BRIEFER

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Converging Risks in Nigeria: Nuclear Energy Plans, Climate Fragility, and Security Trends

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INTRODUCTION

On June 5, 2019, the Intelligence Committee of the U.S. House of Representatives held an open hearing on the national security implications of climate change. The government experts testifying pointed to Nigeria as an example of the complex ways in which such trends are emerging globally. As Peter Kiemel, a counselor for the National Intelligence Council, described:

> "...these places, like in West Africa in eastern Nigeria, for example, where you have water and drought as an issue intermixed with historic tribal rivalries, historic religious rivalries, and ethnic rivalries, you have water as a contributor to---and an intensifying factor in---those kinds of conflicts. And that provides opportunities for extremist groups, for terrorist organizations to take advantage of those conflicts to try and advance their interests as well."[1]

As Africa's largest economy with a monumentally large and young population, Nigeria is a critical country whose future is often seen as a key factor in regional stability. It is also experiencing a wide range of pressures, including domestic conflicts, terrorist threats, water stress, and one of the world's highest rates of urbanization, among others.

Like many countries, Nigeria's story is that of a fragile nation---facing many challenges but holding strong potential---seeking nuclear energy to help meet its mounting energy needs. This briefer provides an overview of Nigeria's nuclear energy plans, set in the context of its complex and dynamic security environment.

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NIGERIA'S NUCLEAR ENERGY PLANS

Nigeria's development is hampered by its limited power generation capacity. As of 2017, 54.4% of the country's residents had access to electricity.[2] At the same time as it is working to increase energy production, via the Paris Agreement Nigeria committed to a 20-30% reduction in greenhouse gas emissions by 2030. The government is leaning heavily on hydroelectric and solar power to reach this target, with several hydro-projects currently under construction and funded by Chinese firms. These include the long-delayed Mambilla power station, slated to become one of Africa's biggest dams.[3] An extensive solar power project meant to bring electricity to rural areas is also expected to be operational by 2023.[4]

The Nigerian government also considers nuclear energy a key part of its extensive energy system expansion and reforms. The Nigeria Atomic Energy Commission, originally created in law in the 1970s, went live in 2006. In the interim the country explored nuclear-related cooperation with France and others, including examination of domestic uranium mining, and established nuclear energy research centers at Ahmadu Bello University in north-central Nigeria and Obafemi Awolowo University northeast of Lagos. Both centers are still operating today.

Its early exploration eventually became more methodical, and Nigeria adopted a roadmap for its nuclear energy pursuits in 2007. The country later established numerous entities with roles in nuclear energy decision-making and governance, including an implementation body comprising relevant government ministries.

Nigeria's latest plans aim to produce nuclear energy by 2025 with 4,800 megawatts of capacity by 2035. As an important step toward this target, the country hosted an International Atomic Energy Agency (IAEA) Integrated Nuclear Infrastructure Review in 2015. This standard process evaluates a country's preparedness in security, safety, emergency response, fuel cycle plans, and more than a dozen other issues. The full report is not public, but the Nigerian government released the following action areas based on the IAEA's recommendations:

- "Nigeria should enact a comprehensive nuclear law.
- The regulatory framework should be strengthened.
- Fine-tune process and expectations and establish national specifications for the NPP [nuclear power plant] prior to the conclusion of key agreements.
- Plans to finalize the structure of relevant organizations and their human resources should be developed."[5]

Though it has made some progress, Nigeria is not yet on target to meet its nuclear energy development target; by its own timeline, this would have required construction to begin prior to 2019, and this has not occurred. Continuing to advance its program will require significant financing and personnel capacity building, further expansion of its electric grid that connects to some neighboring countries, and more.

There is more momentum in Nigeria's pursuit of nuclear energy cooperation deals with potential international suppliers. Its nuclear discussions with Russia began in the late 2000s. The two countries signed several cooperation agreements on a range of nuclear-related activities, with the most recent signed in 2017 for Russia's Rosatom to provide a new research reactor and a full nuclear power generation plant.[6] Though their potential nuclear energy cooperation is in earlier discussion stages, Nigeria and China signed a memorandum of understanding to explore the subject in 2018.[7]

So far, it appears the government favors contracting with one of these countries using a build-own-operate model. This means foreign suppliers (e.g., Russia or China) would not only construct nuclear reactors in Nigeria, but also operate the plants for decades and maintain some portion of their ownership for a designated period of time before they would be transferred fully to Nigerian ownership and operations. Current

plans indicate that the government expects the same country that supplies its nuclear reactors to help shape its approaches to nuclear safety, security, and fuel cycle issues.[8]

For now, Nigeria currently has one research reactor at the Centre for Energy Research and Training at Ahmadu Bello University in Zaria. It is capable of minor energy output but used mostly for education, neutron activation analysis, and other research purposes.[9] China provided technology and assistance in developing this research reactor, and remains involved.

Nigeria is also looking to develop a second research reactor (potentially as part of the aforementioned Russia deal). In 2018, this new reactor concept was the focus of the first of the IAEA's new Integrated Nuclear Infrastructure Review processes specifically for research reactors. The public readout of the review noted progress on Nigeria's part as well as the need for further work in cost assessments and human resource development.[10]

Though Nigeria's current research reactor is solely for peaceful purposes, until recently it harbored one notable threat: the presence of highly enriched uranium.

To remove potentially weapons-usable nuclear material from the country, Nigeria, China, and the United States began discussing the conversion of the facility to the use of low enriched uranium in 2011. The process was accelerated as domestic terrorist threats grew and momentum was built through the multilateral Nuclear Security Summit process. For years, nonproliferation experts warned of the security risks surrounding the material. The possibility of theft at Ahmadu Bello University's research reactor heightened as Boko Haram and other terrorist groups grew stronger.

The effort to remove the highly enriched uranium from Nigeria paused at times due to instability, but eventually formed a successful case of multilateral nuclear security cooperation. American, Russian, Czech, Chinese, and IAEA experts assisted in the material's removal and security in late 2018, with additional financial support from others. The fuel was flown to China on a Russian cargo plane. The operation cost nearly $5.5 million, with the United States providing the majority of the funding.[11]

Luckily, Nigeria is not currently a leading concern for nuclear weapons proliferation. As of today, Nigeria does not plan to pursue enrichment, reprocessing, or fuel fabrication as part of its nuclear energy program; and it has ratified and appears committed to several treaties that bind the nation to only peaceful uses of nuclear technology. This clarifies that as of today the top security priorities surrounding its nuclear program should be in safety, security of nuclear materials and facilities, accident and incident preparedness, and related matters.

THE SECURITY LANDSCAPE

The security environment in Nigeria as it continues to pursue the expansion of peaceful nuclear activities can only be understood by considering the confluence of risks that interact and at times compound one another in this important region. In the above-mentioned 2019 Congressional hearing, expert Peter Kiemel of the National Intelligence Council provided the following description of such interactions:

> "Terrorist groups have exploited natural disasters and water and food shortages in countries, including Iraq, including Nigeria where ISIS West Africa has exploited problems in northeast Nigeria, Pakistan, Somalia. They use this---these problems that intensify problems in governance, for example, or economic problems---they use those to boost recruitment and support...among local populations. And to the extent that these food and water shortages spark local conflicts, that also creates potential for the terrorist groups to move in and gain recruits or safe haven."[12]

This section briefly describes critical dynamics like these that build into Nigeria's security environment, before considering the implications for its nuclear plans.

Instability and Violent Extremism

Nigeria suffers from ongoing instability. The country's Human Development Index value rose by 13% between 2005 and 2015, yet the country's security situation has worsened over the last decade. The state struggles to provide basic goods and services, combat corruption, and calm ethno-national tensions, among other issues. Government forces are unable to exert control across the nation's full territory.

Violence has been on the rise in the mineral-rich northwest, where smuggling is a common challenge. Killings and kidnappings are steadily increasing nationwide. A 2018 poll of Nigerians about violence showed that most respondents believed government and national military forces were complicit in the country's violent extremism.[13]

Facts on Nigeria

Nigeria's 923,768 square kilometres---including arid plains, temperate plateaus, coastal lowlands, mountains, and lagoons---border Benin, Niger, Chad, Cameroon, and the Gulf of Guinea. The West African nation is home to the continent's largest population and economy. Nigeria has one of the largest youth populations in the world: 44% of its residents are under the age of 15.[38]

Current figures for the country's population hover around 190 million people. By mid-century, a point at which climate change effects are projected to be in full force, that number could skyrocket to over 400 million.[39]

Urbanization trends indicate that by this point, most of Nigeria's residents will likely reside in or around Lagos, the country's largest and densest city. At the same time, Lagos is projected to experience an estimated 800% increase in population exposure due to sea level rise by the 2070s.[40] Rapid infrastructure development has left little room for drainage, thus as Lagos grapples with higher seas and extreme precipitation events, its buildings and roads themselves are exacerbating flooding issues. The IPCC notes that flooding threatens the livelihoods of millions of Lagos residents.

Although petroleum accounts for up to 90% of export earnings, it represents only 25% of the national GDP.[41] The government's failure to adequately oversee the sector has served as fuel for seperatist groups and violence. Agriculture constitutes almost half of Nigeria's GDP and its related activities employ an estimated two-thirds of the population.[42] Despite the fact that Nigeria is a major producer, the country imports more food than it exports due to rising demand. Some studies indicate that future climate anomalies may lead to yield increases in certain agricultural subsectors, however over the longer term, precipitation changes and higher temperatures will negatively impact national agricultural outputs.[43]

According to an International Monetary Fund study, Nigerians rank unemployment, high cost of living, and corruption as the most important national issues.[44] In 2018, nearly half of the population lived in poverty and almost a quarter of the workforce was unemployed.[45] These challenges, and especially the search for better economic opportunities, are combining to shape the behavior of Nigerian citizens. One study by AfroBarometer indicates that 35% of Nigerians have considered emigrating to another country. Younger and more educated people more commonly consider leaving Nigeria.[46]

Boko Haram, a northeast-based terrorist group, has killed around 30,000 people and displaced more than two million over the last decade. Attacks have been primarily concentrated in the states of Adamawa, Borno, and Yobe and around the evaporating Lake Chad. Boko Haram's presence has devastated local trade, agricultural productivity, schools, and healthcare systems.[14] The conflict has contributed to rampant food insecurity and exposed millions in the region to famine.[15] However, in recent years there has been some progress as Nigerian security forces (in some cases in partnership with neighboring countries) have had some success in pushing militants out of occupied territories.[16]

Nigeria and the international community must contend with terrorist organizations beyond Boko Haram, including groups splintering off of it. The Islamic State in West Africa Province (ISWAP), for example, aims to form a separate state in the Lake Chad region and is actively working to take over military installations and towns in pursuit of a caliphate.[17]

Compounding and contributing to these terrorist threats in Nigeria's northeast, Lake Chad, which is bound by Nigeria, Niger, Cameroon, and Chad, has been vaporized by a combination of human pressures and climatic changes. Once covering an estimated 25,000 square kilometers, the lake has shrunk to about

1,500 square kilometers.[18] The desert continues to expand, encroaching on villages and consuming farmland.

These conditions have already forced millions from their homes in search of subsistence. In Nigeria, these groups include Muslim Fulani pastoralists looking for land for their livestock. As the Fulani spread out, they are clashing with Christian farmers, aggravating historical tensions.[19]

Porous borders make tracking and constraining terrorist groups like Boko Haram and ISWAP exceptionally difficult. The Global Security Contingency Fund, a joint tool of the U.S. State and Defense Departments, has contributed substantial funding for equipment and training for security organizations in the Lake Chad Basin, including Nigeria. This has included assistance in improving border security and increasing international collaboration [20]

Outside the northeast, the Middle Belt has become the setting of ethnic tensions between semi-nomadic herdsman pushed out by climatic factors and farmers. Further south, the Niger Delta is home to an independence movement fueled by environmental degradation and a perceived injustice related to the government's inability to compensate local communities with oil revenue.

Such tensions are not limited to Nigeria's landmass. Piracy rates along the Niger Delta and the Gulf of Guinea are some of the highest in the world. At the time of this publication, there is an ongoing kidnapping ordeal involving Turkish sailors captured off of the Nigerian coastline.[21] However, on a positive note, the International Maritime Bureau's first quarter report of 2019 notes that piracy incidents in Nigerian waters have decreased since 2018. This is mainly due to the Navy's increased response efforts.[22]

Climate Security Issues

According to a 2018 United States Agency for International Development (USAID) study, Nigeria faces extremely high compound fragility risks, with approximately 24% of the population living in "high climate exposure areas."[23] Nigeria's climate issues are roughly divided by its geography. In the northern part of the country, periodic drought has decimated communities and agricultural productivity. Declining precipitation rates, coupled with human-induced land degradation, have led to extreme desertification. Estimates indicate that up to 60% of the country has been impacted by this process.[24]

In the central and southern parts of the country, the presence of too much water either from overflowing rivers or rising seas often threatens communities. In 2012, the worst flood in decades inundated hundreds of thousands of acres of farmland and displaced more than two million people.[25] As a result, growth in agriculture and trade stagnated. In 2018, heavy rains forced the Nigerian government to declare a national disaster in four different states.[26] Climate forecasts indicate that these extreme weather events are likely to continue, which could strain government resources.

The topography along the coast and delta consists of low lying terrain and an intricate network of waterways, making the area prone to storm surges and flooding. A one-meter rise in sea level could submerge an estimated 75% of the Niger Delta.[27] However, Nigeria may be forced to deal with massive population movement far ahead of that juncture. At a half-meter of sea level rise, USAID estimates that 27 to 53 million people could be displaced.[28]

By the 2060s, mean annual temperatures are projected to increase anywhere from 1 to 2.5 degrees Celsius. If temperatures rise by even 1.5 degrees Celsius, residents in Lagos will be confronted by waves of deadly heat stress.[29] Climate models forecast minor increases in mean annual precipitation, but heavier rainfall in shorter time frames will become commonplace throughout the country. Even taking these conditions into consideration, there is an overall consensus that there will be a precipitous decline in freshwater availability along the southern coast, east, and the arid north.

While on the surface these conditions seem at opposite ends of the spectrum, intense flooding and rapid desertification are already both part of the acute nature of climate impacts in Nigeria. The nation's authorities are aware of the country's climate vulnerabilities and have attempted to incorporate various ad-

aptation methods. Some of the flood resilience strategies being utilized in Nigeria include sea barriers, reforestation of mangroves, bolstering existing infrastructure, and raising transportation routes.[30]

In order to help slow the spread of desertification, Nigeria's government intends to plant a wall of vegetation along the southern edge of the Sahara desert. The government is also promoting advocacy programs via workshops and media campaigns, hosting climate change summits, and supporting reforestation efforts.[31]

It is clear the Nigerian government and people recognize how climate challenges affect their lives and have committed to reducing greenhouse gas emissions even as they try to rapidly expand the country's energy sector. As mentioned previously, nuclear energy is one part of that equation.

Nuclear Security

This broad context will continue shaping security dynamics for Nigeria and its neighbors. If not adequately addressed, the interactions among subnational and terrorist groups, environmental change, population displacement, and more will mean that Nigeria will require unique approaches to security regarding its nuclear energy sector.

The Nigerian government and nuclear officials already show some concern regarding these issues. The country is party to many important nuclear safety, security, and nonproliferation treaties and conventions and shows dedication to longstanding international norms on these issues. These include the Treaty on the Non-Proliferation of Nuclear Weapons and Additional Protocol, the Pelindaba Treaty (or African nuclear weapon-free zone treaty), the Convention on the Physical Protection of Nuclear Material, and others. Nigeria also participated in the Nuclear Security Summit process and has a regular presence in international security discourse.

All of these measures are critically important. Yet whether they will be sufficient as the country's nuclear program expands, depending on how Nigeria's security landscape evolves, remains an open question.

A 2016 document on nuclear security produced by the Nigeria Atomic Energy Commission contains a country map showing nuclear site locations as well as areas of violent extremist control; and lists, in brief, measures the country is taking to dynamically account for its threat environment and promote a culture of nuclear security and responsibility. It describes:

> "As in many countries of the world, home grown violent extremism exists in Nigeria. Its implication for the Nigerian nuclear power programme is in the area of insider threat that could arise from internal radicalised personnel or external radicalized persons in collusion with internal personnel seeking monetary gains or for ideological reasons."[32]

While the Nigerian government is rightly focusing much on its significant violent extremist threats, it must also account for other risks growing and converging in ways that could alter the security landscape surrounding its nuclear energy program. It is worrisome that its nuclear agency described in the aforementioned 2016 document that "It is to be noted that the proposed new nuclear facilities are to be located in areas where fortunately, none of the homegrown violent extremism has the potential to take place."[33]

This is a sweeping statement that no country can state with full confidence regarding nuclear sites that will be active decades into the future. In just one example, some of the longstanding conflicts between herders and farmers that have at times provoked action by Nigeria's military are located within the same regions as current research reactors and possible future sites. Given that these conflicts can intertwine with violent extremism and other threats, they should not be minimized in evaluating the country's nuclear security needs.

Furthermore, though it will likely be infrequent for some time, Nigeria will have to move nuclear materials within the country. It will have to ensure fuel and isotopes are secure as they are transported to and from any research reactors or eventually nuclear energy production sites, and any time they are moved for

storage or disposition purposes. Avoiding areas held by violent extremist organizations will be a given, but a full accounting of nationwide risks as any nuclear materials are transported will still be required. The extreme caution taken in the 2018 removal of highly enriched uranium from Nigeria's research reactor highlights this point.

Other evidence from Nigerian nuclear experts shows clearer recognition of how far the country will have to come to meet the security and safety needs of its nuclear sector. While Nigeria has gained from significant nuclear security collaboration with the IAEA and others, it must finalize relevant national laws and regulations, train personnel in security approaches adequate for the country's threats, and more.

A 2019 briefing by NAEC representative Matthew Nnamdi Agu also smartly acknowledged that some of the greatest security inadequacies can arise during the phase when new nuclear reactor sites are being designed. These issues include "High level classification of design basis threat (DBT) such that designers are not able to access it as well as understand security requirements" and "Low perception of threat among designers: security has often has a low profile among designers because they do not perceive threats being real."[34]

These problems are common to many countries. Compounding these human behavior issues, security risks change over time and can evolve rapidly, which can make the threat basis on which nuclear sites are designed outdated for adequately preparing their country. A reality of the 21st Century is that risks that seem highly unlikely one year can readily manifest the next. The process of preparing for changing and converging threats requires sophisticated tools and strong leadership in any country's nuclear program.

On the positive side, it is a head start that Nigeria has knowledgeable experts well aware of the complexity of security surrounding the nuclear energy program that the country is working to expand. It is also clear that unless many related trends are altered, Nigeria's security landscape will pose daunting challenges to its nuclear sector. The country's institutional and personnel capacities must continue to grow in order to be fully prepared to mitigate them.

RECOMMENDATIONS AND CONCLUSION

There are many signs that the Nigerian government recognizes and is working to address the issues this report highlights. And it is worth emphasizing that the country holds significant resources, especially in its vast and connected youth population, to bring to the challenge. Yet if current constraints and internal pressures continue, it is likely that international assistance will still be needed to help Nigeria prevail against its nuclear, climate, and other security risks.

In nuclear affairs, the United States and others should continue to praise Nigeria's decision to refrain from concerning nuclear fuel cycle activities and its work to fully participate in layers of international nuclear safety and security conventions.

There may also be areas ripe for future nuclear cooperation. The United States and many of its close international partners have had significant success in collaborating with other countries to improve practices regarding the transport of nuclear materials, for example. Nigerian experts have also benefited from collaboration and training with several U.S. National Laboratories. Such work should continue if possible, and the National Lab programs that support international civil nuclear education and cooperation should be sustained or possibly expanded.

The build-own-operate model Nigeria now favors for its nuclear sector may help the country obtain much-needed project financing and support in expanding the nuclear human capital it needs. However, it could also lock the country into tight, multi-decade relations with whatever supplier gets its nuclear contracts (likely Russia if current trends prevail). This can marginalize much-needed support by other countries, whether intentionally or simply due to lack of sufficient institutional capacity to manage the diplomatic, legal, and technical aspects required of multilateral nuclear collaboration. International experts should advise the Nigerian government on the importance of continuing cooperation, especially regarding

nuclear safety and security, with numerous partner countries no matter who provides its future nuclear reactors.

The United States currently has no 123 Agreement in place with Nigeria (and only three concluded with any African country). These agreements are legally required for the United States to supply most significant nuclear energy technology or materials, and are used in part to hold recipient countries to high non-proliferation, safety, and security standards. Nigeria may not be interested in such an agreement with the United States. Still, the U.S. government should make a strategic decision about whether and how pursuing 123 Agreements or less-extensive nuclear cooperation pacts with Nigeria and other African countries would advance its interests. The current dominance of Russia and China in the region's emerging nuclear energy discourse should play a role in setting such policies.

For a nation that is so reliant on environmental- and resource-oriented industries, Nigeria's economic security is straddling a precipitous line that could be aggravated by climate impacts. International support in helping the country diversify its economy away from climate sensitive sectors such as oil and agriculture would help, as would supporting industries that can accommodate the needs of a booming youth population. Expanding economic opportunities may also steer residents away from supporting extremist groups.

Information sharing will also be critical for Nigeria's adaptation to the climate change-altered world. An up-to-date and widespread weather forecast system could decrease fatalities and other negative outcomes. One study tracking how Nigerian rice farmers were adapting to climate change impacts recommended that the government share weather forecast information via rural radio stations in local languages to ensure that all populations could adequately prepare for extreme events.[35]

For the United States, its national security, defense, and diplomatic strategies require a consistent and thoughtful approach to countries like Nigeria and Africa broadly---however humble the objectives may need to be.[36] The U.S. government and other nations continue to provide security assistance. However, the legal ability and political will to do so have been constrained by trust issues on all sides as well as human rights violations, financial crimes, and other acts by Nigerian officials and forces.

In light of these issues, the threads of how security threats converge in Nigeria may offer productive areas of cooperation to augment traditional means. As the Council on Strategic Risks' Working Group on Climate, Nuclear, and Security Affairs described in 2018, all new nuclear energy systems developed "need to be highly sensitive to both climate considerations and security risks."[37] Likewise, any approach to reducing terrorist activities must account for underlying economic, social, and environmental drivers in order to be effective over the longer term.

American government and nongovernmental organizations can do more to collaborate with Nigerian counterparts in advancing many types of analytical and planning tools designed to assist in understanding and addressing such complex challenges. Disaster risk reduction efforts also tend to bridge these needs well, and have the dual purpose of helping to improve preparedness for nuclear incidents in countries seeking to expand nuclear energy programs like Nigeria.

While headlines in the West will likely continue to focus mainly on the actions of Nigeria's terrorist groups and other high-priority threats, more attention must go to the layered and converging character of many of the country's trends and challenges. The potential of an expanding nuclear energy presence in the country raises the stakes of Nigeria succeeding in addressing numerous, interrelated risks and better tapping the potential of its human and natural resources. It is incumbent on the United States and the international community to find win-win ways to contribute to this goal.

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