

Covid-19 and the and the Nigerian Environment: The Way Forward

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Abstract:- The COVID-19 pandemic is still on the increase in some parts of the world. This virus has since mutated despite then availability of vaccines. Death rates in places like India have continued to rise. COVID-19 and its impact on the Nigerian environment was reviewed, with the aim of finding lasting solutions to its impacts. It is no longer news that COVID-19 pandemic as well as climate change are somewhat interwoven and both are regarded as global emergencies. In this review COVID-19 was found to have immense impacts on the Nigerian environment which led to improved air quality, low levels of emission especially in highly populated areas like Lagos and Port Harcourt. This calls for a shift from fossil fuel to renewable energy sources if these unintended benefits are to be sustained. Apart from this, the pandemic had a higher impact on agriculture, where COVID lockdown affected household food security and safety, poor management of waste, which subsequently could give birth to water and other environmental pollution. As a result there is need to sustain efforts at reducing emission levels, above and below ground carbon by making available renewable energy sources. To ensure these, adoption of measures like the use of zoom meetings while increasing bandwidth to accommodate more people on the platform is a step in the right direction. The implementation of a climate smart agriculture, practicing digital agricultural extension, regulating markets, and the use of trade-off analysis, where precision agriculture can be practiced are among the few practicable solutions to ameliorate the impact of COVID-19 on the environment. Despite the impacts that COVID pandemic has had on the Nigerian environment there is hope that with the right policies on deck, some of the unintended benefits can be maximised.

I. INTRODUCTION

Basic ecological studies addressing the effects of human activities on ecosystems include a body of literature on the sustainability of direct resource exploitation, and other major literature on the effects of by-products of human activity, such as pollution, habitat destruction and climate change. It is a well known fact that human beings and nature are part of an interconnected system. While nature provides food, water, air and many other benefits that have enabled man to prosper, the over-exploitation literature has moved

in recent years from a concern with the sustainability of particular levels of harvest mortality, in terms of the population trends of the species being harvested, to a wider concern about ecosystem effects of harvesting, and a more nuanced understanding of the heterogeneity of harvesting effects between species and locations [1,2]. A good example can be seen, in Climate change, mass deforestation, rapid urbanisation, conflicts causing mass movement of refugees, poverty and inequality which exacerbate threats of a breakdown, leading to the outbreak of COVID-19. It is like nature re-asserting itself, turning on a switch that says enough is enough. By this nature is sending us a message with the Corona Virus and the ongoing climate crisis; the direct interactions between individual people and nature (here after human –nature interactions) have attracted growing interest. The principal reasons are fourfold. First, and foremost, there is increasing evidence that direct interactions with nature can provide people with a range of health and well-being benefits [3,4,5], and can play an important role in addressing some chronic health conditions and reducing the need for pharmaceutical interventions [6,7]. Second, there is societal fear and awareness of the negative consequences of some human –nature interactions, such as attacks on people by wild large carnivores [8,9,10], poisoning by venomous animals [11], wildlife – vehicle collisions, Corona zoonotic – like Ebola, Avian Flu, Rift Valley fever, West Nile fever, Zika [12], worsen as wildlife habitats are destroyed; COVID-19 is zoonotic virus - bats appear to be the reservoir of the virus; [13] and the risk of vector-borne zoonoses [14]. The emergence of zoonoses, is linked to the reduction and fragmentation of habitat, pollution, proliferation of invasive species and increasing climate change [15]. The more we change the environment the more likely we are to disrupt ecosystems and provide opportunities for diseases to emerge [16,17]. Third, there is evidence of a progressive decline in positive human nature interactions, the so-called ‘extinction of experience’, with potentially serious consequences for human health, as can be seen with the advent of the Corona virus epidemic [18,19,20,21]. Scientists consider three different types of change that allow virulent pathogens to initiate a new move from host to human. Changes in the environment, in either host, or in the pathogen. Changes in the environment are usually the result of human activities, ranging from land use change to changing climate. Climate change influences environmental conditions that enable or

disable the survival, reproduction, abundance, and distribution of pathogens, vectors, hosts, disease transmission and outbreak frequency. Lastly, recent technological advances in tracking and sensing devices, as well as in environmental monitoring, have greatly improved the ability to describe and quantify an individual person's interactions with nature [22,23,24,25].

Statement of Problem

Humanity is putting too much pressure on the natural world with dangerous consequences, one of which is the evolution of the Corona virus. The immediate priority was to protect people from the Corona Virus and prevent its spreads, in the long-term must be in tackling habitat and Biodiversity loss [26]. Never before have so many opportunities existed for pathogens to pass from wild and domestic animals to people; has our continued erosion of wild species brought us uncomfortably close to animals and plants that harbour diseases that can jump to humans. The unanswered questions are; how have these emerging diseases especially the Corona virus impacted the immediate environment of man? What are the gains and losses of this impact and what measures are there to ameliorate these impacts to the benefits of man and the entire ecosystem? This work puts Nigeria on the forefront of its discussion.

II. METHODOLOGY

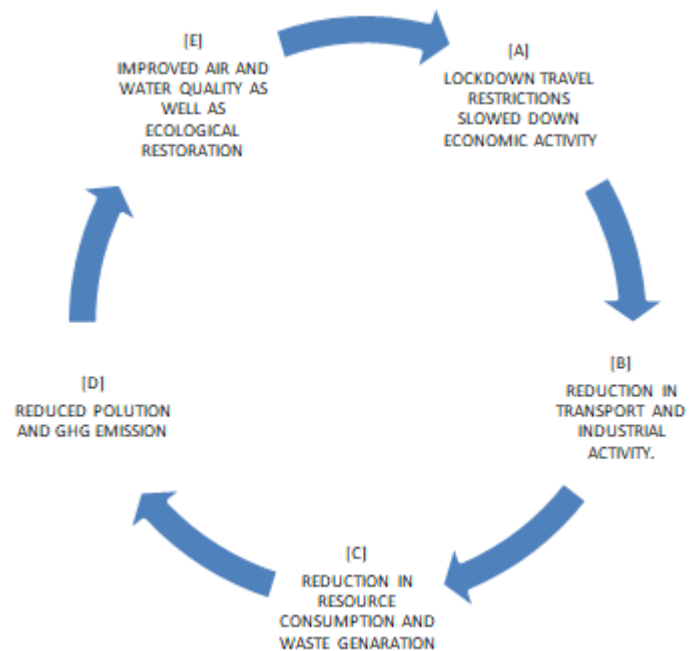
The methodology for this study was carried out by re-examination of published literature, case studies, and different government and non-government organizations, information from reports, and official websites that are currently available. Scientific journals and literature were also collected through electronic means from diverse databases, although, this was not done systematically. Conference presentations were also reviewed. From a wider perspective of studies, this study compiles and presents the data and information which are relevant to the environmental effects of COVID-19 as it regards Nigeria, as a country, hence mirroring the problem statements and providing relevant suggestions to contain the problems.

Theoretical framework.

The model of human interaction with the environment was firstly recommended by Hammond [27]. As human activity expands and degrades or encroaches upon ecosystems, it can reduce the environment's ability to provide some basic resources, while increasing harmful organisms, which can impact negatively on the balance/stability of the ecosystem. The types of environments that affect behavior may be physical (e.g., weather or climate, community resources, the built environment, the information environment), or social (e.g., social support, norms, beliefs, and attitudes) as well as objective (actual) or subjective (perceived) [28]. The environment can be a particularly strong behavioral determinant for behaviors that are directly shaped through environmental constraints and supports, such as physical activity [29,30]. The global disruption caused by the COVID-19 has brought about several effects on the

environment and climate, which could be both positive as well as negative [31].

➤ Positive impacts of covid 19

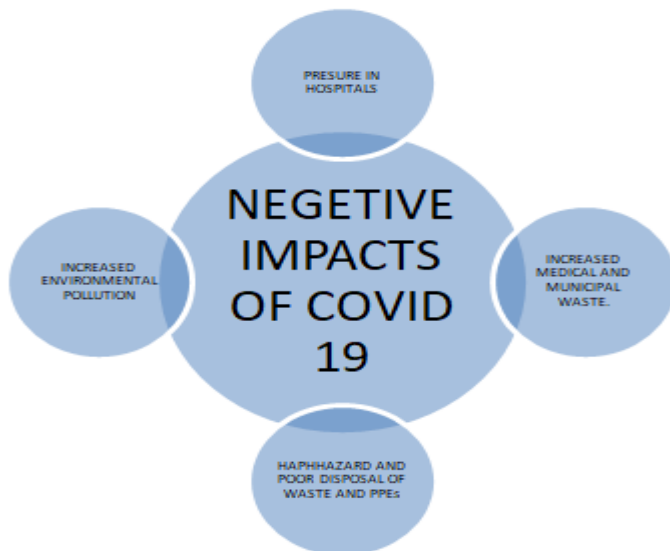


POSITIVE ENVIRONMENTAL IMPACTS OF COVID-19

Source : Excerpt from [31,32,33,34,35,].

COVID-19 triggered a lot of changes across the world. Entire cities were shutdown; transportation systems (air, rail, sea) were all but nearly stopped [36]; industries closed; Public places were shut down; generally, People slowed down, and stayed at home. The earth was given chance to breathe again. Scientists are recording how quickly the climate and nature far and wide are already revitalising from human climate change damage. Compared with this time last year, levels of pollution in New York had reduced by nearly 50% [37]. In China emission levels fell 25%, coal use fell by 40% at Six China is largest power plants [38,39]. The proportion of days with "good quality air" was up 11.4%; compared with sometimes last year in 337 cities across China. In Hong Kong, air quality improved with key air pollutions dropping by nearly a third from January to February [33, 34, and 35]. Satellite images released by NASA and European Space Agency showed a dramatic reduction in nitrogen dioxide emission [40,41,35,34]. In Venice, usually murky canal waters began to get clearer, with fish visible in water below. An estimated 50,000 to 75,000 premature deaths were been prevented simply due to cleaner air in China.

➤ Negative impacts of COVID-19



NEGATIVE ENVIRONMENTAL IMPACT OF COVID-19

Excerpt from [31,34,42,35,43,44].

An overview of the Nigerian environment

Nigeria like most Sub-Saharan countries is faced with several environmental challenges such as deforestation leading to biodiversity losses negative impact of climate change [45,46,47,], high rate of urban population growth 2.6-3.3% per annum, proliferation of slums in urban centres (making it hard for social distancing), poor housing condition, 23 per 1000 inhabitants in Nigeria, with a preponderance of homelessness with 24.4 million homeless people [48,49] alongside lack of water and sanitation with only 26.5 % of the population using improved drinking water source, lack of garbage disposal facilities 23.5% of the population defecating in the open [50], with increased pollution. High pollution especially in cities like Lagos city is caused by the combination of many strongly emitting vehicles and frequent traffic jams [51]. According to [51], SO₂ values within Lagos state varies between 0 and 100 ppb while carbon monoxide have values in the range 0–10 ppm; Port Harcourt (Garden city) which is a humid region with an area of 360 km² and mean annual rainfall of 2400 mm [52]. The city is famous because of many petroleum industries. These industries emit pollutants through gas flaring which are capable of contaminating the environment. Carbon monoxide and SO₂ values within Port Harcourt have been found to exceed standard limits of safety [53]; Kaduna is one of the largest cities in northern Nigeria, located at an altitude of 645 m. It falls under semi-arid region with an annual mean rainfall of about 1200 mm [54]. The major source of pollution in this region is from industrial activities [55]. According to Nimyel and Namadi [56] there were reports of air pollutants values within Kaduna to include carbon monoxide (2.78–33.48 ppm), NO₂(0.006–0.052ppm), and SO₂(0.003–0.037 ppm). Most recently as part of the problems, open defecation generally, high poverty rates which could be worsened by the lockdown

have been found to have exacerbated the COVID-19 conditions within the Nigerian environment [56].

III. HOW COVID-19 HAS IMPACTED THE NIGERIAN ENVIRONMENT

COVID-19 and Migration.

COVID-19 actually impacted negatively on migration status. For example, Nigerian internal migrants, who consistently migrate during the fall season (October/November to May) from their rural areas of origin in the Tillabéri region to work in the city of Niamey, either as casual laborers' (working on building sites, working as street vendors or other types of manual labour) or, for women and girls, as maids. A study by Johnson and Krishnamurthy showed that Nigerian seasonal workers taking off from the North-West of Nigeria migrate from rural, but predominantly agriculture-based areas to the city of Maradi in Niger, engaging in cross-border rural-urban migration. For all population groups studied, the main push behind the migration patterns explored is to supplement existing agriculture-based livelihood sources in the area of origin, which are highly exposed to climate-induced shocks and the recent rise in insecurity especially for the Nigerian migrants. The study showed that there was only a line between acting as an additional livelihood source for the migrants, that is, (to supplement resources otherwise sufficient to secure basic needs), and distress migration according to Johnson and Krishnamurthy [57] (migration as a *sine qua non* to cover basic needs), is thin. Specific with Nigerian internal migrants, all the participants in the study, reported that they migrated out of urgent necessity, specifying that their crops delivered too little to cover the households' basic needs for the year, [58]. Locally, this form of seasonal migration is known as 'exode', French for exodus. Also Burkinabé and Nigerian respondents cited periodic reduced crop yields and livestock losses as increasing the pressure to migrate. Transversing through the three population groups that participated, it was noted that the male head of household most commonly migrated, followed heels up by his sons or brothers. Women and girls migrated more among Burkinabé and Nigerian respondents, albeit to a much lesser extent than male members of the household. Most respondents' migration patterns between January and October 2020 were impacted by COVID-19, as reported by 104 out of 135 respondents in a study carried out by IDMC.. No difference in the level of impact was found between the three different population groups and migration patterns studied, suggesting that both rural-rural/rural-urban and internal and cross-border migration was impacted by COVID-19 in the short-term. How migration patterns were impacted differed by the time of migration, as well as the type of migration. All types of seasonal migration patterns were impacted in the short-term, with travel being longer, more expensive, or delayed, compared to respondents' plans.

Climate Change Evolution as an Impact from COVID-19 on the Nigerian Environment

For most respondents, already at the time of data collection, agriculture -based livelihood sources did not yield sufficient outputs to meet the households' needs. As slow-onset climate change is predicted to continue and further exacerbate intra-and inter-seasonal climate variability, as well as sudden shocks, it is likely that livelihood sources at origin will gradually erode further [59].

The challenges associated with climate change are not the same across the country. Nigeria has a tropical climate with two precipitation regimes: low precipitation in the North and high precipitation in parts of the Southwest and Southeast. This can lead to aridity, drought and desertification in the north; and flooding and erosion in the South [60,61]. Vulnerability analysis demonstrates that states in the north experience higher degrees of vulnerability to climate change than those in the south [62,63]. The pattern of vulnerability to climate change also corresponds to the dominance of climate-sensitive agricultural activities [63]. The Northern regions of Nigeria, which have higher degrees of rurality, are more vulnerable to climate change [62].

Mobility Restrictions

The most immediate impact of COVID-19 in the Sahel region has been the limitation of movement, in particular movement across borders. To what extent internal and regional movement will be restricted in the longer term, thereby limiting habitual migration patterns, will remain a critical element to monitor when assessing the impact of the virus on local populations in the longer term. While restrictions on internal movement were lifted within few months of the virus' surge, at the time of writing of the report (January 2021), restrictions on cross-border movement were still in place. If this trend continues, it is likely that those engaged in cross-border migration will be more severely impacted than those migrating within a country's borders. According to works of Fawupe [63] in a study, which investigated the impact of the lockdown during the pandemic on air pollution in Nigeria, in three highly populated and industrious cities in Nigeria. Comparisons were made with historical mean values, NO₂ levels did increase marginally by 0.3% and 12% in Lagos and Kaduna respectively. Nevertheless, the city of Port Harcourt experienced a decrease of 1.1% and 215.5% in NO₂ and SO₂ levels respectively. Elevated levels of O₃ were observed during the period of lockdown. Result from these studies suggests that there are other sources of air pollution apart from transportation and industrial activities. Findings from this study showed that the COVID-19-induced lockdown was responsible for a decrease in NO₂ levels in two of the locations studied. These results present an opportunity for country-wide policies to mitigate the impact of air pollution in the environment, on the health of citizens.

Cost of Air Pollution

Studies carried out in recent times in Lagos have shown that air pollution can lead to some adverse health conditions which can exacerbate COVID-19 itself. These

include; premature mortality, primarily due to respiratory and heart diseases; and morbidity, due to problems such as chronic bronchitis, hospital admissions, work loss days, restricted activity days, and acute lower respiratory infections in children [64,65]. This may cost the society about US\$2.1 billion, or Naira 631 billion 28, [65].

In a Conference organized by the Michigan State University in April 2020, on the effects of COVID-19 on the Nigerian environment, discussants made it clear that the environments has been neglected due to concentration on containing the spread of the disease, but so far in Nigeria, air quality during the lockdown was better than the pre-COVID-19 era, especially in the Lagos area considering its population and its high level of industrial activity [66]. According to the discussants, there has been about 2.5% reduction in NO₂, as well as slowing down of emission production and the trend is similar in other parts of the world. Based on observations however, these unintended benefits may not be sustained if policies and strategies to maintain them are not put in place. The discussants made it clear that climate change during the COVID-19 era is inevitable, and this may affect adversely, the environment, agriculture and the oil and gas sectors, therefore there is a need for adjustment in order to ensure adequate food security.

In the Oil and Gas sectors as it relates the Nigerian environment, during the periods of March to April 2020, there were no records of oil spillage in oil rich communities, which benefited the environment especially the soil, plants and aquaculture, since people were asked to work from home and gas flaring was drastically reduced. COVID-19 and climate change are global emergencies therefore; sustainable solutions are needed to flatten the curves [66].

The agricultural sectors had most of the impacts of the lockdown, with both positive and negative impacts on the environment. Despite the fact that soil quality improved, the food supply chain was badly affected. Food losses were recorded in large quantities, due to lack of storage facilities as well as inability to transport them to areas that need them because of travel restrictions [67,68]. Farmers could not go to farms even when there were tendencies of a large harvest of babies, nine months into the COVID era, hence pressure increased on rural and urban agriculture. It is also very important that attention should be given to demographics, halting deforestation by the introduction of renewable energy, and reducing the pressures on the demand systems because enough food is needed which can trigger increased use of pesticides and herbicides and eliminate these unintended benefits of COVID-19 lockdown on the environment [66].

The discussants maintained the motion that there is need for sustainability, and made suggestions as follows;

1. Adaptation of virtual meetings can reduce carbon emission, and foster technological advancements that can contain or manage large numbers of participants on the platforms like zoom, by increasing its bandwidth.

2. There should be a shift from the use of fossil fuel as energy source to the use of renewable energy.
3. A cleaner mode of transportation is required to reduce carbon footprint.
4. Regulatory agencies are required to help regulate the Oil and Gas industries to sustain these benefits obtained during the COVID-19 lockdown period.
5. Laws should be put in place to punish notable offenders.
6. From the agricultural perspective, adopting a Climate Smart Agriculture which will help to reduce below and above ground carbon is needful, as this is one of its pillars. Other pillars of the Climate Smart Agriculture include; incremental yield, sequestration and resilience.
7. Agricultural food suppliers and farmers should be included as essential duty workers, in order to promote household, community and national food security.
8. Replicating in large scale climate smart agriculture in other geo-ecological zones of the Nigeria is necessary.
9. Important research agenda such as the 'trade-off analysis' which will enable the country understand the costs and benefits of the Climate Smart Agriculture, in order to adopt all the significant positive impact e.g. Climate Smart Agriculture is expected to help Nigeria reduce emission by 74 million tones.
10. Agro forestry systems as well as biological control systems of agriculture should be activated to control pest and herbs.
11. The use of improved agricultural systems especially for drought areas, like using genetically modified seedlings that can thrive in areas of minimal rainfall should be encouraged.
12. Formulated policies which can be beneficial to agriculture and environment should not be left on paper, but tenaciously implemented.
13. Improved agricultural extension programs with trainings and infusion of new methods that favour environment and healing of mother nature should be promoted.
14. Increased population will adversely put pressure on markets therefore; regulation of the markets will help curtail the spread of corona, assist proper waste management which will in turn help maintain good air, water and soil quality.
15. Under the 'trade-off analysis' precision agriculture should be practiced, soil should be studied to know its soil fertility pattern, if it will or will not require fertilizers and the types of fertilizer needed should be made known to the farmers through extension service.
16. The agricultural Promotion policy (2016) section 4.3.4, should be reviewed by the major stake holders, to know its achievements, and challenges so far, to enhance continuity.
17. Pilot projects in rural communities e.g. provision of alternative energy to connect communities to the national grid should be replicated.
18. There is need for practical policy drivers and implementers to open doors to the cost of policy implementation.
19. Incorporating Climate Smart Agriculture into secondary school curricula could help bridge the gaps in extension services without waiting for the government.

20. There is need to communicate research findings along value chain to avoid limited knowledge and ensure appropriate implementation of research findings.
21. Private stake holders should aggressively own the climate smart agriculture to foster capacity building for farmers.
22. Digital agricultural extension should be practiced.

What the Nigerian Government Can Do in Response to the Above Mentioned Suggestions.

- The Nigerian government should put experts on their toes, to avoid loss of resources, and loss of biodiversity, which can result due to climate change.
- Planting of trees should be encouraged and sustained especially in the north, to avoid aridity, drought, desertification flooding and erosion. Trees especially economic trees should be made available free of cost to those who desire to plant them.
- Government should invest more on agricultural extension services, to ensure food security at the post-COVID era, avoid malnutrition while maintaining soil nature.
- Food processing industries should be encouraged to go more into food processing for preservation and storage.
- Proper waste disposal and the use of renewable energy should be practiced with the help of an effective government monitoring tool, with the encouragement of low carbon technologies as well as innovative bioenergy industries.
- At the local government levels, there should be promotion of public awareness on issues relating to COVID-19, as it relates to climate change and environment especially pollution and pollutants. This should be done on radio stations with native languages for easy understanding.
- The Federal Ministry of Agriculture and Rural Development should at all times interphase with the Federal Ministry of Environment to solve environmental issues that relate to covid 19 as well as agricultural practices.

IV. CONCLUSION

Like a two edged sword it is very obvious that COVID-19 has impacted the Nigerian environment even when most of the positive impacts are desired, sustainability may be very difficult, there is the need to adopt measures that will ensure that the unintended benefits are such as low emission and better air quality are maintained. The government needs to put a task force in place to maintain these unintended benefits that was the result of the COVID-19 lockdown.

RECOMMENDATIONS

1. Fumigation should be carried out at appropriate intervals.
2. Proper waste management should be ensured.
3. More of solar energy should be incorporated for use within communities.
4. Alternative energy should be sourced for transportation, e.g. electric energy.

5. Promote the use of zoom and other similar platforms for conferences, meetings, and other activities.

REFERENCES

- [1]. Clark, C. (1976) *Mathematical bioeconomics: the optimal management of renewable resources*. New York, NY: John Wiley.
- [2]. Gulland, J. 1978 *Fishery management: new strategies for new conditions*. *Trans. Am. Fish. Soc.* 107, 1 – 11. (doi:10.1577/1548-8659(1978)107,1:FM.2.0.CO;2)
- [3]. Bratman GN, Hamilton JP, Daily GC. 2012 The impacts of nature experience on human cognitive function and mental health. *Ann. NY Acad. Sci.* 1249, 118 – 136. (doi:10.1111/j.1749-6632.2011.06400.x)
- [4]. Keniger LE, Gaston KJ, Irvine KN, Fuller RA. 2013 What are the benefits of interacting with nature? *Int. J. Environ. Res. Public Health* 1, 913–935. (doi:10.3390/ijerph10030913)
- [5]. Hartig T, Mitchell R, De Vries S, Frumkin H. 2014 Nature and health. *Annu. Rev. Public Health* 35, 207–228. (doi:10.1146/annurev-publhealth-032013-182443)
- [6]. Kardan O, Gozdyra P, Misić B, Moola F, Palmer LJ. 2015 Neighborhood greenspace and health in a large urban center: neighborhood greenspace and health in a large urban center. *Sci. Rep.* 5, 11610. (doi:10.1038/srep11610)
- [7]. Shanahan DF, Bush R, Gaston KJ, Lin BB, Dean J, Barber E, Fuller RA. 2016 Health benefits from nature experiences depend on dose. *Sci. Rep.* 6, 28551. (doi:10.1038/srep28551)
- [8]. Chapman BK, McPhee D. 2016 Global shark attack hotspots: identifying underlying factors behind increased unprovoked shark bite incidence. *Ocean Coast. Manag.* 133, 72–84. (doi:10.1016/j.ocecoaman.2016.09.010)
- [9]. Penteriani V, et al. 2016 Human behaviour can trigger large carnivore attacks in developed countries. *Sci. Rep.* 6, 20552. (doi:10.1038/srep20552)
- [10]. Bombieri G, et al. 2019 Brown bear attacks on humans: a worldwide perspective. *Sci. Rep.* 9, 8573. (doi:10.1038/s41598-019-44341-w)
- [11]. Chippaux JP. 2017 Incidence and mortality due to snakebite in the Americas. *PLoS Negl. Trop. Dis.* 11, e0005662. (doi:10.1371/journal.pntd.0005662)
- [12]. Daszak P, Cunningham AA, Hyatt AD (2000) Emerging infectious diseases of wildlife—Threats to biodiversity and human health. *Science* 287(5452):443 – 449.10
- [13]. Litvaitis JA, Tash JP. 2008 An approach toward understanding wildlife – vehicle collisions. *Environ. Manage.* 42, 688 – 697. (doi:10.1007/s00267-008-9108-4)
- [14]. Allen T, Murray KA, Zambrana-Torrel C, Morse SS, Rondinini C, Di Marco M, Breit N, Olival KJ, Daszak P. 2017 Global hotspots and correlates of emerging zoonotic diseases. *Nat. Commun.* 8, 1124. (doi:10.1038/s41467-017-00923-8)
- [15]. Morens DM, Fauci AS (2013) Emerging infectious diseases: Threats to human health and global stability. *PLoS Pathog* 9(7):e1003467
- [16]. IPCC (2012) *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Available at www.ipcc-wg2.gov/SREX/images/uploads/SREX-All_FINAL.pdf. Accessed October 10, 2016. 5
- [17]. Walsh J, et al. (2014) Appendix 4: Frequently asked questions. *Climate Change Impacts in the United States: The Third National Climate Assessment*, eds
- [18]. Miller JR. 2005 Biodiversity conservation and the extinction of experience. *Trends Ecol. Evol.* 20, 430 – 434. (doi:10.1016/j.tree.2005.05.013)
- [19]. Soga M, Gaston KJ. 2016 Extinction of experience: the loss of human–nature interactions. *Front. Ecol. Environ.* 14, 94–101. (doi:10.1002/fee.1225)
- [20]. Soga M, Gaston KJ. 2018 Shifting baseline syndrome: causes, consequences, and implications. *Front. Ecol. Environ.* 16, 222–230. (doi:10.1002/fee.1794)
- [21]. Soga M, Gaston KJ, Koyanagi TF, Kurisu K, Hanaki K. 2016 Urban residents’ perceptions of neighborhood nature: does the extinction of experience matter? *Biological Conservation* 203, 143 – 150.
- [22]. Wood SA, Guerry AD, Silver JM, Lacayo M. 2013 Using social media to quantify nature-based tourism and recreation. *Sci. Rep.* 3, 2976. (doi:10.1038/srep02976)
- [23]. Cox DTC, Inger R, Hancock S, Anderson K, Gaston KJ. 2016 Movement of feeder-using songbirds: the influence of urban features. *Sci. Rep.* 6, 37669. (doi:10.1038/srep37669)
- [24]. Amati M, Parmehr EG, McCarthy C, Sita J. 2018 How eye-catching are natural features when walking through a park? Eye-tracking responses to videos of walks. *Urban For. Urban Green.* 31, 67–78. (doi:10.1016/j.ufug.2017.12.013)
- [25]. Mancini F, Coghil GM, Lusseau D. 2018 Using social media to quantify spatial and temporal dynamics of nature-based recreational activities. *PLoS ONE* 13, e0200565.
- [26]. UNEP Frontiers 2016 Report: Emerging Issues of Environmental Concern.
- [27]. Hammond A, Adriaanse A, Rodenburg E (1995) *Environmental indicators: A systematic approach to measuring and reporting on environmental policy performance in the context of sustainable development*. World Res Inst.
- [28]. Sallis, J.F., Owen, N. (2002). *Ecological models of health behavior*. In Glanz K, Rimer BK, Lewis FM, eds, *Health Behavior and Health Education: Theory, Research, and Practice*, 3rd ed. San Francisco: Jossey-Bass, 462-484.
- [29]. Owen, N., Humpel, N., Leslie, E., Bauman, A., Sallis, J. (2004). Understanding environmental influences on walking: Review and research agenda. *American Journal of Preventive Medicine*, 27(1), 67-76.
- [30]. Bandura, A. (1986). *Social Foundation of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall.

- [32]. Tanjena Rume A , S.M. Didar-Ul Islam B, 2020 Science Direct Heliyon journal homepage:www.cell.com/heliyonhttps://doi.org/10.1016/j.heliyon.2020.e04965 Published by Elsevier Ltd.
- [33]. WEF, 2020. High Noon during Coronavirus Lockdown. World Economic Forum, Geneva. https://www.weforum.org/agenda/2020/04/high-noon-lockdown-around-the-world/. (Accessed 12 April 2020)
- [34]. Chakraborty, I., Maity, P., 2020. COVID-19 outbreak: migration, effects on society, global environment and prevention. Sci. Total Environ. 728, 138882.
- [35]. Somani, M., Srivastava, A.N., Gummadivalli, S.K., Sharma, A., 2020. Indirect implications of COVID-19 towards sustainable environment: an investigation in Indian context. Biores. Technol. Rep. 11, 100491.
- [36]. Saadat, S., Rawtani, D., Mustansar, C., 2020. Hussain environmental perspective of COVID-19. Sci. Total Environ. 728, 138870.
- [37]. Sims, J., 2020. Will the world be quieter after the pandemic? <https://www.bbc.com/future/article/20200616-will-the-world-be-quieter-after-the-pandemic>. (Accessed 30 April 2021)
- [38]. Henriques, M., 2020. Will Covid-19 have a lasting impact on the environment? BBC news, 27 March 2020.https://www.bbc.com/future/article/20200326-covid-19-the-impact-of-coronavirus-on-the-environment. (Accessed 30th April 2021)
- [39]. Armstrong, M., 2020. How Covid-19 is affecting electricity consumption. Statista, 9 April 2020.https://www.statista.com/chart/21384/covid-19-effect-on-electricity-consumption-europe/. (Accessed 30th April 2021).
- [40]. CREA, 2020. Air quality improvements due to COVID-19 lock-down in India. Centre for Research on Energy and Clean Air, 16 April, 2020. https://energyandcleanair.org/air-quality-improvements-due-to-covid-19-lock-down-in-india/. (Accessed 30th April 2021)
- [41]. Biswal, A., Singh, T., Singh, V., Ravindra, K., Mor, S., 2020. COVID-19 lockdown and its impact on tropospheric NO₂ concentrations over India using satellite-based data.Heliyon 6, e04764
- [42]. Ghosh, I., 2020. The emissions impact of coronavirus lockdowns, as shown by satellites. <https://www.visualcapitalist.com/coronavirus-lockdowns-emissions/>. (Accessed 30th April 2021)
- [43]. Zambrano-Monserrate, M.A., Ruanob, M.A., Sanchez-Alcalde, L., 2020. Indirect effects of COVID-19 on the environment. Sci. Total Environ. 728, 138813.
- [44]. Singh, N., Tang, Y., Ogunseitan, O.A., 2020. Environmentally sustainable management of used personal protective equipment. Environ. Sci. Technol
- [45]. Calma, J., 2020. The COVID-19 pandemic is generating tons of medical waste. The Verge, Mar 26, 2020. https://www.theverge.com/2020/3/26/21194647/the-covid-19-pandemic-is-generating-tons-of-medical-waste. (Accessed 30th April 2021).
- [46]. Elisha, I. et al.(2017). Evidence of climate change and adaptation strategies among grain farmers in Sokoto State, Nigeria. IOSR Journal of Environmental Science, Toxicology and Food Technology(IOSR-JESTFT), 11(3), 1-7. <http://www.iosrjournals.org/iosr-jestft/papers/vol11-issue%203/Version2/A1103020107.pdf>.
- [47]. Ebele, N. E. and Emodi, N. V. (2016). Climate change and its Impact in Nigerian economy. Journal of Scientific Research & Reports,10(6),1-13. http://www.journaljsrr.com/index.php/JSRR/article/view/21917/40737.
- [48]. Olaniyi, O. A. et al. (2013). Review of climate change and its effect on Nigeria ecosystem. International Journal of African and Asian Studies, 1, 57.https://pdfs.semanticscholar.org/f9bd/9c18dfb45724a2a946a3854c756e62ad9f6b.pdf
- [49]. Emmanuel Abolo Moore, 2019: Addressing Housing Deficit in Nigeria, Issues Challenges and Prospects, CBN Journal of Economics and Financial Review Vol. 57/4 Dec. 2019..pp 201-202.
- [50]. www.borgenproject.org/homeless Accessed May 2021
- [51]. www.unicef.org/nigeria Accessed May 2021
- [52]. Baumbach G, Vogt U, Hein K, Oluwole A, Ogunsola O, Olaniyi H, Akeredolu F (1995) Air pollution in a large tropical city with a high traffic density—results of measurements in Lagos, Nigeria. Sci Total Environ 169(1-3):25–31
- [53]. Salako FK (2008) Rainfall variability and kinetic energy in Southern Nigeria. Climatic change 86(1–2):151–164
- [54]. Augustine C (2012) Impact of air pollution on the environment in port Harcourt, Nigeria. Int J Water Res Environ Eng 1(3):46–51
- [55]. Bununu Y, Ludin A, Hosni N (2015) City profile: Kaduna. Cities 49:53–65.
- [56]. Abdulkareem A, Kovo A et al (2006) Urban air pollution by process industry in Kaduna, Nigeria. AU JT 93(3):172–174
- [57]. Nimyel S, Namadi M (2019) Determination of selected air quality parameters in zaria and its environs, Kaduna State, Nigeria. J Appl Sci Environ. Manag. 23(8):1505–1510.
- [58]. Johnson, C.A. and Krishnamurthy, K. (2010) Dealing with displacement: Can “social protection” facilitate long-term adaptation to climate change? Global Environmental Change, 20, pp. 648655
- [59]. IDMC, No matter of choice: displacement in a changing climate, 2019
- [60]. Akande, A. et al., (2017). Geospatial Analysis of Extreme Weather Events in Nigeria (1985–2015) Using Self-Organizing Maps. Advances in Meteorology. <https://doi.org/10.1155/2017/8576150>.
- [61]. Nkechi , O. et al. (2016). Mitigating climate change in Nigeria : African traditional religious values in focus. Mediterranean Journal of Social Sciences,7(6), 299-308. <https://www.mcser.org/journal/index.php/mjss/article/view/9612>

- [62]. Madu, I. A. (2012). Spatial vulnerability of rural households to climate change in Nigeria: nImplications for internal security. Robert S. Strauss Center for International Security and Law at The University of Texas at Austin.
<https://www.strausscenter.org/research-reports?download=105:spatialvulnerability-of-rural-householdto-climate-change-in-nigeria>
- [63]. Federal Ministry of Environment (2014).United Nations Climate Change Nigeria. National Communication (NC). NC 2. 2014.
<https://unfccc.int/sites/default/files/resource/nganc2.pdf>
- [64]. Fuwape I. A, Okpalaonwuka C. T, Ogunjo S. T (2020) Impact of COVID -19 pandemic lockdown on distribution of inorganic pollutants in selected cities of Nigeria; Springer Nature (2021) 14:149–155<https://doi.org/10.1007/s11869-020-00921-8>
- [65]. Hunt, Alistair, Julia Ferguson, Fintan Hurley, and Alison Searl. 2016. OECD Environment Working Papers Social Costs of Morbidity Impacts of Air Pollution. Paris: OECD Publishing.
<https://www.oecd-ilibrary.org/content/paper/5jm55j7cq0lv-en>.
- [66]. (The World Bank IBRD.IDA Pollution management and environmental health. The cost of air pollution in lagos. 2016).
- [67]. (www.canr.msu.edu Accessed 4th May 2021.)
- [68]. B.A. Oyetoro, M.I.Abdulraheem, T.Adefare (2020): Comparative Effects of COVID -19 Pandemic on Agricultural Production and Marketing in Nigeria.Glob.J.Sci. Front. Res. (GJSFR): (D) Agricult. Vet.pp. 24-30. Google Scholar.
- [69]. www.msn.com/enxl/new/other/food production-suffers-price-balloon