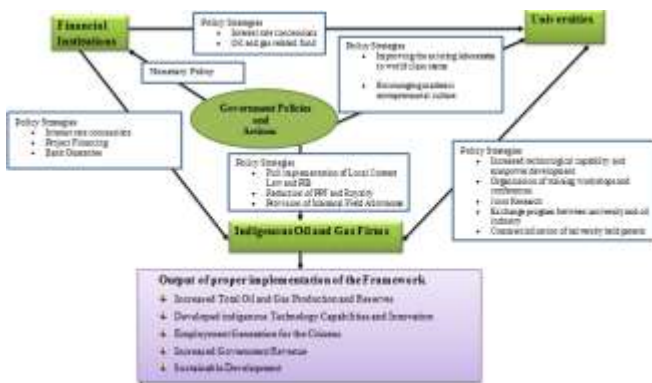


Figure 1: A Policy Framework to foster collaboration and enhance marginal oil and gas field development in Nigeria

Government and private companies should provide adequate oil and gas related funding for the public universities so as to enable them have world class laboratories which are equipped to adapt existing foreign technologies to the local environment as well as provide cutting-edge technologies and

innovations relevant in the oil industry. There should be a special fund from which brilliant proposals and ideas of oil and gas researchers shall be supported. University administrators should also create a culture of academic entrepreneurship that builds on stronger ties between the university and industry as well as encourage academia to patent their inventions by strengthening the existing ‘support and reward platforms’ to encourage them in this regard. Moreso, members of staff from the oil industry should be involved in teaching oil and gas related courses so as to be able to blend theory and practice. Joint research between the university and industry should also be encouraged. The Nigerian government, through appropriate financial and monetary policies should encourage the commercial banks within the country to give funds and financial support to the indigenous oil and gas firms and University researchers. This may require the government through Central Bank of Nigeria to direct the financial institutions to give concessions (such as interest rate concessions and less stringent documentations) to this category of borrowers since most of the respondents claimed to have low level of credit from Nigerian financial institutions. This is expected to foster collaboration between the financial institutions and other stakeholders in the oil sector.

More indigenous oil and gas firms will be able to break-even and produce from the marginal fields allotted to them if the Nigerian government can make the fiscal regime more suitable for the indigenous oil firms through reduction of PPT and Royalty as well as various allowances for the marginal field operators. Indigenous oil firms

should be mandated to adequately train the Nigerians working with them so as to easily learn, assimilate, adapt and reproduce some of the foreign technologies imported to execute their projects. The Nigerian government can also provide certain tax exemptions for those firms that adequately provide R&D funds to train and develop their staff on technological capabilities. There should also be incentives for the indigenous oil firms to engage in collaborative research, consultancy and internship with the Universities. This will make the University Academia to understand the kind of research required in the industry and at the same time make industrialists provide the University Academia and the students with what is expected from them in the oil industry.

The “political will” of the Nigerian government is the main driving force of this framework. This requires the government to engage in a concerted effort toward using policies such as science, technology and innovation (STI) policy, energy policy, education policy and the final output of PIB once it is passed into law, to create an enabling environment for other stakeholders and steer their actions towards a sustained oil and gas sector. If the current administration is committed to effective implementation of this framework, there would be an increase in total crude oil production and reserves, an accelerated development of indigenous technology and innovation capabilities, and an increase in employment generation for the Nigerians. This will lead to economic growth and sustainable development.

5.0. Conclusion

This study investigated the level and nature of collaborations among the indigenous stakeholders that engage in the development and operation of marginal oil and gas fields in Nigeria. Effective collaboration among the actors or stakeholders in a particular innovation system is expected to foster technology innovation which could lead to sustainable development. The results of this study showed that there is a weak collaboration among the indigenous stakeholders relevant to the development and production of marginal oil and gas fields. The banks are not supporting academia and the indigenous oil companies operating the marginal fields because of high risks attached to the project, insufficient capital base to give lump sum

credit to the oil firms, supply of incomplete documents by the oil firms and the dearth of government policy to support this nature of research. There is also a gap from the university as many perceived the universities not to have the requisite state-of-the-art facilities to provide what the oil industry requires. Moreso, it was also found that many university academics have never contacted the banks and oil companies for any kind of research support and credit in the past five years. This means that so many university lecturers and researchers have not sought for industrial support for their oil and gas related research. There is no clear-cut policy made by government to foster the collaboration university-industry linkage as shown by the respondents from the government agencies. Evidently, the collaboration between the oil firms and other stakeholders is weak but there are some factors which have been found to have a significant impact in influencing collaboration among the stakeholders. This includes government policy directed to marginal field development, R&D funding, bank guarantee and credit facilities, workshop, training and conferences among the stakeholders, joint research of oil firms with academics and engagement of academics in consultancy and projects among others. Involvement of staff of oil firms in teaching certain modules of oil and gas related courses should also be encouraged to blend theory and practice. A policy framework is therefore suggested for effective collaboration among the indigenous stakeholders of marginal field operation.

This study has implications for all the indigenous stakeholders relevant to the oil and gas industry. Collaborations among the stakeholders would build indigenous human capability among the citizens which would increase their productivity and at the same time create more wealth in the country. As human capability is built in the area of technology innovation as a result of collaboration among the stakeholders, this would enable more abandoned wells to be developed, and this would generate more income for the present and future generations and at the same time reduce the search and depletion rate of oil reserves. There is a need for further studies which would include multinational oil companies as well as the polytechnics and private universities which were not considered in this study. The polytechnics and few private

universities are known for some practical skills with the potentials of developing technology and innovative products needed in the oil industry.

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