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Review

Comparative Review of Energy, Crude Oil, and Natural Gas for Exchange Markets in Nigeria, India and Bangladesh

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Abstract: In 2021, there was a global energy crisis that affected different parts of the world. In most countries, energy heavily relies on natural gas, including Nigeria, India, and Bangladesh. Several studies have explored the differences in the energy of crude oil and natural gas. Nonetheless, little effort has been made toward exploring the exportation of energy for exchange markets in Nigeria, India, and Bangladesh. This paper primarily aims at comparatively exploring the energy of crude oil and natural gas for exchange markets in the aforementioned countries. The methodology used in this paper is qualitative content analysis (QCA) and a systematical literature review (SLR) which includes various sources such as journals, the core collection of the Web of Science (WOS), oil peer review resources, and library sources. The study systematically mapped out different bibliographic materials whereby the visualization of similarities (VOS) was used to explore exchange markets for energy, crude oil, and gas in Nigeria, India, and Bangladesh. The results of the analysis indicated that, in Africa, Nigeria is regarded as the largest producer of natural gas and crude oil, with an approximation of 1.2 million barrels per day. Concerning oil and gas reserves, the country is considered the 10th and 8th largest producer in the world, having 37 billion barrels and roughly 206 trillion cubic feet, respectively. Thus, the exportation of energy is considered a central pillar of the country's economy. In addition, India is regarded as the second largest producer of crude oil with 4.972 million barrels per day, which is approximately 5.1% of the entire world's capacity for refining crude oil. Similarly, at the global level, India is considered the topmost consumer of crude oil, accounting for 4.8% of the world's consumption. In the context of Bangladesh, their gas reserves account for 39.4 trillion cubic feet, and they are considered to be 70% of the commercial energy supply in the country. In conclusion, the importance of energy, crude oil, and natural gas cannot be underestimated, specifically, for the exchange import markets in the current context of the aforementioned countries. It is, therefore, suggested that the governments of Nigeria, India, and Bangladesh should strengthen their national policies on energy in order to be responsive to the global energy crisis as well as boost the exchange market in the energy sector.

Keywords: crude oil; energy; exchange markets and natural gas

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1. Introduction

The efficiency of energy and economic stability are instrumental in promoting and fostering sustainable economic development in different parts of the world. In contemporary times, fostering the energy sector has become an important aspect of the economy and stakeholders such as policymakers and researchers have focused their attention on it. Most developing countries such as Nigeria, India, and Bangladesh have been trying to enhance their natural resources in order to mobilize for productive investment in the oil sector of the economy. Most developing countries have been trying to make a significant impact on the oil and energy sector in order to improve their economic development. Nonetheless, the exchange market in the oil and gas sector is rapidly becoming an emerging economy. The

literature posits that the trends of the economy at the international level have advocated for making it more integrated and sustainable.

There is a connection between energy and digitization because the latter provides productivity and safety. The literature contends that digitization helps in reducing the consumption of energy in modern times and enhances the economic growth of most countries [1]. Hence, there is a need for improvement in the energy sector. It should be reiterated that this paper establishes a connection between the energy sector and market exchange in the selected countries. More so, without the efficiency of the energy sector, the economy cannot effectively thrive in modern times. Most labor-intensive sectors require efficient energy consumption. Studies have advocated efficiency in the energy sector despite the fact that other studies posited that the current advancement of technology has drastically reduced the intensity of energy consumption in different parts of the world. This invariably means that efficiency in the energy sector is being utilized in fostering economic growth. Hence, digitization has a positive impact on the labor market and consequently, digitization can also be instrumental in fostering the exchange markets of natural resources such as oil, gas, and energy in Nigeria, India, and Bangladesh [2].

It is important to note that the cultural diversity in the contexts of Nigeria, India, and Bangladesh would certainly influence energy, crude oil, and natural gas. This assertion is in line with the position of previous studies that contend that various countries have been making a tremendous effort in diversifying their economic growth through the efficiency of the energy, oil, and gas sectors of the economy. Hence, the policies on energy also need to take cultural dynamics into account in order to significantly reduce the effect of carbon by making the citizens adapt to the change in society. As most of the advanced countries, such as the United States of America, are trying to attain a 100% clean energy economy as well as projecting to attain net zero emissions by 2050, most of the developing countries also need to have targets for achieving low carbon energy in the near future. Undoubtedly, most developing countries face the challenges of poverty which directly or indirectly affect energy affordability. Thus, this assertion could be regarded as a necessity for the formulation and strengthening of energy policies in Nigeria, India, and Bangladesh in order to have a future plan that will boost economic growth [3].

The literature acknowledges energy poverty as an impediment to socio-economic development which threatens the lives of many people in various parts of the world. Furthermore, there is a lack of adequate electrification in different households in many developing nations. The literature posits that there are approximately 1 billion people who lack adequate access to power or electricity and 2.6 billion people in most developing countries who are used to the use of unclean sources of energy for cooking their daily meals. This is an indication of poverty in most developing countries. More specifically, in Sub-Saharan Africa, there are almost 600 million people who have limited access to electricity. In addition, there are roughly 900 million citizens living without meaningful cooking facilities [4].

Most countries of the world, including Nigeria, India, and Bangladesh, are dependent on natural resources such as oil and gas, and the export of energy remains a central pillar in the nation's economy. Similarly, industries also depend on raw materials obtainable from natural resources. However, this study is important because of the current global destabilization of oil prices emerging as a result of the transition of energy and geopolitical risks or insecurities which hinder the adequate and judicious use of natural resources in most developing countries such as Nigeria, India, and Bangladesh. More importantly, the challenges of insecurity in the oil wells located in different parts of the country and, more specifically, in the Niger Delta part of Nigeria, and incessant theft of crude oil on onshore pipelines have systematically led to the withdrawal or inactivation of many OICs in the exploration of oils and natural gas. The challenges of pollution in the exploration, development, and production of energy, oil, and natural gas in the aforementioned countries also affect the exchange market of natural resources. However, there are a number of studies in the three mentioned countries that have deeply explored the current state of

energy and natural gas. Various studies in Nigeria [5,6] have advocated for sustainable renewable energy in the country; regarding India, studies have emphasized the exploration, development, and exploration of energy and natural gas, while in Bangladesh, there has been the development of the National Energy Policy (NEP) for the substantial development of the energy sector. However, the global energy crisis in 2021 affected that sector. The literature affirms that there is a potential exploration of energy and natural gas for sustainable economic development. Hence, other studies have clamored for a policy framework for the efficiency of operations of energy and natural gas in different parts of the world such as India. Nonetheless, there is still a gap in the existing studies, especially in comparatively exploring energy, crude oil, and natural gas in the exchange market [7,8].

Studies on the impact of energy market integration in the region include analyzing the potential benefits and challenges of energy market integration and identifying potential opportunities for collaboration and trade between these countries in the energy sector. The impact of global events on energy markets cannot be underrated. The energy markets are affected by a wide range of global events, such as political instability, natural disasters, and economic downturns. However, there is limited research on the specific impact of these events on the energy markets and how they affect prices, production, and consumption. In addition, government policies have an impact on energy markets because policies play a significant role in shaping energy markets. Nevertheless, there is limited research on the specific impact of different policies on energy markets, such as the impact of subsidies, taxes, and regulations. In addition, the impact of new technologies on the energy markets has been identified in the literature and the energy markets are constantly evolving with the introduction of new technologies, such as renewable energy and energy storage among others. However, there is limited research on the specific impact of these technologies on energy markets, and how they affect prices, production, and consumption. Undoubtedly, energy market integration has an impact on the global economy which is becoming increasingly integrated with the growth of international trade in energy products. Furthermore, there is limited research on the specific impact of energy market integration on the global economy and how it affects prices, production, and consumption [9].

Based on the exploration of extant literature, there are no current studies that provide deep insights into the paramountcy of the market exchange of oil, gas, and energy in the contexts of Nigeria, India, and Bangladesh considering the number of studies that advocate for sustainable economic development through the efficiency of energy. It is against this background that this study attempts to provide essential contributions to the existing studies concerning energy, crude oil, and natural gas for exchange markets in order to enhance sustainable economies throughout the oil and gas sector. The principal aim of this study is to examine the state of energy, various sources of energy, and liquefied natural gas in Nigeria, India, and Bangladesh. This study, therefore, tries to bridge the gap between the existing studies by exploring energy, crude oil, and natural gas for exchange markets in Nigeria, India, and Bangladesh.

Similarly, to the best knowledge of the researchers, there are insufficient studies that comparatively explore the four major factors of this research (energy, crude oil, natural gas, and exchange markets) in the contexts of these three nations. The research gap in this study manifests from the fact that there is a lack of comprehensive comparative analysis of energy, crude oil, and natural gas exchange markets in Nigeria, India, and Bangladesh. Thereby, the novelty of this study is that various frameworks on energy, crude oil, and natural gas are harmonized in fostering sustainable economic growth and exchange markets of natural resources. Thus, this study includes all three markets in the aforementioned countries (i.e., Nigeria, India, and Bangladesh) in the analysis, as well as focuses on the exchange markets for these commodities. This paper provides a comprehensive understanding of the current state and future prospects of energy, crude oil, and natural gas markets in Nigeria, India, and Bangladesh. It allows for the identification of similarities and differences in the markets across the three countries and provides insights into the impact of government policies and regulations on the markets. In addition, it can help to identify potential opportunities

for collaboration and trade between these countries in the energy sector while providing insights into how these countries are responding to fluctuations in global energy prices and how they are diversifying their energy sources, which is crucial for energy security and sustainable development. This study may be important for policymakers and investors in these countries, as well as for researchers and academics studying the energy markets in these countries in particular, and in different parts of the world in general.

This paper, therefore, aims at explaining the significance of energy, crude oil, and natural gas and exchange markets in the aforementioned countries in order to achieve sustainable economic development.

2. Materials and Methods

The methodology employed in this research is a combination of qualitative content analysis (QCA) and systematical literature review (SLR). The combination of the two approaches enabled the researchers to provide a critical explanation of energy, crude oil, and gas in the exchange markets in Nigeria, India, and Bangladesh. It is essential to note why these three countries' (i.e., Nigeria, India, and Bangladesh) energy, crude oil, and gas for exchange of market are explicitly elaborated in this research. This study is justifiably explored because the three countries have similar experiences of having international oil companies such as Shell, Chevron, and ExxonMobil, among others, evaluating their natural resources such as energy, oil, and gas in upper stream and downstream explorations. It should be emphatically stressed that the secondary data used in this research were acquired from various sources such as journals, the core collection of Web of Science (WOS), oil peer review resources, and library sources. The study systematically mapped out different bibliographic materials whereby visualization of similarities (VOS) was used to explore exchange markets for energy, crude oil, and gas in the aforementioned three countries. Given the existing data and methods, this study can provide an in-depth analysis of the energy market in Nigeria, India, and Bangladesh, and would be able to identify the key factors affecting the market, as well as the trends and patterns in the market [10]. It can also identify the key challenges and opportunities facing these markets, which would be useful for policymakers and investors in these countries. Furthermore, by comparing the three countries, it is possible to identify the unique characteristics of each market, and the similarities and differences between them, which would be useful for researchers and academics studying energy markets [11]. Data collection involved gathering relevant data on the prices, production, and consumption of energy, crude oil, and natural gas in Nigeria, India, and Bangladesh. Data were obtained from government sources, international organizations, and industry publications.

This study, therefore, provides an analysis of the results of content analysis and a systematic literature review. In so doing, the study provides significant highlights as identifications and contributions for potential researchers that may wish to replicate the study in the future within the scope of energy, crude oil, and gas. The research lucidly explains different themes of the study by collating various materials for a 12-year-period, specifically that between 2000 and 2022, regarding the themes of oil and natural gas, biomass and charcoal, biofuel, electricity, coal, and liquefied natural gas. The results and discussions are centrally focused on the themes generated in this research in the contexts of Nigeria, India, and Bangladesh. The subsequent section provides the results of the study.

3. Results

This section presents the results of the study drawn from a critical literature review and content analysis of the secondary data obtained from different studies. Hence, this section is subdivided into three parts with a specific focus on energy, crude oil, and natural gas for the exchange markets in Nigeria, India, and Bangladesh. Each of these is presented in subsequent sub-headings.

3.1. Energy, Crude Oil, and Natural Gas in Nigeria

Nigeria is endowed with various natural resources and the country has been playing significant roles in the oil and energy sector of the African continent. The discovery and drilling of oil started in Nigeria in 1958 at Oloibiri, in present-day Bayelsa State. This was the beginning of oil exploration in the production of oil and gas in the country [12]. Consequently, it started oil and gas production and the country appeared as one of the topmost producers of oil and gas at the global level. The literature posits that in 2022, the country remains the biggest producer of oil in Africa, and it is rated as one of the largest producers of oil and gas in the entire world. Indeed, many international oil companies (IOCs) are regarded as important companies in the production of oil and gas in the country. For example, the Chevron Corporation, Shell, Equnor, Total Energies, and Exxon Mobil, among others, have invested hugely in the country's oil and gas sector for many decades. The challenges of insecurity in places such as the Niger Delta have affected the exploration activities of many IOCs and have given opportunities to indigenous exploration and production (E&P) companies to serve as prime players in the Niger Delta part of the country [13]. Such indigenous oil companies are Conoil, Oando, Seplat Energy, and Neconde Energy, among others. More importantly, indigenous companies play significant roles in the energy sector and the country obtains most of the use or consumption of energy basically from traditionally known biomass and wastes. The literature contends that as of 2018, 73.5% of the entire energy was from consumption while 26.4% was acquired from fossil fuels and hydropower. It should be reiterated further that there are many other sources of energy in the country such as wind, petroleum reserves, hydroelectricity, solar, natural gas, coal, etc. In the entire African continent, Nigeria is regarded as the topmost producer of natural gas and crude oil. For instance, in 2022, the country produced an average of 1.2 million barrels of oil per day and there was the production of 300 barrels of condensate per day [14].

Furthermore, it must be explained that the role of Nigeria in oil and gas cannot be underestimated, and this is due to the fact that the literature acknowledges that the oil reserves of the nation are roughly estimated as 37 billion barrels, and notably, the estimate for gas reserves is approximated as 206 Tcf. This position has helped the country to attain recognition of ranking 10th in oil reserves and 8th in gas reserves in the world. Undoubtedly, with the world ranking, it can be said that the country has attained a better position than many other countries with respect to oil and gas reserves. Nonetheless, it is essential to posit that there is a need to intensify efforts in improving, developing, and growing the hydrocarbon industry of the county. It is undoubtedly noted that Nigeria plays a significant role in the Organization of the Petroleum Exporting Countries (OPEC) and that the country is always being considered in production quotas of its petroleum and gas resources [15].

Fundamentally, Nigeria and Libya are regarded as having two-thirds of the crude oil reserves in the entire African continent. Additionally, Nigeria is regarded as the second country producing natural gas in Africa apart from Algeria. In addition, lignite and bitumen reserves are mostly found in Nigeria; the discovery of all of these resources in the country has caused it to be recognized as a significant producer of natural resources in the African continent. The aforementioned are culminating factors that have caused the country regarded as one of the giant oil-producing countries in all of Africa. Indeed, there is no country in Africa that can compete with Nigeria in terms of natural resources, thus, energy export is a prime source of the country's economy. It should be emphatically stressed that the government is planning to have a 90% of electrification rate by the year 2030. Indeed, the prime energy resources are commonly found in the endowment of natural materials that are useful for industrial raw materials as the literature posits [16,17].

Furthermore, there is a challenge of oil contamination and spillage in most of the oil field areas in Ogoniland in the Niger Delta part of the country. More importantly, the challenges are historical in nature; for instance, in 1950, Ogoni people in the Niger Delta, in the Southeastern geo-political zone of the country, had oil facilities that were being operated upstream on their behalf by the Shell Petroleum Development Corporation as well as the

Nigerian National Petroleum Company in operation in the downstream. However, the Movement for the Survival of the Ogoni People (MOSOP) campaigned against Shell Oil Company as one of the international oil companies to be kicked out of Ogoni land. This assertion has been further confirmed by the United Nations Environmental Programme (UNEP) in 2011 which confirmed oil spillage and contamination resulting in pollution of the area and the literature confirms that the Niger Delta is one of the most polluted regions in the entire world This is due to the fact that in the last two decades, the Nigerian government has confirmed more than two thousand major spillage sites in the Niger Delta area of the country. As a result of these challenges, the Ogoni people started a campaign against Shell Petroleum Development Corporation in the upstream. Reiteratively, the negative consequence of pollution has affected fishing and farming due to the contamination of oil in the land areas and the fishermen tend to move to the less contaminated areas while fishing. Hence, the consequences and challenges of pollution as well as environmental damage to the living conditions of people in the Niger Delta cannot be underrated [18,19].

There is the persistence of challenges as a result of the fact that environmental laws are not adequately enforced by the government. In other words, the agencies that are responsible for the enforcement of environmental law are not effective and sometimes tend to compromise certain things due to conflicts of interest and, above all, corruption and bribery are fundamental factors for the lack of enforcement of a law that caused the pollution and environmental damage which affected the lives of citizens in the Southeastern part of the country. It is essential that the government enlightens Niger Delta communities with vital information on the impact of the oil industry on their lives in order to keep them safe from environmental pollution. Furthermore, it is noteworthy to posit that more than a decade ago, Shell Nigeria showed concern over a crude oil spill of over forty thousand barrels which was considered the worst in the country. It is further noted that coal is another mineral resource in the country that is regarded as a fossil fuel. The Nigeria Coal Corporation is the agency responsible for the mining of coal in the country. The literature contends that coal was a prime source of energy and it was being used for powering electricity plants. In the entire world, Nigeria is ranked 44th as a country with a reserve of coal [20,21].

Similarly, natural gas is another mineral resource that was discovered onshore and offshore of the Niger Delta area which caused the country to export liquid natural gas (LNG) as well as use it for energy. Within the country, natural gas is being used by different industries in places such as Port-Harcourt and Lagos [22,23]. It is noteworthy to say that the literature contends that gas is one of the cheapest sources of energy, specifically in the manufacturing sector in many states such as Lagos, Cross River, Rivers, Edo, etc. Currently, there are two prime power stations in the country which are hydro and natural gas. It should be stressed that there are 28 grid-connected power stations across the country and that the Egbin thermal plant is considered the largest gas plant and the Mambilla power plant is regarded as the biggest hydroelectric power station. Nonetheless, there is a breakdown of the entire twenty-eight power plants across the country. For instance, nine are regarded as independent power plants (IPP); eight are considered Nigerian National Integrated Power Projects (NIPP) plants, and eleven are regarded as privatized legacy power (PLP) plants [24,25]. There are different rivers and natural falls in the country as prime water resources to be regarded for hydropower. For example, the Niger River, River Benue, and Lake Chad Basin are considered the sources of the country's hydropower which have an installed capacity of 12,522 megawatts. In addition, the Jebba hydropower plant located in the Niger river has an installed capacity of 578.4MW. Nonetheless, there is still a power shortage due to the fact that approximately 85% of hydropower has yet to be adequately explored in order to solve the power shortage problem [26,27].

Undoubtedly, renewable energy is another important aspect or source of power in Nigeria. With the total population of the country at 200 million, the energy that the country is currently generating from renewable sources such as solar, biomass, wind, and hydropower is not sufficient. For instance, the Energy Commission of Nigeria tried to develop Renewable Energy Master Plan (REMP) in 2005. Invariably, this is the policy on

renewable energy and it emphatically stresses the integration of technology in achieving the goals of the Commission, purposely aiming to expand access to energy to almost 90% of the entire population by 2030 as well as to attain 30% of total renewable sources to be generated by the Commission as the literature contends. With this future target, there is a lot of potential for the country to generate energy from different sources, especially solar. More importantly, most cities such as Abuja, Benin City, Lagos, Kano, Kaduna, Port-Harcourt, and many others are powering street lights using solar energy through the platform of state beautification projects and there is a firm from the United Kingdom that has been contracted to build solar streetlights in different parts of the country. Similarly, the World Bank has granted Nigeria roughly NGN 350 million in building a solar power grid which will be helpful in generating power for different sectors such as households, schools, rural areas, hospitals, etc. by the year 2023 [28–30].

Furthermore, the power industry in Nigeria solely depends on natural gas which is a significant source of fuel in the country. It is articulately stipulated that the Energy Commission of Nigeria Act and National Gas Policy are responsible for policies and implementations on energy and gas, respectively. The government is dedicated to the power and natural gas sector in order to drive important industrial development through regulation of the market in the country. Undoubtedly, the policies and regulations of the government have a significant impact on power and natural gas because the participants in the markets are expected to comply with the policies and regulations of the government. Gas producers and international oil companies are the prime market participants that operate on the basis of sole risk or under contractual agreement. For instance, the policies and regulations specifically mention that they can operate under petroleum ventures and production-sharing contracts (PSCs) with the Nigeria National Petroleum Corporation (NNPC), which is regarded as a national oil company [31–33]. In addition, the policies and regulations identified the roles of the marketers and transporters of local gas distribution companies in the gas industry. There are other participants in the marketability of natural gas and different companies meant for downstream gas utilization such as power generation companies as well as independent power producers (IPPs) who also play significant roles. The power sector is regulated by the Nigerian Electricity Regulatory Commission (NERC) and the Nigerian Oil and Gas Industry Content Development Act which are responsible for the growth of local content in various arrangements, operations, activities, projects, and transactions in the oil and gas industry [34,35]. Finally, one can see Nigeria's Crude Exports vs. Asia's Share in Nigeria's Exports from 2017 to 2021 (million barrels per day, %) as demonstrated in Figure 1.

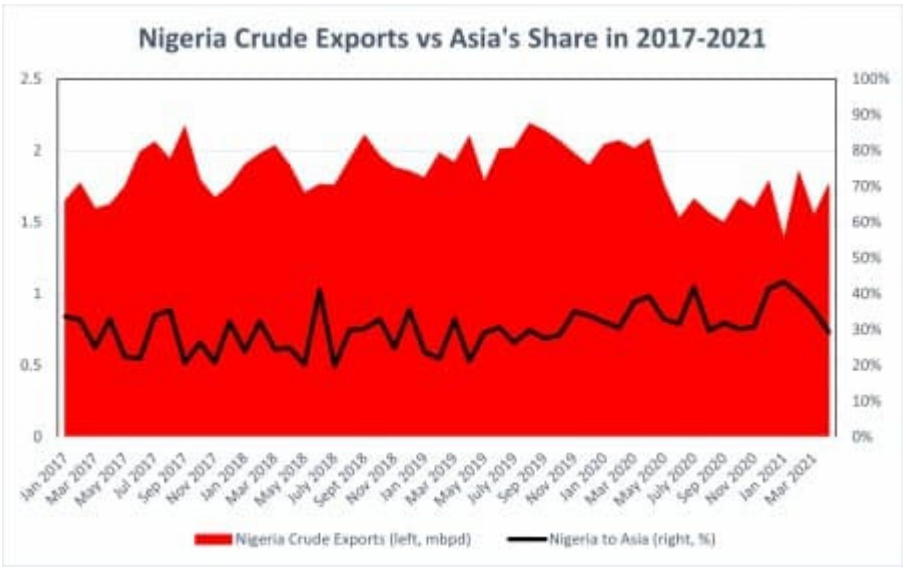

Figure 1. Thomson Reuters (Source: Quartz India, 2018).

3.2. Energy, Crude Oil, and Natural Gas in India

Remarkably, India has been making tremendous progress in the energy sector. For instance, according to the finding of the World Energy Consumption, India is regarded as the third highest in the world regarding primary energy consumption, ranking behind China and the United States specifically. Similarly, the literature contends that India is the second country after China with respect to the consumption of coal. A large quantity of imported coal is used for pulverized coal-fire and thus, the raw biomass cannot be used in pulverized coal mills. Hence, almost 100% biomass can be used for fire after torrefaction in the pulverized coal mills which is meant for the replacement of imported coal in the country. The literature posits that the northwest and southern regions of India have been trying to replace imported coal with the use of biomass and it became the fourth top coal producer in the year 2017. In addition, India is ranked third in the entire world after the United States and China regarding the consumption of oil [36].

The literature contends that the importation of energy by India has reached 47% of total primary energy in the last three years. It should be further reiterated that coal is the major source of energy in India and roughly 80% of total electricity is generated from coal which is the fundamental source of greenhouse gas emissions in the country. It should also be emphasized that the highest concentration of coal seam fires by the mine area greatly pollutes the land, water, and air. In fact, in the year 2019, the production of coal in India was specifically blended into the central government; it has been mentioned that the ownership of approximately 75% of coal belongs to the government under Coal India Limited (CIL) which is responsible for 84% of the supply of India's thermal coal. Nonetheless, there is a challenge to procure quality coking coal which is most suitable for the production of iron and steel. As a result, India has decided to import coking coal in order to fulfill its demand [37].

Furthermore, the role of India in the exchange markets of oil and natural gas cannot be underestimated at the international level. This is because India as a nation is regarded as the third consumer of crude oil in the entire world, accounting for 4.8% of the entire world in terms of the consumption of oil and gas. Similarly, India was regarded as the second-most importer of crude oil in 2019 and its capacity for refining crude oil is ranked 4th in the global ranking for the year 2017. Obviously, there is a high demand for the domestic consumption of liquefied petroleum gas (LPG) for cooking purposes in the context of India. The country is considered the second largest consumer of LPG in the entire world and thus, most of the LPG needed in the country is imported. With the current scenario in India, there is a need to develop gas supply pipes for the cities and the roles of oil and gas companies cannot be underestimated in this regard [38].

Furthermore, it is essential to reiterate that India focuses on the paramount importance of biomass as an important source of renewable energy as well as for the generation of energy through carbon-neutral fuel. The country is regarded as one of the most prominent leaders in the investment and installation of renewable energy in the world. India has been strategizing to increase their capacity for renewable energy to 175 gigawatts (GW) by 2022, which will be drawn from solar energy, wind power, biopower, and small hydropower. Currently, only 20% of households in the country utilize biomass and charcoal for cooking and the growing demand in the use of LPG is proliferating on a daily basis. With the potential of biomass as a source of energy, it is on record that some people already use biomass for commercial cooking, process industries, and the generation of electricity. For instance, the literature contends that there was 177 Mtoe of biomass used in India more than a decade ago. In addition, it should be further noted biomass is available on a yearly basis in the country. However, most agricultural and crop residue biomass that has been burnt tends to cause air and environmental pollution. In a nutshell, it can be said that most traditional biomass has been replaced by liquefied petroleum gas (LPG) at a rapid pace. There are several schemes being implemented that are meant for the productive utilization of biomass or agro-waste for improving the economic conditions of people living in rural areas and it has the future potential of job creation for citizens as a result of an emphasis on streamlining a policy framework for the operations of oil and natural gas as the literature posits [39].

Moreover, the petroleum product is a very essential resource in India and thereby, it should be emphasized that the country tends to import almost 85% of petroleum products with an estimated cost of USD 55 billion between 2020 and 2021. The country has been trying to set a particular target of integrating 20% of ethanol into petrol by the year 2025. To demonstrate their commitment, the Indian government has tried to provide funds to manufacturing industries such as wheat, rice, corn, sugarcane, etc. With this development, the literature posits that there is a 3.3% rate of penetration of ethanol into the market. This shows the potential for an exchange market that can boost the economic growth of the country. In addition, electricity production is an essential aspect of the economy and livelihood of the citizens in India. Notably, the country is regarded as the third producer of electricity in the entire world with 1,383 TWh generated between 2019 and 2020, constituting 4.8% of the global share of electricity, and surpassing both Russia and Japan. The literature acknowledges that almost 99.99% of the entire population of the country has access to a supply of electricity. Similarly, in a domestic capacity, the country also has 136 gigawatts (GW), constituting 30% of the capacity for renewable energy as the literature states [40,41].

Furthermore, in India, the power and natural gas exchange market has been making a tremendous improvement, and the roles of regulators as manifested in the policies and regulations cannot be underrated. It has been mentioned that integrated products specifically from power plants would enable the country to buy gas from exchanges coming from the gas industry and consequently sell electricity in exchange for power as a single transaction. Similarly, in 2020, the Indian first gas exchange was given the responsibility to achieve the expectations of the government through the availability of gas which would enable the country to create a free market and promote a gas-based economy. The literature posits that the current regulations and guidelines of the government in India are that Oil India Limited (OIL) is expected to have freedom in marketing its product and the Ministry of Petroleum has been intensifying efforts towards the development of the gas markets in the country. There is a proposition by the government that some companies such as fertilizer companies are expected to specify their need for gas through exchanges. In addition, the literature contends that India strives to increase their share of natural gas in the energy market from 6.7% to 15% by 2030. Currently, crude oil represents 27.91% of the total consumption of energy in India [42,43]. Nonetheless, there is a gap between the demand and supply of crude oil which is fulfilled via the importation of the product. Figure 2 shows India's reliance on oil as the source of gross domestic product (GDP).

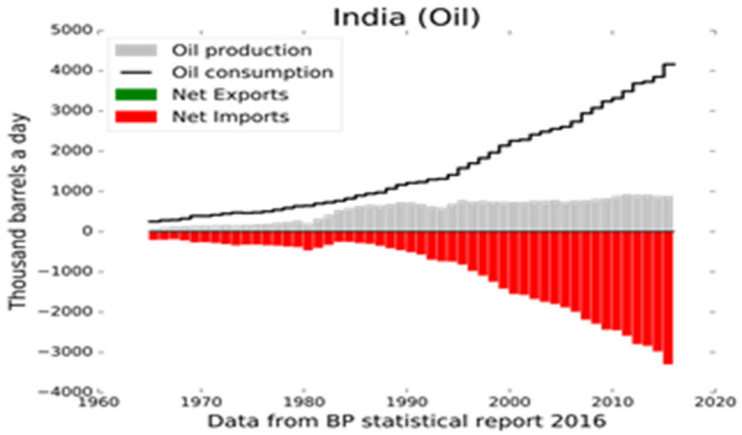

Figure 2. India's reliance on oil (Source: Singh, 2017).

3.3. Energy, Crude Oil, and Natural Gas in Bangladesh

Undoubtedly, Bangladesh is blessed with different natural resources even though the country is also a developing country like Nigeria and India. Nonetheless, Bangladesh is faced with an energy crisis in spite of the fact it is trying to improve its economic activities. The literature contends that there is currently insufficient utilization of available energy

resources in the country which has prompted the government to emphasize strengthening the sector; however, there is great potential in this regard when there is an effective and efficient policy that is geared towards the adequate exploration of energy in the country. Notably, successive governments in Bangladesh have been trying to formulate policies that would effectively address the issues relating to climatic change as well as environmental pollution emanating from the energy and oil sector which has been felt significantly in the country. In fact, the country has a policy on energy [44]. The literature contends that the first National Energy Policy (NEP) in Bangladesh was formulated by the Ministry of Energy and Mineral Resources in 1996. The policy emphatically stresses the adequate exploration, production, and distribution of energy. It also elaborated on the significant and rational use of energy resources in order to fulfill the needs of the citizens and the growing demands of various parts of the country in attaining sustainable development. The government also intensified efforts for the efficiency and effectiveness of the energy sector in fulfilling global and domestic needs. There has also been a review of the energy policy in 2004. In the updated version of the policy, there is the inclusion of new objectives, among others, which are specific to establishing that there is environmentally sustainable energy development as well as minimal environmental damage [45]. Similarly, it also aimed at encouraging both public and private sectors to actively participate in the effective management of energy in the country. Nevertheless, the said policy has been criticized extensively, specifically in the aspects related to approaches to the extraction of energy and its exportation. In addition, according to National Energy Policy (NEP) in Bangladesh, there is support for putting conservative measures in place in order to ensure that there is a meaningful, economic, and effective utilization of energy in the country [46]. In order to achieve this, it is explicitly pointed out that energy conversation can be achieved with an emphasis on the reduction in wastage, energy audit, etc.

Furthermore, it is essential to note that there are electricity companies owned by the government in Bangladesh and that the companies are responsible for the generation of half of the electricity. US companies supply roughly 55% of the country's natural gas for domestic production and the US companies are regarded as part of the largest investors in power projects specifically. There has also been a tremendous improvement in the energy sector; for instance, Bangladesh produced 5 gigawatts in 2009 and currently, in 2022, the country has generated approximately 25.5 gigawatts. Hence, there is a future plan by the government of Bangladesh to generate up to 50 gigawatts by 2041 in order to attain sustainable energy development in the country. However, there are challenges hindering the required level of progress in the energy sector. For example, it is noted that 168 million residences, constituting between 70% and 80% of the entire country, experienced blackouts, and out of the said percentage, only 45% of residences were restored with power. This invariably means that the country needs to intensify efforts in addressing these challenges in order to achieve its future plan of generating 50 gigawatts by 2041 as part of sustainable energy development in the country [47,48].

Notably, the global energy crisis that hit the entire world in 2021 brought about a shortage of natural gas and affected the natural gas sector. Indeed, the electricity sector in Bangladesh relies on the availability of natural gas and was negatively affected when the government of Bangladesh stopped the purchase of the spot price of liquefied natural gas (LNG) around June 2022. This decision led to a drastic reduction in the percentage of LNG from 40% in 2021 to 30% in 2022 [49,50]. More importantly, the literature posts that approximately 77 natural gas plants in Bangladesh experienced a lack of sufficient fuel to meet their expectations. It is unfortunate to note that the government is still importing LNG in accordance with future exchange markets. Nonetheless, the government trying to subsidize energy and indeed LNG imports by approximately USD 4.6 billion in the 2021 fiscal plan and the government has also tried to spend approximately USD 9.4 billion in the 2022 fiscal year. Thus, tariffs are being put on the imports of LNG in order to assist in subsidizing the expensive cost of the development and production of energy in the country [51,52].

Natural gas in Bangladesh is said to achieve 70% of the supply of energy for commercial purposes. Several studies such as the ones conducted by Hydrocarbon Unity and Norwegian Petroleum Directorate have examined the possibilities of expanding the exploration of natural gas in Bangladesh and the findings have demonstrated that natural gas can be further discovered in the country for the benefit of the citizens. Nonetheless, in recent times, there have been concerns raised by experts that there is a need for the urgent exploration of new gas fields in the country. However, Bangladesh is also blessed with coal, the largest coal fields are located in the northwestern part of the country, and has approximately 3 billion tons of Bituminous coal which was discovered more than two decades ago [53,54]

In Bangladesh, the policies and regulations are explicit with regard to energy security and accessibility within the framework of a sustainable gas-based economy. In addition, the government provides protection against price volatility in the oil market. It was in 2009 that energy and natural gas producers were allowed to enter the market. The purpose of entering the market was to be able to address the gap between the demand and supply in the country. There is a subsidy in the energy sector in Bangladesh which amount to 5% of the entire GDP in 2018. Recently, Bangladesh announced regulations on the provision of prices in the energy sector as an integral part of the protection of the environment as part of the Perspective Plan (PP) for 2041. There is also a need to enhance savings and investment by lowering the tax rate on capital. The literature advocates for policy reforms in Bangladesh that can create an enabling environment for a gas-based economy and also acknowledges the need for taxes on these natural resources between 2019 and 2041 [55].

In summary, the foregoing explanations have demonstrated that in the contexts of Nigeria, India, and Bangladesh, there are great potentials for energy, crude oil, and natural gas specifically for exchange markets. Hence, the government needs to address the challenges that may hinder the potentiality and sustainability of energy and natural gas in the aforementioned countries in order to enhance the nations' economies and overall development.

4. Discussion

This section discusses the major findings obtained from content analysis and a critical literature review performed on the exploration of energy, crude oil, and natural gas in the context of Nigeria, India, and Bangladesh. For several years, there have been studies on energy, crude oil, and natural gas, and there is a gap in relation to exchange markets in order to boost the economies of the three countries (Nigeria, India, and Bangladesh). To achieve this, there is a need to emphasize the significance of effective policy in expanding and strengthening the exchange markets in the countries. In other words, there is a need for effective policy formulation as an intervention for the sustainable efficiency of energy in the countries. The results demonstrated that the three fundamental resources investigated in this study (i.e., energy, crude oil, and natural gas) in the three countries are significant for promoting economic growth. More specifically, energy policies are essential in promoting the production of hydrogen and renewable energy. It has also been shown in the existing literature that, if successful, there would be a drastic decrease in the consumption of fossil fuels between 2000 and 2050 [56].

Most countries of the world have been trying to comply with the Paris Agreement on the international investment in renewable energy resources. The literature contends that there has been a drastic decrease in fossil fuels and the usage of nuclear power between 2010 and 2020. This is a result of the proliferation in the use of renewable energy sources. It is important to reiterate that the report by International Energy Agency (IEA) contends that the consumption of renewable energy by 2030 will rise to 53%. These data demonstrate that there is likely a security threat with regard to energy in the nearest future. It is on this basis that there is a need to assiduously work toward a policy that will address the future threat emanating from a need for energy. It should be further reiterated that there are global demands for fossil fuels and the literature acknowledges that the said demands have been met over a decade ago. Nonetheless, there has been a transition from the use of fossil fuels

to the use of renewable sources of energy as an integral part of energy stability. Notably, hydropower significantly contributed to a larger part of the 8% consumption of sources of renewable energy. In addition, there has been a significant increase in solar sources of renewable energy. This progress is the manifestation of an intense global effort to foster the utilization of renewable energy sources. Hence, the sustainability of energy can only be achieved when efforts are made to decrease fossil fuel energy generation. Figure 3 shows the global growth of Fossil, nuclear, renewable energy.

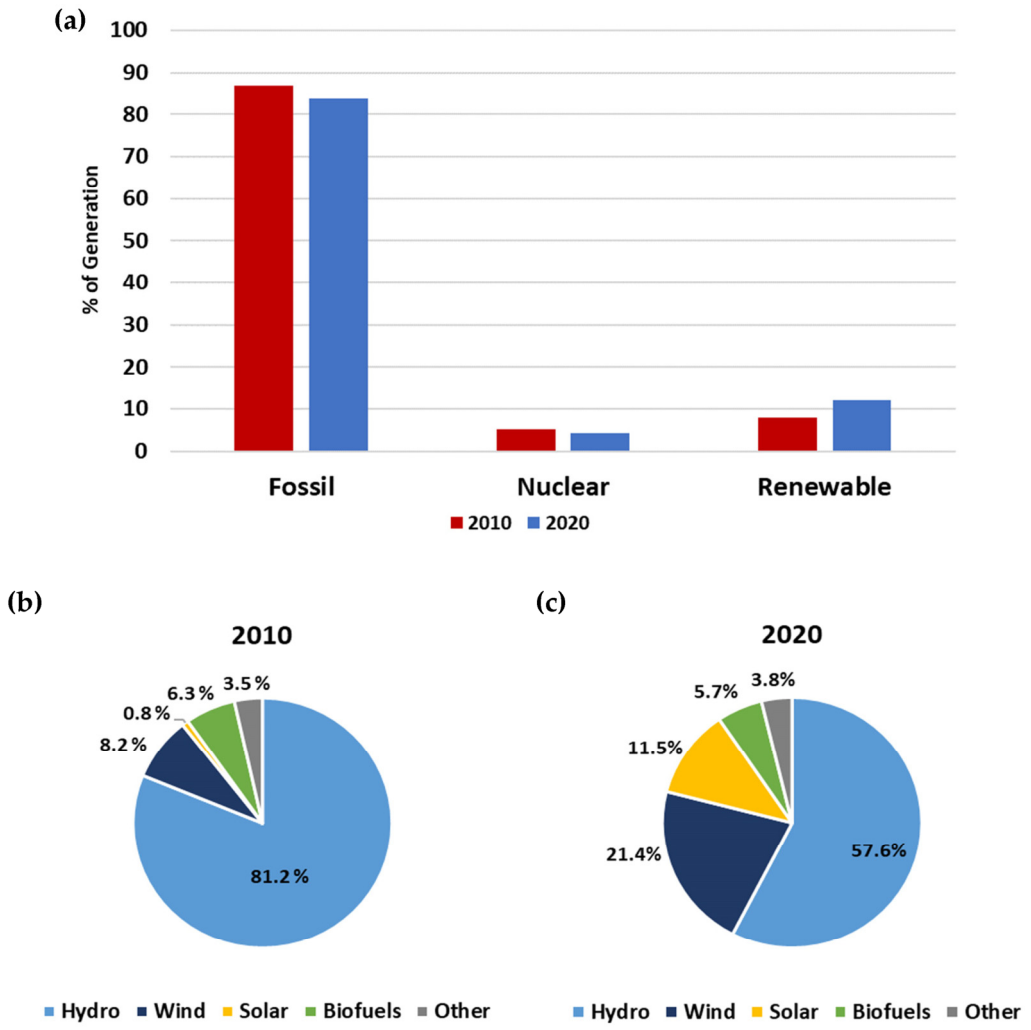

Figure 3. (**a**–**c**) Global growth of Fossil, nuclear, renewable energy.

Reiteratively, energy system stability can only be achieved when emphasis is given to the adequate utilization of renewable resources of energy. In order to achieve this need, hydrogen can be utilized as a direct option for clean fuel and can be used as an alternative to hydrocarbon-based fuels in various sectors, specifically transportation, industrial production, and power generation. In so doing, the total reliance on fossil fuels can be considerably reduced as an attempt to enhance the need for energy at the global level. The literature acknowledges that hydrogen can be integrated with natural gas in order to drastically reduce emissions without causing any inconvenience to citizens' lifestyles. It has also been further demonstrated that hydrogen can be adequately transformed into electricity through the use of fuel cell technologies for the efficiency of energy. Nonetheless, hydrogen can be produced through the use of fossil fuels and clean fuel can be harmonized with different materials. Therefore, it is possible that 98% of global hydrogen can be produced through the utilization of methane and coal with only 1% produced from fossil fuels through the

utilization of capturing and storage systems as the literature contends. Figure 4 shows global coal, renewable electrolysis, methane, Chlor-Alkali Byproduct, coal.

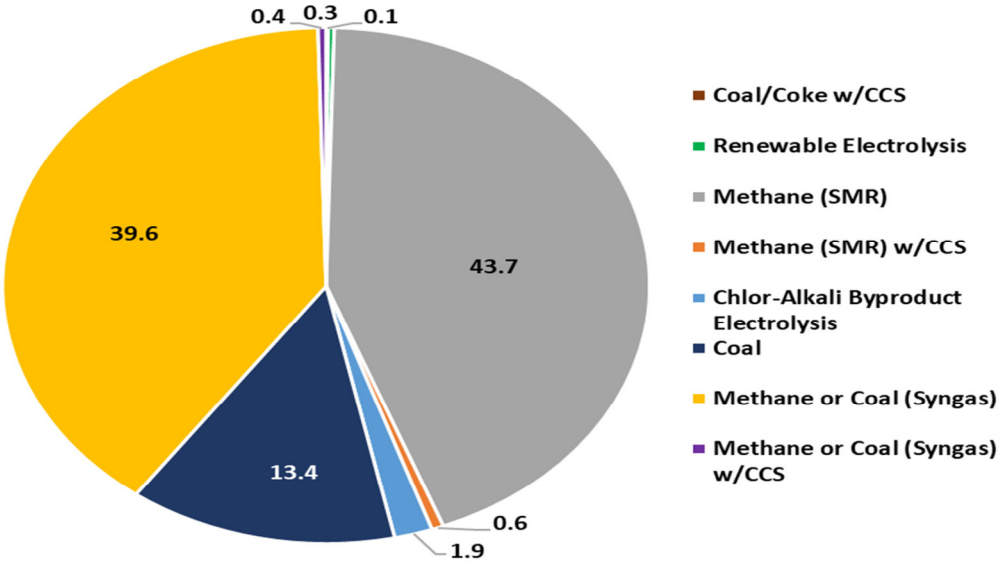

Figure 4. Global coal, renewable electrolysis, methane, Chlor-Alkali Byproduct, coal.

Comparatively, the findings and analysis of this study demonstrated that Nigeria, India, and Bangladesh are endowed with natural resources that serve as an impetus upon which the economic prosperities of the countries are built. It is on this note that that literature acknowledges Nigeria as one the largest producers of oil and gas in the entire globe and this assertion has been further buttressed with the enactment of the Petroleum Act [2021] for the efficiency of energy and natural resources in the country. The literature explored in this study explicitly indicated that Nigeria engaged both international oil companies (IOCs) and indigenous oil companies in the exploration, development, and exploration of oil and gas. However, India and Bangladesh have also engaged IOCs and indigenous oil companies but the studies explored in this paper are not clear in this regard. Similarly, regarding the consumption of energy, the analysis of previous studies showed that Nigeria possesses 73.5% of its energy consumption but it is relatively incomparable with India which is the third largest consumer of energy after China and the United States. In the case of Bangladesh, the country has a lot of potential with respect to the development of energy, and the roles of Petrobangla and the Bangladesh Petroleum Corporation (BPC) cannot be underestimated in the plan and strategy for the development of the sector [57].

However, there is an under-utilization of different sources of energy in the aforementioned countries. In fact, the three countries (i.e., Nigeria, India, and Bangladesh) have identified pollution and environmental damage as critical effects of the oil and gas sector. The literature has indicated that there is a lack of effective environmental laws which has enabled pollution to affect the lives of citizens. This is important because the countries should not only consider energy export as a fundamental source of economic sustainability but rather all challenges emanating from the resources serving as the bedrock of the nation's economy should be addressed as well. Furthermore, the Nigeria Coal Cooperation (NCC) is responsible for the mining of coal resources just like Coal India Limited is responsible for the supply of thermal coal in India. Nonetheless, Bangladesh also has the Directorate General of Hydrocarbon (DGH); however, the country needs to strengthen this directorate in order to address the challenges facing the sector. More importantly, gas is an important resource and an essential source of power in different parts of the world. The three countries also export liquefied natural gas (LNG), as used in Nigeria and Bangladesh, and liquefied petroleum gas (LPG), as used in India. Findings showed that the Energy Commission of Nigeria developed a Renewable Energy Master Plan (REMP) in 2005 while the National Energy Policy was developed in Bangladesh in 1996. However, available studies have not

explicitly elucidated a specific policy on renewable energy despite the fact that India is one of the leading countries investing in renewable energy. Undoubtedly, the analysis of this study has demonstrated that the three nations have similar sources of energy such as natural gas, coal, hydroelectricity, wind, petroleum reserves, etc.

The overall result of this study demonstrates that there are challenges inhibiting the efficiency of energy, crude oil, and natural gas in the three countries examined in this research. Nonetheless, the study indicated that the efficiency of energy, crude oil, and natural gas would enhance the exchange markets and economic growth of the aforementioned countries. Thus, this research has implications for policymaking, contributing especially to exchange markets and economic sustainability. Hence, different opportunities can be explored in the energy sector for improving the exchange markets in order to attain the sustainability of the economies of the three countries explored in this study.

This study is in line with a previous study that provided an in-depth analysis of the natural gas markets in Asia and it is useful for understanding the dynamics of natural gas markets in India and Bangladesh. In addition, this study provides a comparative analysis of energy access in India and Bangladesh and is useful for understanding the challenges and opportunities facing the energy markets in these countries. More specifically, the literature provides an in-depth analysis of the power and gas sectors in India and is useful for the diversification of energy markets in the country. Furthermore, an in-depth analysis of the power sector in Bangladesh was explored as well as the dynamics of the energy markets in Bangladesh. This study aligns with a study that provides a comparative analysis of energy security and sustainable development in Nigeria and South Africa and provides an understanding of the sector challenges facing energy markets as well as opportunities in Africa [58].

4.1. Policy Implications of the Study

There is a contrast in the security and accessibility of energy and gas in Nigeria, India, and Bangladesh. However, the frameworks in the three countries should lead to a gas-based economy and overall sustainable economic development. The policy implication of the study should address the following: reforms in markets in the gas sector, gas exchange, provision of benchmark prices of power and natural gas, boosting of the domestic production of gas, the roles of the Gas Exporting Countries Forum (GECF), and opportunities for collaboration and networking,

Firstly, it should be reiterated that there is a need to introduce reforms in markets in the gas sector. For instance, there is a need to be cognizant of demand-supply-price considerations as well as local taxes. This is paramount because these are issues that contribute to the inefficiency of markets and thus the government. One of the essential reforms that can be brought into the natural gas sector in the countries is an introduction to an integrated operation of gas management, supervision, and control as a meaningful positive step toward the development of gas markets. Similarly, regulators are expected to implement market-friendly policies in the power and natural gas industries.

Secondly, gas exchange is expected to provide flexible terms involving a contractual agreement among the parties, and the gaps between the requirement for the terms of the agreement and the availability of the gas product should be made explicit. Similarly, gas exchanges in the three countries can have frequent auctions on a monthly basis in accordance with the terms and conditions of the agreements among the parties that are involved. Hence, the creation of an integrated power plant that will give room for the purchase of gas from the gas exchanges and, in turn, selling electricity in a power exchange as a single transaction should be promoted. In so doing, the foregoing explanations will create competitive gas markets in Nigeria, India, and Bangladesh by instilling confidence among the suppliers and consumers in the natural gas sector.

Thirdly, the provision of benchmark prices of power and natural gas in the exchange market will help the three countries have collaborations towards addressing the challenges of financial trade and hedging solutions to both buyers and sellers of the product, respectively. Thereby, the aforementioned measures will help the policymakers and the active

players in the power and natural gas sectors in the countries to create an enabling environment for enhancing and sustaining a gas-based economy. Fundamentally, the price of gas produced in the three countries is determined by the weighted average gas price consumed in the USA and Mexico, Canada, Europe, and Russia. Nonetheless, high and international LNG prices are regarded as a basic challenge the countries are faced with; in order to stabilize the gas exchanges in the countries, there is a need to remove the barrier of an annual limit of a certain percentage imposed on the gas producers while selling the product through the exchange.

Fourthly, there is a need to boost the domestic production of gas and in so doing attempt to stimulate investment; the governments of these countries are to address the high regulations of lowered prices in domestic gas industries. The governments' policies, regulations, and guidelines in Nigeria, India, and Bangladesh are obscure on gas production and attempts have been made to allow freedom for the marketing of gas products. Thus, all factors that can hinder or distort the marketability of energy and natural gas should be addressed, especially if there is a need to create a risk manipulation in royalty revenue for the government. All the aforementioned considerations would help developing countries such as Nigeria, India, and Bangladesh in the gas market in order to achieve a gas-based economy.

Fifthly, the roles of the Gas Exporting Countries Forum (GECF) cannot be underestimated in determining the market and pricing of natural gas across the world. There has been advocacy for a long-term trend in the natural gas market and pricing in continental and regional settings; especially, there has been clamoring for a more harmonized and interrelated global gas market through which Nigeria, India, and Bangladesh can play active roles. This advocacy is necessary since LNG has become affordable and abundant. With the introduction of LNG trade in the gas sector, there has been an increase in the numbers of producers and consumers in national and international markets. These are fundamental factors contributing to the transformation of the natural gas industry market. The literature suggests that considering the aforementioned will add to the growth of the gas market as well as to the diversification of the economy with significant inputs from the trading importers and routes.

Sixthly, natural gas is traded globally through the existing transportation and storage capacities that are mostly conveyed through the networks of international pipelines. Nonetheless, the literature posits that the trading of gas in the Asian market is limited to seaborne trading as a result of geographic constraints; therefore, India and Bangladesh should meticulously explore how to open further opportunities beyond the identified geographical constraint. Similarly, Nigeria can also play an active role in Africa by partaking in the global natural gas market. Hence, this could open another vista of opportunity for the three countries by collaborating in the natural gas market. Notably, since the three countries are working towards joining the international community in the natural gas market, they must comply with the existing ethos pertaining to how the price is determined, which is the long-term-take- or pay bilateral sale and purchase agreements (SPAs) between the producer and consumer.

Notably, there are opportunities and challenges for energy trade in South Asia whereby there is an intra-regional energy trade. It should be stressed that there is a potential collaboration of trade between India and Bangladesh in the energy sector. More importantly, India possesses a surplus in the generation of energy; in the year 2022, the country possessed the highest capacity of solar energy in the entire world, accounting for 6.5% of the global cumulative capacity. Therefore, the exportation of energy to Bangladesh will significantly contribute to an investment in the power sector which helps the country to generate revenue earnings. In addition, there has been a collaborative effort between India and Nigeria to enhance the energy capacity in order to generate power that will drive the economy. Corroboratively, there are 135 Indian companies in Nigeria working on different levels in the energy sector which will open a new vista for business activities through regional energy cooperation. Similarly, Nigeria can also collaborate with South Asia, including India and Bangladesh. There is also a need to develop strategies for the enhancement of the energy sector in the three countries

in order to overcome the hindrances that might impede the joint development of the sector. Hence, in order to achieve different strategies that could enhance the energy sector, there is a need for proper planning, political will, and visionary leadership that could improve the overall system. Undoubtedly, the literature advocates for bilateral energy trade despite the fact that there are limited energy resources and rising demand for the cross-border trade of energy. Hence, there is a need to engage stakeholders toward expanding collaborations among the three countries in the energy sector.

4.2. Limitations of the Study

This research explicitly explored the existing research problems in the field of energy, crude oil, and natural gas exchange markets in Nigeria, India, and Bangladesh including:

1. Limited data availability and quality: In some cases, data on energy markets in these countries may be difficult to obtain or may be of poor quality, making it challenging to conduct a comprehensive analysis.
2. Lack of consistency in the data: In some cases, data are inconsistent across different sources, making it difficult to make accurate comparisons between the countries.
3. Limited research on the long-term implications of energy policies: While there is a lot of research on the short-term effects of energy policies, there is limited research on the long-term implications of these policies.
4. Limited research on the impact of energy market integration in the region: While there is some research on the energy markets in these countries, there is limited research on the potential impact of energy market integration in the region.
5. Limited research on the role of renewable energy in the energy mix of these countries: While there has been some research on the renewable energy policies in these countries, there is limited research on the role of renewable energy in the energy mix of these countries.

4.3. Future Scope for Research

Further studies could be conducted using a variety of methods, such as econometric analysis, policy analysis, and case studies, and they could be based on data from a variety of sources, such as government statistics, international organizations, and industry publications. The future scope for research in this field includes:

1. Further research on the impact of global events on energy markets: This could include analyzing the specific impact of different events on energy markets, such as the impact of political instability, natural disasters, and economic downturns, and identifying ways to mitigate these impacts.
2. Further research on the impact of government policies on energy markets: This could include analyzing the specific impact of different policies on energy markets, such as the impact of subsidies, taxes, and regulations, and identifying ways to improve these policies.
3. Further research on the impact of new technologies on energy markets: This could include analyzing the specific impact of different technologies on energy markets, such as the impact of renewable energy and energy storage, and identifying ways to improve the deployment and use of these technologies.
4. Further research on the impact of energy market integration on the global economy: This could include analyzing the specific impact of energy market integration on the global economy and identifying ways to improve the functioning of integrated energy markets.

5. Conclusions and Suggestions

This paper has explicitly elaborated on the importance of energy, crude oil, and natural gas which cannot be underestimated for exchange import markets in the current context of Nigeria, India, and Bangladesh. These three countries have been performing excellently with respect to the consumption of energy and the improvement of different

sources of energy. However, this paper has highlighted the environmental pollution emanating from the oil and gas sectors in these three countries. Thus, there is ineffective enforcement of environmental law as an attempt to solve the problem of the pollution of the environment. It has been highlighted that energy export and the export of liquefied natural gas (LNG) are considered important sources of economy in the three countries. The three countries (Nigeria, India, and Bangladesh) have extensively enhanced renewable energy sources such as solar, biomass, wind, and hydropower and have developed energy exploration, production, and distribution. However, this paper is not without limitations and fundamentally, the limitation of the study is that it solely depended on secondary literature. Nonetheless, the paper provides a substantial direction for future research in energy and natural gas in the contexts of the aforementioned countries (i.e., Nigeria, India, and Bangladesh). It is therefore suggested that:

1. The governments of the aforementioned countries should strengthen national policies on energy in order to be responsive to the global energy crisis.
2. The governments should enhance bilateral relationships among different nations in order to foster exchange markets of energy, crude oil, and natural gas in order to achieve sustainable economic growth in the aforementioned nations.
3. The challenges of pollution that can serve as an impediment to the market exchange of energy and natural gas in Nigeria, India, and Bangladesh need to be addressed.

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