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## CHAPTER 8

# Implications of COVID-19 Pandemic on Energy and Environment Research in Nigeria

*Olatokunbo Ofuyatan, Joshua Ighalo, David Olukanni,  
Adewale Adeniyi, and John Oluwafemi*

## INTRODUCTION

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1 In the last part of December 2019, a new strain of the Coronavirus known  
2 as COVID-19 began to spread from mainland China (Novel, 2020). Due  
3 to the high infection rate (Liu et al., 2020), it spread through most  
4 countries of the world within a few months (WHO, 2020). The emer-  
5 gence of this pandemic virus is unknown (El Zowalaty & Järhult, 2020).  
6 COVID-19 is a zoonotic virus. From phylogenetics analyses undertaken  
7 with available full genome sequences, bats appear to be the reservoir  
8 of COVID-19 virus, but the intermediate host(s) has not yet been

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1



9 identified. The pandemic has a doubling widespread effect on the human-  
10 to-human transmission affecting the lower respiratory tract of patients  
11 with pneumonia (WMHC, 2020). The WHO announced that the official  
12 name of the 2019 novel coronavirus is coronavirus disease (COVID-19),  
13 early patterns have shown a trend similar to Severe Acute Respiratory  
14 Syndrome (SARS) and the Middle East respiratory syndrome (MERS)  
15 coronaviruses (Fehr et al., 2017). More specific statistics are not given in  
16 this paper as infection rates are so high that they quickly become outdated  
17 a few weeks after writing.

18 Nigeria is the most populated black nation on earth with a population  
19 of over 200 million people (NBS, 2018). Studies have shown that the  
20 aged have the highest fatality rate for COVID-19 (Dowd et al., 2020).  
21 Considering that Nigeria has a fairly young population (Stanislas & Iyah,  
22 2016), there is a chance that the death rate might not be high in the  
23 country due to the poor existing healthcare system. The daily reported  
24 number of cases has been on the rise over the past week and this is likely  
25 going to continue for the short term. As of May 2020, there are over  
26 3000 COVID-19 cases in Nigeria. This statistic is changing almost every  
27 day hence specific figures are not presented. The real number of infected  
28 persons is most likely far higher here than these reports. If this is true,  
29 it means there are numerous individuals unaware of their infection who  
30 currently are not in self-isolation. As in the case in Italy (Remuzzi &  
31 Remuzzi, 2020), there could be an explosion of reported cases, deaths  
32 and a total failure of the healthcare system to cope.

33 In a paper published on the 2nd of March by Mustapha et al.  
34 (2020) (and probably written a few weeks before that), strong optimism  
35 was expressed at the preparedness of the country for the COVID-19  
36 pandemic. However by the 11th of March, Ebenso and Otu (2020)  
37 already raised questions on Nigeria's preparedness albeit not giving full  
38 discourse and the situation. A lot has changed in that time and now.

39 In this chapter, the implications of the COVID-19 pandemic on  
40 research in energy and environment are discussed. The extent of prepared-  
41 ness and the current scenario of Nigeria was gauged based on the  
42 synthesis of the efforts as a backdrop of Nigeria's population. The poten-  
43 tial for positive environmental consequences of the lock-down due to the  
44 COVID-19 pandemic is highlighted.

## THE CURRENT SCENARIO

45  
46 As originated from the index case, the epicentre of COVID-19 outbreak  
47 in Nigeria was Lagos state (Durotoye et al., 2020). Most of the early  
48 cases were in Lagos state, Abuja and Ogun state. Lagos being the former  
49 headquarters of the government has the highest population density, Abuja  
50 being the headquarters of government and Ogun being an industri-  
51 alised state. This has now rapidly spread to the northern part of the  
52 country. The healthcare system in Nigeria is quite poor for a popula-  
53 tion of over 200 million people. There has been a long history of poor  
54 funding, mismanagement and corruption in the health sector in Nigeria  
55 (Anaemene, 2016). The country neither has enough hospital beds nor  
56 ventilators for the COVID-19 pandemic and more ventilators were not  
57 purchased (Ibeh et al., 2020). There have been efforts to increase the  
58 available bed spaces, but these will not be enough at the peak of a crisis.

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59 The indigenous educators and researchers are trying to seek all possible  
60 avenues to reawaken their sense of responsibility to avoid the Italian  
61 (Remuzzi & Remuzzi, 2020) and Iranian (Arab-Mazar et al., 2020)  
62 scenarios. Nigeria Centre for Disease Control (NCDC) has so far done an  
63 excellent job of updating Nigerians on the reported cases and sensitising  
64 the populace on appropriate measures and precautions for self-protection  
65 via her official Twitter feed (Reuben et al., 2020). However, the individ-  
66 uals with social media presence and those in the rural areas are not as  
67 enlightened about the pandemic. More awareness will need to be made  
68 at the grassroots level to avoid a high mortality rate from the pandemic  
69 (Olapegba et al., 2020). There would need to be more proactive testing  
70 as there are concerns that the current low numbers are due to few tests  
71 being done and numerous individuals are still moving about completely  
72 oblivious of their infection. Finally, there needs to be more government  
73 investment in the health sector (in the short term) so that personal protec-  
74 tive equipment (PPE), ventilators and other needed infrastructure can be  
75 put in place (Adesegun et al., 2020). It must, however, be said that this  
76 is a little too late as there are production orders from numerous countries  
77 and manufacturers are currently struggling to meet up.

## A CHANGING PARADIGM IN THE ENVIRONMENT

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79 Recent studies have shown that human activities have led to polycyclic  
80 aromatic hydrocarbons in sediments and marine organisms in the coastal

environment (Sun et al., 2018), poor nutrient cycling and food web dynamics in lacustrine ecosystems (O’Beirne et al., 2017), reduced taxonomic and functional diversity of bacterio-plankton communities in lotic ecosystems (Meziti et al., 2016), dwindling ungulates (M’soka et al., 2017), sea-birds (Miller et al., 2019) and fish (Teichert et al., 2016) populations and a host of others (Mahmoud & Gan, 2018). Reduced human activities could lead to the amelioration of environmental pollution as most pollution sources are known to be anthropogenic (Adeniyi & Ighalo, 2019; Ighalo and Adeniyi, 2020a). It could also lead to ecological changes as animal, hunting and feeding routines, gestations, breeding and migration patterns could also change.

Several key questions are relevant in the domain of the research area. How has this period of self-isolation, quarantine and restricted public movement and reduced commercial activities affected the extent of environmental pollution in Nigeria? What air, water and soil quality parameters are most improved due to the lock-down and which are unchanged? If there are other significant environmental changes during this period, what are they? And what are the mechanisms and processes facilitating it? What significance does this bear in the long term for environmental pollution research, if any? What will be the long-term implications environmental implications of the COVID-19 pandemic on the environment especially in the domain of sustainability and climate change? These issues are all in the domain of research in environmental science and pollution.

It is highly likely that indigenous journals in environmental science and engineering would begin special issues on the subject and put up call-for-papers to encourage researchers to investigate these observations in scientific studies. The authors foresee a new generation of research papers focused on data inventorying on the recent developments in the environment. Investigations will abound on the mechanisms of environmental pollution and how the recent changes in the dynamics have affected these mechanisms. Furthermore, ecological research would not be left behind as the way organisms relate with the physical surrounding would change both the aquatic, terrestrial and arboreal domain.

Though this might not lead to drastic policy changes in Nigeria, there is a likelihood of policy adjustments (slackening) in environmental laws if long-term positive environmental influences are observed. Furthermore, there would be a pressing need by industries affected by the lock-down to

119 make up for lost ground in productivity and profit. This would indirectly  
120 place more pressure on the environment in due course.

121 Based on this, the authors express scepticism on the true long-term  
122 positive environmental implications of the pandemic in Nigeria. All stake-  
123 holders might not be ready to take advantage of this opportunity except  
124 there are drastic post-pandemic changes in modus operandi down to the  
125 ones regarding the most basic lifestyle patterns. This is where the issue of  
126 sustainability needs to be revisited. Sustainability is a concept that boils  
127 around avoidance of the depletion of natural resources to maintain an  
128 ecological balance (Huetting & Reijnders, 2004). Sustainable processes  
129 try to minimise and mitigate the negative environmental impact. These  
130 sustainable processes are monitored by economic, social and environ-  
131 mental indicators (Amrina & Vilsi, 2015). A potential way of banking  
132 on the post-pandemic environmental advantage is to maintain focus on  
133 the tenets of sustainability in most of its applied domain.

## 134 IMPLICATIONS ON ENERGY 135 AND ENVIRONMENTAL RESEARCH

136 African countries are at high risk of being decimated by the pandemic due  
137 to lack of preparedness but there are already improvements in this regard  
138 in recent times (Gilbert et al., 2020). Most research labs are closed and  
139 researchers are now working and teaching from home. Global research  
140 output is likely to be on the decline in the coming months in most  
141 specialisations in science, engineering and technology if the lock-down  
142 due to the pandemic continues. In this section, the authors discuss the  
143 current and potential implications of COVID-19 pandemic on energy  
144 and environment research in Nigeria and the place of computer-based  
145 simulations as an alternative solution for research productivity. There are  
146 generic scenarios presented in this discussion, the peculiar challenges of  
147 the indigenous African researchers are carefully highlighted.

148 In most African countries, it is quite difficult to get funding for  
149 research activities (Teferra & Altbachl, 2004) even before these pandemic  
150 times. This has made it difficult for researchers to publish quality papers  
151 (in SCOPUS indexed journals). Research output in STEM from African  
152 countries has been relatively quite low in quality and quantity (North  
153 et al., 2020). Furthermore, most indigenous researchers fund their energy  
154 and environment research by themselves. The COVID-19 pandemic

155 might not in itself affect funding in this scenario, as it was almost non-  
156 existent in the first place. However, there are other short and long-term  
157 implications for indigenous researchers.

158 In the short term, access to labs is one of the major issues. Tertiary  
159 institutions in most of these developing countries have been shut down  
160 and only virology labs (in a few cases) are allowed to run. This would  
161 mean that experimental studies would be difficult to perform at these  
162 times. With the COVID-19 likely to be around till the summer and  
163 maybe beyond (Yong, 2020), it means that the already meagre research  
164 productivity would be greatly hampered. Furthermore, already running  
165 research works have now been prematurely paused or terminated due to  
166 the pandemic (Jacob et al., 2020). Distractions from family members and  
167 the psychological hindrance from working from home are general factors  
168 that are affecting researchers in these times. However, peculiar to the  
169 Nigerian researcher is the lack of stable electricity and internet connec-  
170 tions in their homes to sustain office levels of productivity. These are  
171 usually available on the university campuses where research works were  
172 always done.

173 In the long term, there are bound to be physical health issues on  
174 the researchers due to extended periods of self-isolation. Humans are  
175 social animals (Frith & Frith, 2007). Mental health could be a problem  
176 too for those who have self-isolated without the presence of family.  
177 There is likely to be a downturn in the growth of the already weak  
178 economy and economic depression in more severely hit countries (Ozili,  
179 2020). Researchers might get laid-off and research students might have  
180 to discontinue studies. This is also a significant challenge in the long term.  
181 This would mean that the post-pandemic research contributions from  
182 Nigeria to energy and environment research are likely to be epileptic at  
183 best.

184 In the area of energy policy, Nigeria is usually quite reactive (and  
185 not proactive) to such challenges. There have been recent policy adjust-  
186 ments in Nigeria to mitigate the cost of electrical energy. What else can  
187 be done about these issues? This discussion would only make sugges-  
188 tions regarding the measures researchers can take to improve research  
189 productivity. Other wider issues would require more technical analysis and  
190 investigations to come up with a sustainable and workable road map.

## THE WAY FORWARD

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The indigenous researchers in energy and environment have always shown little interest in *silico* studies. This research team has tried to change that paradigm over the past year as we have utilised computer-based models (Ofuyatan & Edeki, 2018b) in investigating a variety of renewable energy systems ranging from pyrolysis (Adeniyi et al., 2019c; Ighalo & Adeniyi, 2019), steam reforming (Adeniyi et al., 2019a, 2019b) and air gasification (Adeniyi et al., 2019d; Ighalo and Adeniyi, 2020b). This is a call to researchers in energy and environment in Nigeria in particular and developing African countries in general to embrace the opportunities in process modelling and simulations to advance their research. It would be very important that we take up this gauntlet in times when we are being affected by the pandemic. Though it was quite important in the pre-pandemic times, such studies are even more important now with restricted access to labs (Ofuyatan & Edeki, 2018a). If we do not accept such a challenge, then we could end up experiencing a near-zero research output and productivity in the coming months in light of the current global health challenges.

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## CONCLUSIONS

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In this paper, the current and potential implications of COVID-19 on energy and environment research in Nigeria were discussed. Due to the high infection rate and lack of vaccine and cure, COVID-19 has now affected most countries of the world. The extent of preparedness and the current scenario of Nigeria was gauged based on the synthesis of the efforts as a backdrop of Nigeria's population. More isolation centres will need to be prepared across the 36 states on the federation as there is likely to be an upsurge in the reported cases in the coming months. There would need to be more proactive testing as there are concerns that the current low numbers are due to few tests being done and numerous individuals are still moving about completely oblivious of their infection. There needs to be more government investment in the health sector (in the short term) so that personal protective equipment (PPE), ventilators and other needed infrastructure can be put in place.

The potential for positive environmental consequences of the lockdown due to the COVID-19 pandemic is highlighted. Some important



226 questions were raised on the subject in the domain of research in envi-  
 227 ronmental science and pollution. How has this period of self-isolation,  
 228 quarantine and restricted public movement and reduced commercial  
 229 activities affected the extent of environmental pollution in Nigeria? What  
 230 air, water and soil quality parameters are most improved due to the  
 231 lock-down and which are unchanged? If there are other significant envi-  
 232 ronmental changes during this period, what are they? And what are the  
 233 mechanisms and processes facilitating it? What significance does this bear  
 234 in the long term for environmental pollution research, if any? What will  
 235 be the long-term environmental implications of the COVID-19 pandemic  
 236 on the environment especially in the domain of sustainability and climate  
 237 change?

238 For research in energy and environment, there is a lack of access to  
 239 labs, psychological hindrance of working from homes and lack of stable  
 240 electricity and internet connections at homes. In the long term, there are  
 241 bound to be physical and mental health issues on the researchers due to  
 242 extended periods of self-isolation (especially for those without the pres-  
 243 ence of family in their locations). This is a call to indigenous researchers  
 244 in energy and environment area in developing Nigeria to embrace the  
 245 opportunities in process modelling and simulations to advance their  
 246 research.

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