

State of Art of Oil and Gas Exploration in Kenya – Progress and Challenges

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Abstract:

In 2012, Kenya discovered oil deposits which has placed it among the global oil exporters. Huge expectations from this discovery among all the stakeholders has ignited unmatched interested both locally and internationally. The expected socio-economic changes for the nation, however need to be surgically addressed and assessed. This paper therefore aims to explore upstream sub-sector of the oil and gas industry in Kenya. It analyses the history, development and future potential of the exploration upstream sub-sector of the oil and gas industry. Furthermore, it evaluates the challenges facing the sector and outlines the necessary recommendation for its potential development.

Keywords — Exploration, Tertiary Basin, Oil Seeps, Energy Tribunal, Resource Curse.

I. INTRODUCTION

A. Oil and Gas Explorations in the World

The critical role played by oil and gas operations in the global energy mix cannot be underestimated. Figure 1.1 below, clearly shows the world's projections of the energy mix of up to 2035. Oil is the world's leading fuel accounting for approximately one-third of the total world energy consumption, [1]. As per the BP Energy Outlook, 2017, the world economy will double over the next 20 years with a yearly increment of 3.4%, led by

India and China. Even though renewable resources are growing, oil, gas and coal will account for more than 75% of the overall energy matrix by 2035. By 2021, oil demand had shot from 94.4 Mbbl/day in 2015 to 100Mbbl/day. Similarly, with an estimated increase of 1.6% [2], gas will replace coal as the second positioned source of fuel source by the year 2035. Meanwhile in Africa, the unexploited potential for unknown oil and gas resources is extremely formidable due to low exploration operations. Many areas, the likes of offshore East Africa, Gulf of Guinea and Congo basin are new frontiers that remain very attractive to the oil and

gas industry. Many new oil finds, were discovered, especially, during the 2003-2014 season of lucky strikes, where both old and new players made the list. Nations including the likes of Liberia, Cote d'Ivoire, Chad, Ghana, Togo, Sierra Leone, Nigeria, Senegal, Central African Republic, Sao Tome and Principe in the Gulf of Guinea, Angola, Mozambique, Tanzania, Uganda and Kenya. Consequently, Africa seems to be gripped with the 'Africa rising' fever.

B. Oil and Gas Explorations in Kenya

Oil and gas exploration in East Africa began in early 1930s by the British colonialists. It is only in the 1990s, [3], that the first few oil wells were struck amidst multiple obstacles. This was the commencement of the first series of oil explorations in Kenya led by Shell and BP. Mandera in the East, was the first stop of seismic surveys, gravimetric and aeromagnetic surveys, followed by Anza in the North and then Lamu in the South-East. While Mandera is onshore in the Tertiary Rift basin to the North-west, Lamu lies onshore. Upon the establishment of the Kenyan Petroleum Act in 1985, the next series of explorations began. Total and Amoco led the way with a sum of 15 wells. Their areas of interest were in Mandera and Anza basins. Their efforts bore little fruit since the oil and gas they discovered had no economic value.

In the year 2000, government sponsored geological explorations of oil and gas began in earnest in the Tertiary Rift basins and Lamu. This was the star of the third and current series of surveys for fossil fuels. Onshore oil discoveries in Uganda in 2006, [4], coupled with offshore gas discoveries in Mozambique and Tanzania and prevailing high global prices, a wide array of oil companies swiftly arrived on the Kenyan fossil fuels shoreline. Among them were firms like Africa Oil, Anadarko, Apache, BG Group, Centric, Cove Energy, Pancontinental, Premier Oil, Simba Energy, CNOC, Total, and Tullow Oil, (Table 1.1).

In late March 2012, Tullow Oil, a UK-based firm announced an oil find in Turkana, with the potential of 300 million barrels of oil. This reignited the hopes of Kenya becoming an oil producing nation. Since then, Tullow announced a further

discovery of 300 million barrels, hence bringing the total commercially viable reserves to 600 million barrels with a further potential for 1 billion barrels, [5]. Notably, the current discoveries remain limited to Lokichar area, in Turkana county, however, by the estimates of Tullow, [6] Kenya could hold as much as 10 billion barrels of oil. Furthermore, indications of slicks on the surface of Lake Turkana and oil seeps on its northern shore suggest that drilling in the lake is yet another potential oil play, (Figure 2). Tullow Oil Plc, in its profile reports, (2013, 2014) give insights into its oil exploration activities in Northern Kenya. Tullow spent a total of Kshs 23.4 billion (\$23.4 million) in 2013 alone, on their operations in Kenya, with the bulk of it on oil explorations in Turkana county, (Figure 2).

The consequences of these successful exploration and appraisal drilling activities in the last eight years (since 2012) for the oil and gas industry in Kenya, have been the evolvement and segmentation of the industry into three distinct sections: upstream, midstream and downstream. While the midstream and downstream sections have a fairly developed economic and technical ecosystem, the upstream is still in its nascent stage. Traditionally, the upstream segment of the oil and gas industry is made up of the exploration, drilling and production sectors. Despite the low level of drilling and cementing activities in the Kenyan oil and gas industry, in comparison with major world oil and gas producing nations, geothermal drilling has however been ongoing in Kenya.

A. *Table 1: The Summary of the History of Oil and Gas Industry in Kenya*

Period	Site	Outcome
1950s	Lamu bay and surrounding islands	Ten wells were drilled by BP and Shell Oil explorations companies, but none of the wells were fully evaluated or completed for production despite indications of oil staining and untested zones with gas.
	Mandera Basin	Photo geological field gravity,

	aeromagnetic and seismic surveys were conducted by the Frobisher Ltd., Adobe Oil Company and Burmah Oil Company but did not materialize into drilling programs	1991-1995	Lamu Basin	National Oil Cooperation of Kenya (NOCK) initiated an in-house study of the Lamu Basin as part of a long-term strategy to re-evaluate the existing geological, geophysical and geochemical data relating to each of the sedimentary basins in Kenya. Lamu embayment (both onshore and offshore) was divided into ten (10) exploration blocks, each with a specific exploration play. New interests were generated and new entrants into the exploration industry
1975	Lamu Basin	Explorations conducted by Texas Pacific in 1975 encountered oil and gas shows in the Cretaceous rocks		
1976	Anza Basin (Anza-1 and Bahati-1)	Explorations conducted by Chevron and Esso companies. Hydrocarbons and microfossils were suspected from the drills		
1982	Lamu Basin offshore portion (Simba-1, Maridadi-1 and Kofia-1)	A consortium of Cities Services, Marathon and Union exploration companies conducted Seismic data revealing that salt diapiric structures were present along the Kenyan margin/coasts	2000-	Tertiary Rift Valley
1986	Garissa-1 , Kencan-1	Joint venture between GOK and Petro-Canada International Assistance Corporation	2010-	Tertiary Rift Valley (Turkana)
8 wells drilled in Anza Basin and Mandera Basin (i.e. Ndovu-1, Duma-1 and Kaisut-1 etc.)	Consortium led by Amoco and Total Exploration conducted surveys in many parts of North Eastern Kenya (Anza and Mandera). The wells were dry but with indications of oil and gas			NOCK Tertiary rift study led to quantification of potential source and reservoir rock units in the study area as well as the petroleum system at play in the sub-basins
Eliye Springs-1 and Loperot-1, located west of Lake Turkana in a Tertiary Rift Basin.	Shell Company explorations encounter wells with non-commercial reserves, but it was believed that the explorations weren't deep enough	2010-2016		Tullow Oil Kenya makes major oil discoveries in Turkana in 9 confirmed commercially viable wells

B. (Source: National Oil Corporation of Kenya, 2016)

II. REGULATORY ECOSYSTEM

Kenya as a nation has a number of legal and regulatory instruments meant to govern the oil and gas industry. In the mid-1990's, the Electric Power Act of 1997 was enacted, shortly followed later by the Energy Act of 2006. Later, all the legislation affecting the energy sector was congregated into the Energy Act of 2006, and the Energy Regulatory Commission (ERC) was established as the legally mandated regulator of the energy sector. Initially, the petroleum sector had been regulated through the Petroleum

(Exploration and Production) Act of 1994 and the Petroleum Development Fund Act 1991.

A. Oil and Gas Sub-Sector:

The oil and gas sector, especially the upstream (exploration) sub-sector, however, has its own unique objectives, some of which include:

- ✓ Enhancement of exploration for fossil fuels especially hydrocarbons through subdivision of exploration acreage into smaller blocks and collection of additional geological data to attract more oil prospecting companies. This has been ongoing, especially in the Northern country and Lamu basin.
- ✓ Strengthening of regional and interaction cooperation to promote data and information exchange on oil exploration.

Petroleum Act

The Petroleum Act, 2019, (Part IV), Section 22, Section 23 and Section 24, regulate on exploration activities in Kenya. Section 22 handles application for non-exclusive exploration permit, Section 23 deals with granting of non-exclusive exploration permit while Section 24 outlines the ground for operational permits. The legal framework in Kenya need to be robust [7] especially at this tender age of the oil and gas industry. The Kenyan government needs to remain cognizant of the need to establish an effective governance framework for this sector. He asserts further that, this would go a long way in averting the perennial, ‘resource curse’ that has bedevilled many nations across the globe.

Kenya remains a signatory of several global conventions on the extractive industry. The oil and gas industry therefore abides with the International Finance Corporation (IFC) and World Bank Group (WBG) guidelines and policies, performance standards and directives for this industry.

The IFC Environmental, Health and Safety (EHS) Guidelines provide technical guidance, performance levels and measures considered to be achievable at reasonable cost using existing technology. Relevant guidance includes the EHS

General Guidelines (IFC, 2007), the EHS Guidelines for Onshore Oil and Gas Development (IFC, 2007b), EHS Guidelines for Crude Oil and Petroleum Product Terminals (IFC, 2007c), EHS Guidelines for Natural Gas Processing (IFC, 2007d) and the EHS Guidelines for Water and Sanitation (IFC 2007e). Furthermore, the Extractive Industries Sourcebook offers detailed guidance on improving transparency and accountability, including dealing with challenges and special issues, such as entrenched interests. The World Bank Group also has an extended series of operational policies (OPs) and bank procedures (BPs) relating to the conduct of the Bank’s operations. These generally mirror the intent of the IFC PS

III. UPSTREAM – EXPLORATION

A. National Oil Company of Kenya (NOCK)

Globally, most governments have set up national oil and gas companies that operate oil and gas operations in their nations on behalf of their governments, [8]. In the same vein, in Kenya, the National Oil Corporation of Kenya plays this vital role. It was formed in 1981, as a fully integrated State Corporation involved in all aspects of the petroleum supply chain covering the upstream oil and gas exploration, midstream petroleum infrastructure development and downstream marketing of petroleum products.

The international duty and role of national oil firm, has continued to transform as the world energy landscape metamorphoses to reflect trends in demand, discovery of new ultra-deep water oil and gas deposits, global geopolitical developments and supply. NOC's traditionally perceived as the custodians of each nation's natural resources, have generally owned and managed the entire national oil and gas value chain from upstream to downstream operations.

In the upstream segment NOCK aids, facilitates and actively participates in oil and gas exploration operations in Kenya. National Oil, therefore, is tasked with the marketing of Kenya's exploration acreage, management of gas and

exploration data and the running of the National Petroleum Laboratory among other attendant responsibilities. National Oil is stands counted as one of the few African national oil companies directly involved in the search for oil and gas resources. National Oil operates its own exploration acreage in Block 14T which is located within the Tertiary Rift Basin and runs from the shores of Lake Bogoria down to Lake Magadi Basin in the south of the country. National Oil has been in the process of setting up a Seismic Processing Center and a Geochemical-Petrophysical analysis laboratory within the new premises in Kawi House, South C, Nairobi.

Kenyan state firms have had a tough ride in the stormy waters of efficient management. Several studies allude to this malady, [9, 10, 11, 12, 13]. These investigations identified and established challenges of strategy formulation and implementation in the oil and gas industry in Kenya with special emphasis on National Oil Company of Kenya. Their research demonstrates that strategy implementation challenges in the petroleum industry in Kenya has both a relationship to global oil industry factors and state regulatory legal statutes. Consequently, no single strategy is able to confront decline in business performance especially for state firms. Additionally, the research findings indicate that challenges of strategy implementation can be addressed appropriately through use of proper resource allocation and prioritization, appropriate technology, involvement of stakeholders, safety regulations, adoption of reward systems and strategic partnerships since they impact brand visibility and growth, improve technological capacity, enhance financial capacity and facilitate knowledge transfer.

While many national oil companies around the globe are evolving not only into joint venture partners with global major oil firms, but are increasingly becoming major global players themselves, thus setting up stiff competition with the traditional international oil companies, [8]. It is intriguing that; the Kenyan NOCK has been progressing in the opposite direction. By 2020, NOCK was ailing economically, [14]. As per the report by Leadwood Energy and Kurrent

Technology consultants, the state could either pump in more cash (up to \$74 million) into the corporation or seek an investor to take over the assets of the firm. And the state didn't think of bailing out the firm. In 2021, NOCK's creditors sued it, [15]. Just when the discovered Turkana oil needed a national player to manage it on behalf of the state, the firm becomes admitted in ICU with a chronic economic virus at the proverbial age of forty years. The Office of Auditor-General Report of April 2020, clearly put NOCK in the red. According to the report, NOCK's assets were meagre \$ 69 million while its liabilities stood at a whopping \$ 227 million, confirming it as insolvent, [16].

B. Exploration:

Hydrocarbon exploration (or oil and gas exploration) is the search by petroleum geologists and geophysicists for deposits of fossil fuels, particularly oil and natural gas, in the Earth using petroleum geology, [17]. Exploration involves the use of various methods in the search for oil and gas reserves. These includes seismic acquisition, magnometric surveys, aerial surveys, etc.

I) Methods of Oil and Gas Exploration

Reference [18] observes that seismic acquisition leads to acoustic emission and accidental spills of chemicals that pollute the offshore marine ecosystem. This research conducted in the Norwegian seas also established that seismic shooting could cause fish to travel tens of miles, with some never returning unless after a few weeks. As for onshore locations, these seismic data acquisition usually demand vegetation clearance of large areas for accessibility of Vibroesis and other seismic equipment. Admittedly, this is even more profound in mangroves and forests.

Exploration in Kenya hasn't been as active as in most oil and gas producing countries. Reference [19] in their study of hydrocarbon prospectivity in Mesozoic and Early – Middle Cenozoic Rift Basins of Central and Northern

Kenya, East Africa," zeroed in on the northern (NKR) and central (CKR) segments of the Kenya Rift as being among the most important areas of the East African rift system for hydrocarbon prospecting because they offer the oldest and longest lived sedimentary basins. Further, they represent a crossover area between Cenozoic and Cretaceous rifts. During the 1970s and 1980s, the Turkana depression and the northeastern region of Kenya were the areas of interest to exploration firms. The then analogue technology of seismic reflection surveys and several exploration wells enabled the identification of several deeply buried basins: (1) In the NKR, three strings of north-south-oriented half grabens, the oldest known basins being of Cretaceous–Paleogene to middle Miocene age; (2) In the CKR, two north-south half grabens, the Baringo-Bogoria Basin (Paleogene–Present Term), and the Kerio Basin (Paleogene–upper Miocene). All basins are filled by up to 8 km (5 mi) thick sediments of alluvial, fluviodeltaic, or lacustrine origin and volcanics of late Eocene to Neogene age.

Recent research has focused on reservoir and/or source rock quality in several of these basins. Arkosic sandstones in CKR or NKR showed a fair to good reservoir quality of hydrocarbon potential, with a porosity of up to 25%. Tectonic activity and hydrothermal fluid circulation associated with volcanism catalysed strong changes in form of diagenetic alteration and changes in sediment source. Excellent quality formations were deposited in freshwater lake environments under a tropical climate. Such environments have been identified during the Paleogene in the NKR and lower Neogene in the CKR. Therefore, the joint results of source rock and reservoir characteristics provided for a provisional classification of each studied basin, terming them from very high to medium potential for hydrocarbons.

In assessing the hydrocarbon potential in the key basins in East Africa, the evolution and sedimentary filling characteristics of regional structures in sedimentary basins were soberly explored, [20]. The study discusses the geological conditions of hydrocarbon accumulations. i.e. the source rock, reservoir, the caprock, and their

exploration potential on the East coast of Africa. Apparently, these basins are superimposed basins developed on the Precambrian basement, that were successfully fulfilled with three sedimentary sequences, i.e. the late carboniferous – early Jurassic intra-continental sedimentary sequence, the mid/late Jurassic – early Cretaceous intra-continental weak rifting sedimentary sequence, and the late Cretaceous – Neogene passive margin marine sedimentary sequence. All the three, even though with different source – reservoir caprock assemblages they show good prospects for exploration. They did comprehensive comparisons and analyses on such geological conditions in six basins, (Somalia, Lamu, Ruvuma, Tanzania, Mozambique and Morondova). They suggest that the basins highly potential for superior geological conditions, such as excellent source rocks, caprocks and good preservation are the ones in Tanzania, Ruvuma and Somalia. In their conclusion, the Mozambique basin is also favorable for exploration, but not the Lamu and Morondova basins, since these are unacceptable, (Table 3.2). These findings contradict what international oil companies have been discovering of late in the area. The Somalia basin is hasn't shown any commercially viable finds, yet. Meanwhile, the Lamu basin has seen some discoveries of gas, and the Kenyan government has approved further explorations, [21].

Table 3.2 - Evaluation Table of Geological Conditions of Hydrocarbon Accumulation for Key Basins in Coastal Area of East Africa – Lamu.

Basi n	Sour ce Rock	Capro ck	Later Structural Transforma tion	Comprehen sive Evaluation Level
La mu	Bad lacki ng	Comm on	Common strata in the west suffer from erosion, with medium development degree of	III

fault	
(Source, Zhou, 2013)	

The study of qualitative fatty acid and n-alkane stratigraphy of the Lake Turkana Basin for correlation of isolated sedimentary strata, has been done, [22]. The results of this study indicate that most of organic matter present was derived from terrestrial plant waxes. And in sediments where extensive diagenesis has occurred, microbial input of organic matter may have been substantial. Additionally, the fate of the original paleosol organic matter has been governed to some extent by weathering processes. Weathering decreased the amount of extractable lipids, particularly fatty acids and the low molecular weight alkanes (C₁₇-C₂₀); produced or retained relatively large amounts of alkanes greater than C₂₁ within a unimodal distribution; and lowered CPI values. Consequently, stratigraphic correlation by unique alkane and fatty acid distributions has been confined to short distances (many meters). Both n-alkanes and fatty acids have been retained better by association with clay minerals than by sand matrices. The alkane distribution of sandstones differs from that of clay organics in having a narrower carbon chain length distribution and lower CPI values.

For years till 2013, a slight drop in the scientific research of oil and gas exploration was recorded in Kenya. As of June 2014, the state agency in charge of oil and gas exploration, the ministry of petroleum and mining, issued several licenses to firms that desired to conduct oil and gas exploration in Kenya, (Table 3.3).

Table 3.3 Licensed Petroleum Exploration Companies in Kenya as of June 2014.

No.	Exploration Companies	Exploration Block Nos	No of Blocks
1	Tullow Oil Corporation	10A, 10BB, 10BA, 13T, 12A & 12B	6
2	Anardarko	L-5, L-7, L-12, L-11A, L-11B	5
3	BG Group	L-10A, L-10B	2
4	Ophir/Dominion	L-9, L-5	2

5	Apache (now withdrawn)	L-8	1
6	Vanoil Resources	3A, 3B	2
7	Africa Oil Corporation	10BB, 13T	1
8	Zarara	L-4, L-13	2
9	FAR/Flow Energy	L-6	1
10	Lion Petroleum	2B	1
11	NOCK	14T	1
12	Simba	2A	1
13	Afren	L-17/L-18, 1	3
14	A-Z Petroleum	L-1A, L-3	2
15	CAMAC Energy	L-1B, L-16, L-27, L-28	4
16	Rift Energy	L-19	1
17	Imara Energy Corp	L-2	1
18	Adamantine Energy Ltd	11A	1
19	Pacific Seaboard Investments Ltd	L-20	1
20	ERHC Energy Inc.	11B	1
21	Lamu Oil Exploration	L-14	1
22	Total Kenya B.V	L-22	1
23	ENI Spa	L-21, L23, L-24	3

(Source: KCSP OG, 2014).

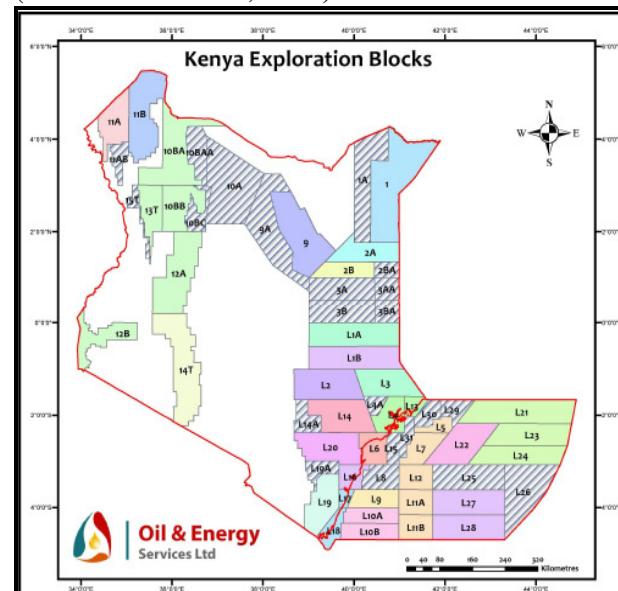


Figure 1.1. Current Kenya exploration blocks.
(Source: Oil and Energy Services Ltd, year)

The need for more exploration in the four basins is crucial to give a clear picture of Kenyan fossil fuels' reserves. Pancontinental (one of the licensed international Australian oil companies operating in Kenya in partnership with the British Tullow Oil) claimed prospective resources of 3.7 billion barrels of oil or 10.2 trillion cubic feet (bcf) of gas in Lamu Basin after drilling to a depth of 2,553 meters and hit 52 meters of gas [23]. This ultimately cancels the earlier myth, [20]. Despite low exploration activity levels, a few cases are ongoing.

In May 2020, Zarara (A British oil and gas fully-owned subsidiary firm owned by Midway Resources International – MRI) received the National Environmental Authority approval to drill for commercial gas in Lamu. At an approximate bill of \$159 million and a duration of 120 days, Zarara contracted Great Wall Drilling rig for the project [24]. By the late April 2021, fresh exploration operations and activities were being approved in Kenya. Among the beneficiaries of these approvals was an American firm, ION Geophysical Corporation, based in Houston, Texas. It was awarded a license to explore and quantify the oil prospects in Lamu basin, specifying mandatory seismic surveys, – one 3D and the other re-imaging old 2D data, [25]. The total recoverable reserves in Kenya, as at the end of 2018, were estimated to be 1.3 billion cubic feet (Bcf) of natural gas and 870 million barrels (MMbbl) of oil (totaling 1 billion barrels of oil equivalent [Bboe]) in 21 undeveloped discoveries in the Lamu Basin, the Lokichar trough in Turkana (East Africa Rift System) and the Anza Basin in Mandera.

Oil exploration in Turkana has brought with it numerous environmental queries, a plethora of political issues, an assembly of social challenges and both internal and external risks, [26, 27, 28, 29, 30, 31]. Apparently, the need for long-term sustainable actions with the full involvement of all actors from four sustainable domains – political, economic, ecological and cultural pillars is clearly revealed. Additionally, the studies demonstrate that

organizational changes adopted by exploration and production firms, should be based on reducing the impact of risk factors.

These observations are confirmed by the research work on oil and gas exploration and sustainable environmental management in oil block 13T South Lokichar Basin, Turkana county, Kenya, [32]. In an attempt to determine the effects of oil and gas exploration on biophysical and socio-economic environments in Oil Block 13T South Lokichar Basin, Turkana South-sub-county, the study obtained several sustainable environmental management strategies in the oil fields. Furthermore, gaps in the existing environmental policy and legal framework in relation to the oil fields environmental management coupled with poor enforcement of the laws by the right statutory agencies, were identified.

The study, however, noted enhanced socio-economic characteristics, physical and social infrastructures in the study area. Indeed, 70% of the respondents highlighted the changed status water provision, health facilities, education facilities, employment opportunities had improved since oil and gas exploration began. Admittedly, some issues arose such as lack of adequate engagement of the locals, population influx, land displacement, gender inequalities, increased number of conflicts cases since 2012 and health challenges of the locals. The study suggested adoption of latest oil drilling and drill waste management technologies, enforcement of the existing environmental legislations and development of oil specific environmental laws, as well as participatory environmental management approach in the oil fields.

For any successful oil and gas exploration and production in Kenya, then every stakeholder must sustainably participate and engage in the social, ecological, political and economic domains, [26]. This notion is confirmed by [33] who sought to understand the influence of institutions and the location of oil and gas explorations. The study demonstrated that institutions shape exploration companies 'incentives to invest in drilling as well as host countries supply of drilling opportunities. Additionally, the study assert that the observed distribution of natural capital across countries is

endogenous with respect to institutions and for governments it is an important message that promising geology may not be sufficient to attract oil exploration. Even so, where governments can improve the institutional environment, they will consequently accelerate discovery and increase their country's level of natural capital.

In examining the determinants of petroleum exploration, the influence of oil exploration and why oil companies should explore in Turkana at all, [34, 29, 35], it was observed that several factors come into play. They include the need to enhance the investment ecosystem in terms of provision of proper legislation and regulation, transport network, dispute resolution mechanisms, security, investment funds, supply of trained human personnel, clear oil and gas policies while putting the interests of the local community first. These observations are in line with the conclusions drawn by [31], who established that the operational efficiency of oil and gas exploration firms can greatly increase when local content, infrastructure issues, community issues and security issues are adequately addressed.

IV. CHALLENGES

A. Information Gap:

Article 35 of the Constitution of Kenya 2010, guarantees access to information, as a fundamental right enshrined in the Kenyan constitution. This is imperative to enable citizens to make informed decisions, to take part in decision-making processes and to hold those in authority accountable. Even more important for the extractive industry (where oil and gas sector falls), access to information is necessary to enhance transparency and accountability, public participation and good governance. In Kenya, the scenario is on an ad-hoc and roller coaster trend. As per the Kenya Mid-Term Report (2016-2018),[36], there was no progress made on the release of information, contracts nor financial information on oil and gas operations in the country. The case example of Niger Delta in Nigeria clearly highlights how failure to integrate access to information as a component of transparency and accountability in

the Extractives Industry leads to regenerative resource curse, unparalleled environmental pollution and disastrous ecological degradation, unending armed conflicts, inflation leading to high costs of goods and services and corruption, [37].

B. Resource Curse:

Reference [38] in his recourse curse theory, argues that dependency on natural resources like oil may lead to conflicts [39,40,41] or not [42]. Additionally, the theory amplifies that the conflict may be non-ethnic, [43] and may as well nurture other variables such as corruption, weak rule of law of even a weak economy. On the contrary this causal relationship can also swing in the opposite direction, [44]. Therefore, oil drilling in Turkana can possibly lead to community greed for enrichment and grievances about social exclusion, relative deprivation and inequalities like ethnic divides [45] which can lead to amplified conflict, [46]. This was witnessed, [47] in 2020 when the Early Oil Pilot Scheme began to transport crude oil in iso-heated road tankers from Lokichar in Turkana to the coastal city of Mombasa. Ultimately, all these theories call for well-designed resource management and benefit sharing for inclusive development.

The Nigerian oil boom, for instance, triggered massive urban migration, which drastically reduced the size of the rural labour force, [48]. This in turn led to a fall in production and therefore a rise in food prices. A similar projection upon Kenya would be disastrous: 70% of Kenya's labour force job's would be a risk as agricultural products would become very expensive for the global market and any job losses would only add to the current 40% unemployment. Ultimately, would arm-twist the state to support a huge unemployed population, at a time of rising food prices

C. Legal Ecosystem:

Both Tanzania and Mozambique have discovered huge amounts of gas. The underlying geological formations and exploratory studies confirm the same bed in the Lamu basin.

Admittedly, despite the potential of natural gas, the current level of exploration in Kenya remains biased towards oil to the detriment of gas, due to the current legal framework governing the issue of gas explorations remains gray.

Gaps in environmental legislation on environmental protection during exploration and production of oil and gas in Kenya abound, [49]. In assessing transparency in the management of oil and gas blocks by reviews of the Kenya legislative framework, [50] this gap is affirmed. The study opines that having a transparent licensing regime on oil and gas blocks in a country diffuses avenues of corruption and potential conflict between the community and the IOC and or the state.

This gap in legislation is confirmed by NEMA itself in its assessment of Kenya's readiness in dealing with oil and gas environmental issues. These issues can be categorized into two groups:

- 1) The first lot deals with issues that are hazy or lie in gray areas as per the environmental guidelines on oil and gas disposal
- 2) The second lot of issues deals with those that lack regulation to evaluate, guide and monitor them.

In the first instance, we have the following gaps on:

- a) Methods of treatment of non-hazardous waste
- b) Specifications on equipment for treatment of non-hazardous waste.
- c) Methods of monitoring discharges to the environment
- d) Tracking of hazardous waste.
- e) Oil dispersant use policy.

In the second case, we have:

- a) Kenyan laws do not regulate the produced sand, completion and well work-over fluids and naturally occurring radioactive materials
- b) Water Quality Regulations do not provide sufficient requirements and methods for disposal of Liquid Effluents derived from the

petroleum sector, except for discharge into water bodies and sewage system.

- c) Underground disposal for contaminated oil and gas products isn't available.
- d) Soil contamination by oil and gas materials isn't provided for in the Kenyan law.
- e) Kenya doesn't have legislation applicable to deck drainage systems for removing oil containing fluid from an offshore facility.
- f) Current regulations entice procedural alterations of processes to produce less waste, but do not offer suggestions or incentives.
- g) Most of Kenya's requirements on waste apply to hazardous – as opposed to non-hazardous – waste. Thus, it fails to impose a number of restrictions non-hazardous waste that are in place in other jurisdictions.
- h) Kenya's legislation only allows for the possibility of disposing of production waste by shipping it to a licensed facility. This is a limitation, that hinders such other variants like underground injection.
- i) For drilling muds, current regulations make no provisions for the use of oil-based, synthetic-based, or water-based drilling muds. Most jurisdictions restrict or prohibit the use of synthetic or oil-based drilling muds for both on- and offshore operations.
- j) Lack of details on the disposal of drilling fluids and cuttings beyond "best petroleum industry practice".
- k) NEMA or any other regulator does not have monitoring or reporting requirements for drilling fluids or muds.
- l) Water Quality Regulations discusses discharges into sewers. However, there are no limitations placed on oil waste, which might meet with opposition from the public, even if treated as required for all industrial facilities. Furthermore, water quality regulations do not recognize specific waste waters that are common in all the three segments of oil operations. Therefore, application of Water Quality Regulations to petroleum sector may be challenging.

D. Human Resource:

Human capital remains an area of great concern for the oil and gas industry in Kenya. According to the World Economic Forum, Kenya ranks dismally in the development of future skills (101 out of 130 countries) and the in the use of specialized skills at work (74 of 130), [51]. In the report *Executive Briefing on the Future of Jobs and Skills in Africa* (2017), Kenya captures only 58% of its full human capital in comparison with South Africa (63%), Ghana (64%) and Mauritius (67%). Additionally, the reports records that 30% of employers in Kenya are citing inadequately skilled workforces as a major constraint to business expansion. Indeed, Tullow Oil cited this growing skills gap as the main reason for not hiring local talent in its workforce. This challenge is extreme in technical and vocational skills like pipeline design, welding, repair of heavy equipment, drilling etc. Despite the country having relatively good engineers, a majority of them aren't skilled to operate in this sector.

The approach of how the skills gap in Ghana was tackled, is an apt example for the Kenya oil and gas industry. In both countries, Tullow operates oil and gas activities. In 2013, Tullow Oil led the Jubilee Partners to set up a \$15 million state-of-the-art training centre at the Takoradi Polytechnic, Ghana. This is a public-private initiative aimed at addressing the skills gap in technical and vocational education in the oil and gas industry, [52]. The initiative is further supported by an education foundation established by the Ghana National Petroleum Corporation and the World Bank provided further support by donating \$4.7 million fund to support training in relevant engineering fields. [53]. In Kenya, Tullow Oil has, together with Africa Oil Corporation, established a polytechnic in Lodwar to provide oil and gas training to Kenyans, [54]. Lodwar Vocational Training Centre (LVTC) - The LVTC, constructed and equipped by Lundin Foundation and Africa Oil Corp in collaboration with Turkana County Government, is at the forefront in improving the availability and quality of technical and vocational education within Turkana County.

The World Bank Report No. 85714 (2014) shows how the lack of specialized expertise is a major bottleneck obstructing the potential for more well paid jobs and home grown supplier firms in the oil and gas industry in Africa. Further, it highlights the crucial skills shortages that exist both in terms in numbers and quality, particularly within the technical and technological fields and recommends the establishment of regional centers of excellence through Public-Private partnerships as a key in building these specializations. It is therefore highly recommendable that more capacity in forensic audit and enhancement of legislation and cooperation between state agencies be implemented to keep up with the growing needs of the oil and gas sector, [55]. The Kenya Revenue Authority for instance has only six staff members in its extractives unit. Therefore, for the 10 active PSCs, this is approximately 2 staff members for each license, which is at par with emerging economies, [56]. The department has received training from the IMF, World Bank, the Norwegian Agency for Development Cooperation (NORAD), plus the Australian government, [57].

E. Security:

Globally, security has been one of the most common challenges facing the oil and gas industry. This is due to the substantial change that communities have to undergo once oil or gas has been discovered. Land loss and other insecurities may intensify with oil extraction [58, 59, 63], igniting ugly confrontations with the Pokots. Insecurity has further increased because of the perceived unfair distribution of wealth and job opportunities; the new roads benefiting cattle rustlers; and because former community guards and the Kenya Police Reservists are now protecting Tullow Oil instead of the community.

Meanwhile, these oil and gas confrontations are not limited within the internal boundaries of Kenya, but have rather spilled to the international arena, with Kenya withdrawing from an important hearing at the International Court of Justice (ICJ) on its maritime boundary dispute with Somalia, [60]. The dispute is

based on a triangular piece of maritime area believed to have oil and gas reserves. The Oxford Institute for Energy Studies (2014) conclude in their report that if Kenya is to become the transit hub of East Africa's oil boom, it must strive for relative stability and security are paramount matters that must be tackled in the entire Northern frontier regions

F. Environment:

According to NEMA, waste management is mostly the responsibility of county governments, [61]. However, these authorities have neither prioritized this duty nor allocated sufficient resources for effective implementation.

With the onset of climate change issues looming over the oil and gas industry, balanced decisions need to be made. Inclusive development for developing nations who have recent oil discoveries is sufficiently addressed, [62]. This paper concludes that (a) Kenyans have a right to extract and use oil resources and that rich countries should reduce their extraction and use; (b) such a claim could be integrated in an appropriate emissions trading scheme; and that (c) Kenya should also account for the national and local socioecological aspects to reduce potential local conflict, question of climate change, phasing out oil and gas resources may lead to abandoned assets in both developed and developing nations, which in turn will leave developing nations poorer since abandoned assets are more expensive than abandoned resources.

V. RECOMMENDATIONS

This paper has therefore explored the exploration of oil and gas resources in Kenya. And indeed it has shown that this industry can either uplift a nation to very high standards of living or shove an entire community into the gallows of poverty unknown to mankind. It thus, without prejudice, recommend the following measures as critically necessary:

- a) The legal and regulatory landscape in Kenya is rich and diverse. It is robust enforcement of the

law and regulations that should be executed in all the upstream sub-sectors (exploration, drilling and production) of the oil and gas industry in Kenya. This will be the white smoke for international investors that the climate is right and the dividends will be fat.

- b) Sufficient standard investments in the training institutions with an aim of producing a knowledgeable human personnel able to manage, evaluate, monitor and operate the oil and gas industry in all the three sectors.
- c) Intense, efficient and effective public campaigns on the rights of citizens and their sober expectations from the extractive industry, should be enshrined, enabled and empowered in the law of the nation.
- d) Civil societies, non-governmental organizations and community forums should engage international oil companies and national oil companies' in their home jurisdictions (for instance, the Nigerian Shell firm was successfully sued in a Dutch Court, etc) while monitoring the specific roles and duties of all stakeholders and raising alerts and red flags over duplicity and duality for purposes of individual accountability.

VI. CONCLUSION

This paper reviewed the latest studies undertaken by various researchers in oil exploration in Kenya and an attempt has been made to compare and contrast their results. The paper, therefore concludes that if Kenya so desires to utilize its scarce and finite resource of oil and gas in a manner similar to Norway, then, it has a great chance of emulating, the real practices adopted and industry-proven over the years by simple adherence to legislation. Only then, will the Dutch disease die a natural death in Kenya.

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