OIL DRILLING AS A CORRELATE OF THE PREVALENT CLIMATE CHANGE IN NIGERIA

Enobong JAMES, *Ph.D*, FCE
Fuel Operations, Quit, UN Logistics
Mobil Producing Nigeria Unlimited

ABSTRACT

This paper carefully assessed oil drilling as a correlate of the prevalent climate change in Nigeria. Oil drilling is the boring of the earth that is designed to bring petroleum oil hydrocarbons to the surface. The paper provided the concept of oil drilling, noting that it is the process by which tubing is bored through the Earth's surface and a well is established. It also gave an explanation of the concept of climate change, oil drilling technique, the effect of climate change and control of exploitation, which were used as the concept of oil drilling to produce repetition. It was on this basis that the paper concluded that oil drilling contributes to climate change by causing pollution, upsetting wildlife, and destroying public areas that were set aside for people's benefit. As a result of continuous human-caused climate change, climate change impacts include those on the physical environment, ecosystems, and human civilization. One of the recommendations was that the management of oil companies should try as much as possible to understand the plight of the host communities and ensure that their oil exploration is effectively controlled in order to avert the devastating effects of it.

KEYWORDS: Oil Drilling and Climate Change.

Introduction

Oil drilling is the boring of the earth that is designed to bring petroleum oil hydrocarbons to the surface. Usually, some natural gas is released as associated petroleum gas along with the oil. This is where an oil well is required to be drilled. The oil well is created by drilling a long hole into the earth with an oil rig (Geller, 2020). A steel pipe (casing) is placed in the hole to provide structural integrity to the newly drilled well bore. Holes are then made in the base of the well to enable oil to pass into the bore. Finally, a collection of valves called a "Christmas tree" is fitted to the top; the valves regulate pressures and control flow. The drilling process comes under "upstream," one of the three main services in the oil industry, along with mid-stream and downstream. However, peak oil and climate policy for fossil fuels have made fewer and fewer of these wells and expensive techniques viable. Oil drilling has a serious impact on our wild lands and communities (Geller, 2020). Drilling projects operate around the clock, generating pollution, fueling climate change, disrupting wildlife and damaging public lands that were set aside to benefit all people. Climate change, on the other hand, is directly linked to fossil fuels that release heat-trapping gases into the atmosphere. While we are all impacted, black, brown, Indigenous, and working-class communities are feeling the heat quite literally. Due to unjust housing policies and practices, these communities often live in treeless, concrete neighbourhoods that are more susceptible to extreme weather events. These groups also have a harder time accessing natural landscapes that can help mitigate climate impacts. First of all, the burning of oil, coal, and natural gas releases greenhouse gases into the air, which (as I'm

sure you know) contributes to global warming. Secondly, the process by which oil is extracted from the earth is highly detrimental. Fracking, as an example, can cause earthquakes, leach dangerous chemicals into the ground, contaminate sources of precious drinking water, and send nasty, cancer-causing contaminants into the air (Masson-Delmotte, Zhai, Pirani, & Connors, 2021).

Concept of Oil Drilling

Oil drilling is the process by which tubing is bored through the Earth's surface and a well is established. A pump is connected to the tube, and the petroleum under the surface is forcibly removed from underground. Oil drilling is a highly-specialized business that grew into the largest industry on the planet by the early 21st century. The first oil drilling occurred in China during the 4th century. It expanded throughout Asia and the Middle East by the 8th century. Marco Polo reported to Europe the volume of oil drilling that existed in the East during the 13th century. Until the late 19th century, oil drilling only occurred where the oil was readily available near the surface. Edwin Drake created a method of drilling using pipes that allowed for deeper exploration and prevented the collapse of the borehole. This method is still used today. The standard oil drilling process is conducted by boring a hole between 5 and 36 inches into the earth. A drill string is used, which is a series of tubes put together that continue to dig deeper until oil is found. On the basis of safety, it is noted that cement is generally placed on the outside of the drill string in an effort to prevent the borehole from collapsing. This also helps prevent a loss of pressurization, which can lead to a possible explosion or collapse. This is accompanied by back pressure holes being drilled. Due to its efficiency, the drill bits vary greatly depending on the type of rock that is being drilled through. To make the work easier, drilling fluid is pumped down into the piping. This complex mixture of chemicals and mud brings rocks to the surface and keeps the drill bit cool.

Concept of Climate Change

Climate is the average of the weather conditions at a particular point on the Earth. Typically, climate is expressed in terms of expected temperature, rainfall, and wind conditions based on historical observations. Climate change is a change in either the average climate or climate variability that persists over an extended period (Turner, Calder, Cumming & Hughes, 2020). The Earth’s climate has always changed. Changes in the Earth’s orbit, the energy output of the sun, volcanic activity, the geographic distribution of the Earth’s land masses, and other internal or external processes can influence the climate. Scientists refer to this type of long-term climate change as "natural climate change." As a result of natural climate change, the Earth has experienced regular cold periods (or ice ages) in the past, when glaciers covered large parts of the Earth’s surface. The Earth has also experienced warmer periods when sea levels were much higher than they are now. In the Earth’s long-term history, the current period is characterised by a relatively warm, stable climate that has lasted since the end of the last ice age about 11,700 years ago. This period is known to geologists as the Holocene and is the period during which human civilisation has flourished (Bagley, 2013). If this were the only type of climate change, sociologists would be uninterested. However, scientific observations and models indicate that the Earth’s climate is now changing due to human activity. This is termed "anthropogenic climate change". The processes involved are complex but can be summarised as follows. Human activities, such as burning fossil fuels (coal, oil, and natural gas) to make electricity and

power vehicles, clearing forests for farms and cities, and cultivating livestock, release "greenhouse gases" into the atmosphere. The main greenhouse gases are carbon dioxide, methane, halocarbons, and nitrous oxide. These gases accumulate in the atmosphere and allow radiation from the sun to pass through, but trap some of the heat radiating back from the Earth. This is called the "greenhouse effect" because the principle is similar to that of a greenhouse, where the glass roof allows sunlight in but traps heat for growing plants. Over time, the enhanced greenhouse effect results in "global warming"—an increase in the Earth's average temperature (Turner et al., 2020). Global warming is one type of climate change, and it drives other changes in the climate, such as changes in rainfall patterns and the frequency and distribution of weather events such as droughts, storms, floods, and heat waves. Although the terms "climate change" and "global warming" are often used interchangeably, "climate change" is a broader term that incorporates both global warming and other observed changes in the climate. Many scientists argue that the impacts of climate change will be devastating for natural and human systems, and that climate change poses an existential threat to human civilisation.

Climate change is a long-term shift in the average weather conditions of a region, such as its typical temperature, rainfall, and windiness. Climate change means that the range of conditions expected in many regions will change over the coming decades. This means that there will also be changes in extreme conditions. The climate varies naturally from year to year and decade to decade. This is caused by natural processes linking the atmosphere, ocean, and land, as well as variations in heat output from the sun. In addition to changes in climate that are caused by natural climate variability, climate change can also be caused by human activity (Rogelj, Shindell, Jiang & Fifta, 2018). The kind of climate change we are experiencing now is being caused primarily by these human factors. Climate change is also of interest to sociologists because the activities that are responsible for anthropogenic climate change are embedded in human social life. Everyday social practises like eating, working, moving about, and heating and cooling our homes result in emissions of greenhouse gases that contribute to climate change. Further, the causes and impacts of climate change are unevenly distributed, raising questions of social justice. In general, wealthier countries produce more greenhouse gas emissions per person than poorer countries, whereas poorer countries tend to be more vulnerable to the impacts of climate change. Proposed responses to climate change also have social impacts that are unevenly distributed. Consequently, climate change poses the first truly global social dilemma, and it is one that has proven politically intractable at multiple governance scales (Rogelj et al., 2018).

Oil Drilling Techniques

Oil and gas exploration makes use of several types of drilling methods and platforms based on the type of formations, geographic location, soil type, and the like. Here are five of the most common drilling methods used in extracting oil and gas from beneath the earth:

• **Percussion drilling:** is employed when auger or wash boring is not possible in very stiff soil or rock. It's a manual drilling technique that was used in the first well drilled in North America. It can also be used in most soil types. Here, the advancement of a hole is achieved by alternatively lifting and dropping a heavy cutting or hammering bit that is attached to a rope or cable that is lowered into an open hole or inside a temporary casing (casings are hollow cylindrical pipes

used for borehole stability and to prevent the loss of drilling fluid through the boreholes). Usually, a tripod is used to support the cable. The stroke of a bit varies according to the ground condition. The major disadvantage of this method is that it is not possible to get good-quality undisturbed samples. In very hard rock (and especially fractured hard rock), down-the-hole (DTH) drilling can be employed. In this case, the hammer, applying repeated percussive pressure, is located just behind the drill bit inside the hole, unlike in open percussion drilling, where the hammer is on top of the drilling string. The drilling string provides the necessary force and rotation to the hammer and bit, as well as compressed air or fluids to the hammer and for the flushing of cuttings. This arrangement also allows for much deeper percussion drilling. However, the DTH drills are typically more expensive.

• **Rotary drilling:** This type of technique is used to form a deep observation borehole or to obtain representative samples of rock. The drilling method involves a powered rotary cutting head on the end of a shaft, driven into the ground as it rotates. The system requires lubrication (air, water, or drilling mud) to keep the cutting head cool. There are two types of rotary boring: open-hole and core drilling. Material recovered from open-hole drilling is mixed with the drilling lubricant. It is unsuitable for effective sampling, and it is often difficult to observe and record the strata. Open-hole boring is only suitable for rapid drilling to enable core recovery at a greater depth or for the installation of monitoring wells. Core drilling is carried out using wire-line, double or triple-tube core barrels with diamond or tungsten-tipped core bits. Wire-line core barrels are rotated from the surface by rods that are normally the same diameter as the outer core barrel. The core is brought to the surface within the inner barrel using a wire rope or attached line to a recovery tool. This system is particularly suitable for superficial or weak deposits, as any vibration from the drilling action is minimised due to the close-fitting rods used within the hole.

The conventional double-tube core consists of two barrels; the outer barrel is rotated by the drill rods and carries the coring bit. The inner barrel does not rotate, and the core passes up into this inner barrel, enabling the sample to be recovered and brought to the surface. With triple-core barrels, the non-rotating inner barrel contains a removable tube or liner. At the end of each core run, this liner with the core it contains is extracted and stored in a core box. This method does not increase core recovery but is more likely to preserve the core in its original condition.

• **Reverse Circulation drilling:** Reverse circulation drilling, or RC drilling, is a method of drilling that uses dual-wall drill rods that consist of an outer drill rod with an inner tube. These hollow inner tubes allow the drill cuttings to be transported back to the surface in a continuous, steady flow. Unlike diamond drilling, it compiles sample rock cuttings instead of rock core. The drilling mechanism is most often a pneumatic reciprocating piston called a hammer, which in turn drives a tungsten-steel drill bit, specifically made to be able to crush hard rock. The hammer is used to remove rock samples, which are pushed through the machine with compressed air. When air is blown down the annulus (ring-shaped structure) of the rod, the pressure shift creates a reverse circulation, bringing the cuttings up the inner tube. When the cuttings reach a deflector box at the top of the rig, the matter is moved through a hose attached to the top of the cyclone. The drill cuttings will travel around the cyclone until they fall through the bottom opening into a sample bag. These bags are marked with the location and depth of the place where the sample was collected and can be transported directly to the assay lab for analysis.

• **Electric Drilling:** In the art of drilling into or penetrating earth formations and rock structures, it is well known to utilise electric arcs to melt into the structure desired to be penetrated. It is also known to use circulating fluids in conjunction with it to clear the arc area and carry away cuttings, shavings, and so on. It is also old to drill electrically while maintaining a wellbore pressure greater than the rock pressure in order to drive molten rock back into the formation. Withdrawal of molten, electrically drilled material from the wellbore is additionally known by the fluid circulation of the same to the surface. Still further, it is known to utilise electrical cutting means with air blowing or water supply means associated therewith to simultaneously heat and cool the rock surface to disintegrate the same. The above-noted electrical arc drilling art finds its reflected counterpart in the older flame blast, gas flame, or burner drilling art, which is of more ancient derivation. It has been long known to alternately apply gas and a cooling medium against a rock face whereby to disintegrate the rock by thermal shock in this manner. Circulation of liquids to carry cuttings and spallings out of the way of the cutting operation is also well known in this art. Mechanical means are often employed with the flame blast drilling method to aid in breaking up slag created by the drilling blast. It is additionally known to utilize, in a drill bit, air blast nozzles or cooling fluid nozzles spatially alternated with heated gas blast nozzles whereby flame contact is followed by cooling fluid contact with circulation of mud or the cooling fluid to remove cuttings. Mechanical cutters may also be associated with such a drill head. Rotating flute blow pipes with simultaneous water injection to carry away slag are additionally known.

• **Directional drilling (or slant drilling):** According to Bryan, Cox, Blackwell, Slayden, and Naganathan (2009), directional drilling is the process of drilling a well which is to follow a prescribed traverse and intersect a specific objective. The objective is called a "target" and is usually an enclosed area in a horizontal plane. The target could also be a circular area at the top of a producing zone. Both the azimuth and deviation angle are primarily for directional drilling. Regarding the historical development of directional drilling, the first directional drilling was due to a "fish", unrecoverable drilling tools lost in the bore-hole. Special tools and techniques were being utilised to handle the "fish." In the early 1930s, the first records of directional wells were drilled deliberately to reach their target and to produce oil from beneath shallow coastal waters by setting up a drilling rig on a jetty that ran out at right angles to the shore at Huntington Beach, California (Short, 1993). Thus, the offshore oil fields in California could be regarded as the spawning ground for directional drilling practises and equipment (Inglis, 1998). This was the beginning of directional drilling as it is known today. In 1934, directional drilling was used to drill a deviated well to kill a blowout in the Conroe Field, Texas. The blowout was killed by pumping heavy mud down the deviated relief well, and it first gained prominence for further applications. From then on, directional drilling has been widely applied to exploit oil and gas from beneath shallow coastal waters in the United States. In 1941, the turbo-drill was invented by the Soviet Union, and the directional wells were drilled using the turbo-drill. In 1944, the first recorded true horizontal oil well was drilled in the Franklin Heavy Oil Field, Pennsylvania, at a depth of 500 ft. In the 1950s, cluster wells (also called multiple wells) began to be used. In the 1960s, directional drilling was used in offshore oil fields, such as the Gulf of Mexico and North Sea. In the 1970s, the positive displacement motor (PDM) was produced by various companies, such as Dyna Drill, Navi Drill, Baker Drill, Christensen and Smith. In the 1980s, to improve the control precision and adaptability for directional drilling, measurement while drilling (MWD)

was invented and widely applied, and computer assisted drilling was also involved due to the application of computer techniques (Kelessidis, 2009).

Directional drilling has now become an essential element in oil field development, both onshore and offshore (Chen, 2011). It is widely used and is gaining acceptance in the petroleum industry. Applications of directional drilling can be summarised as follows: sidetracking, controlling vertical wells, drilling beneath inaccessible locations, cluster drilling, off-shore development drilling, salt dome drilling, fault control, relief wells, horizontal wells, extended reach wells, multilateral drilling, and non-petroleum uses (Chen, 2011).

Effect of Climate Change

The effects of climate change span the impacts on the physical environment, ecosystems and human societies due to ongoing human-caused climate change. The future impact of climate change depends on how much nations reduce greenhouse gas emissions and adapt to climate change (Oppenheimer 2014). Effects that scientists predicted in the past—loss of sea ice, accelerated sea level rise, and longer, more intense heat waves—are now occurring (IPCC, 2019). The changes in climate are not expected to be uniform across the Earth. Land areas, in particular, change faster than oceans, and northern high latitudes change faster than the tropics. There are three major ways in which global warming will cause changes to regional climate: melting ice; changing the hydrological cycle (of evaporation and precipitation); and changing currents in the oceans. Physical changes include extreme weather, glacier retreat, sea level rise, declines in Arctic sea ice, and changes in the timing of seasonal events (such as earlier spring flowering). Climate change has degraded land by raising temperatures, drying soils and increasing wildfire risk (IPPC, 2019). Recent warming has strongly affected natural biological systems. Species worldwide are migrating poleward to colder areas. On land, species move to higher elevations, whereas marine species find colder water at greater depths (Rosenzweig, Casassa, Karoly, & Imeson, 2018).

Food security and access to fresh water are at risk due to rising temperatures. Climate change has profound impacts on human health, directly via heat stress and indirectly via the spread of infectious diseases. The vulnerability and exposure of humans to climate change varies from one economic sector to another and will have different impacts in different countries. Economic sectors that are likely to be affected include agriculture, fisheries, forestry, energy, insurance, financial services, tourism, and recreation (Hoegh-Guldberg, 2018). Climate change is recognised as a serious threat to ecosystems, biodiversity, and human health. It is associated with alterations in the physical environment of the planet Earth and affects life around the globe.

Climate change has a cascade of negative consequences for the planet's physical environment and living organisms. All the changes in the physical planet Earth’s environment affect the lives of plants, animals, and humans. Coral reefs, forests, and coastal human communities are particularly vulnerable to climate change. Some of the effects of climate change may be through the enhancement of the susceptibility to chemical pollution (Lesnikowski 2011). Adaptation to the consequences of climate change and prevention of aggravation of climate change are key challenges for society. Policymakers must implement personalised strategies, especially for vulnerable populations.

Control of Oil Exploitation

Oil control is the management of the dangerous effects caused by the unexpected release of formation fluid, such as natural gas and/or crude oil, upon the surface equipment of oil or gas drilling rigs and escaping into the atmosphere. Technically, oil control involves preventing the formation gas or fluid (hydrocarbons), usually referred to as "kick," from entering into the wellbore during drilling or well interventions. Oil control also includes monitoring a well for signs of an impending influx of formation fluid into the wellbore during drilling and procedures to stop the well from flowing when it happens by taking proper remedial actions (Schlumberger Limited, 2011). Oil well control is one of the most important aspects of drilling operations. Improper handling of kicks in oil well control can result in blowouts with very grave consequences, including the loss of valuable resources and also the lives of field personnel.

The control of oil exploitation can be done in several ways, (Environmental Pollution Centers 2022). It includes:

Use of barriers and adsorbent materials to mechanically recover the spilled oil: is a commonly used method when the oil spill happens in a water environment, implying the use of physical barriers for the mechanical prevention of oil spreading. Some of the barriers may also chemically interact with the spilled oil and thus providing both mechanical and chemical control means. The main types of barriers used are:

- *Booms* - Fire resistant booms are used in order to restrict the burning area, especially when controlled burning is applied.
- *Skimmers* - Skimmers are usually propylene mop-like pads that are placed on the ocean surface to adsorb the spilled oil film.

Natural and synthetic absorbing materials- These have a sponge-like behavior, used to control a large variety of spills by removing some of the spilled oil and serving as a physical barrier that limits oil migration.

Use of monomolecular surface films around the oil spilled on water to compress it into a thick layer that can be recovered more easily and reduce the damage to the environment, fishing and properties. This technique appeared in the early 1970's and was incorporated by the Navy into the control programs of bays and harbors.

Use of chemical and biological methods for the cleaning up of oil spills increases the oil's natural chemical or biological degradation processes. These methods are used together with mechanical control techniques and are especially relevant when the spill has reached a sensitive ecosystem.

Conclusion

It is clear that oil drilling contributes to climate change by causing pollution, upsetting wildlife, and destroying public areas that were set aside for people's benefit. As a result of continuous human-caused climate change, climate change impacts include those on the physical environment, ecosystems, and human civilization. The future impact of climate change will be

determined by how much greenhouse gas emissions produced during oil drilling are reduced and how well we adapt to it.

Recommendations

1. The management of oil companies should try as much as possible to understand the plight of the host communities and ensure that their oil exploration is effectively controlled in order to avert the devastating effects of it.
2. Regulatory bodies to oil companies should ensure that oil spillage is minimized.
3. Non-polluting technology should be employed.

REFERENCES

Bagley, M. (2013). *Holocene epoch: The age of man*. Live Science: https://www.livescience.com/holocene-epoch.html

Bryan, S., Cox, J., Blackwell, D., Slayden, F. and Naganathan, S. (2009). *High dogleg rotary steerable system: A step change in drilling process*. Paper SPE 124498 presented at the SPE annual technical conference and exhibition, 4–7 Oct, New Orleans, USA

Chen, P. (2011). *Drilling and completion engineering*, 2nd edn. Petroleum Industry Press, Beijing

Environmental Pollution Centers (2022). *Oil Spill Pollution Control*. Retrieved from: https:// environmentalpollutioncenters.org/oil-spill/control/

Geller, D. (2020). *More exposures from abandoned oil and gas wells come into focus*. Verisk Analytics Blog: https://www.verisk.com/more-exposures-from-abandoned-oil-and-gas-wells-come-into-focus/

Hoegh-Guldberg, O., Jacob, D., Taylor, M. and Bindi, M. (2018). *Chapter 3: Impacts of 1.5°C global warming on natural and human system*s. IPCC SR15 2018. pp. 212–213.

Inglis TA (1998). *Petroleum engineering and development studies: Directional drilling*. Graham & Trotman Limited, London

IPCC (2019). *Summary for Policymakers. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.- O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press.

Kelessidis, V.C. (2009). *Challenges for very deep oil and gas drilling will there ever be a depth limit*. Paper presented at the third AMIREG international conference: assessing the footprint of resource utilization and hazardous waste management, 2009, pp 220–230

Lesnikowski, A.C., Ford, J. D., Berrang, L., Paterson, J.A., Barrera, M. and Heymann, S.J. (2011). *Adapting to health impacts of climate change: A study of UNFCCC Annex I parties*. Environmental Research Letters.

Masson-Delmotte, V., Zhai, P., Pirani, A. and Connors, S. L. (2021). *Climate change 2021: The physical science basis*. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

Oppenheimer, M. (2014). Section 19.6.2.2. The role of adaptation and alternative development pathways, in: Chapter 19: Emergent risks and key vulnerabilities, pp.1072-1073: in IPCC AR5 WG2 A, 2014

Rogelj, J., Shindell, D., Jiang, K. and Fifta, S. (2018). Chapter 2: Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. *IPCC SR15* 2018, pp. 93–174.

Rosenzweig, C., Casassa, G., Karoly, D. J. and Imeson, A. (2007). *Chapter 1: Assessment of observed changes and responses in natural and managed systems*. IPCC AR4 WG2 2007. pp. 79–131.

Schlumberger Limited (2011). *Well control*. Schlumberger Oil Field Glossary

Short, J. A. J. (1993). *Introduction to directional and horizontal drilling*. Pennwell Publishing Company, Tulsa

Turner, M. G., Calder, W. J., Cumming, G. S. and Hughes, T. P. (2020). Climate change, ecosystems and abrupt change: science priorities. *Philosophical Transactions of the Royal Society*. 375 (1794).