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# The synergistic impact of climate change and COVID-19 on gut health in Africa

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## Abstract

*Background: Agriculture represents the cornerstone of Africa's economy and accounts for the majority of livelihoods across the continent. Therefore, African countries economy is highly exposed for climate change impacts. Countries with low-middle income are highly affected by extreme weather and climate events and are often overrepresented in the number of individuals displaced by these events. On the other hand, the poorest continent, Africa with the most vulnerable populations to infectious diseases, is predicted to be significantly affected by the ongoing COVID-19 outbreak. Currently there are no studies in the literature addressing the synergistic impact of climate change and COVID-19 on gut health in Africa.*

*The African Middle East Association of Gastroenterology (AMAGE) and the Clinical Research Committee of the World Gastroenterology Organization (WGO) had established a joint research group called Climate change in Africa Group (CCAG) to study this point.*

*Aim of the Work: The aim of the current review is to study the synergetic impact of both climate change and COVID-19 pandemic on gut health in Africa.*

*Conclusion: Climate change events lead to planned and unplanned migrations with emerging new zoonotic disease due to increased exposure of humans to animals. Drastic overwhelming global events carry the risk of water scarcity, food insecurity and population gathering in camps which may increase the prevalence of water-born , food-born and vector-borne diseases. The low-middle income countries are highly affected by extreme weather and climate events and are often over represented in the number of individuals displaced by these events. Africa with the most vulnerable populations to infectious diseases is predicted to be significantly affected by the ongoing COVID-19 pandemic.*

**Keywords:** Africa, Climate change, COVID-19, SARS COV2

## Introduction

The COVID-19 pandemic was first reported in Africa on 14 February 2020, with the first confirmed case announced in Egypt [1].

On the 23rd of February, 2021, Africa had 348,251 active cases of coronavirus (COVID-19). South Africa and Algeria were leading with 36,714 and 31,930 person respectively with active infection. By the same date, the cumulative number of coronavirus in Africa reached more than 3.87 million, while there were 102,286 deaths due to the disease, and 3,421,548 recoveries [2].

On the other hand, the state of the climate in Africa in 2019 was characterized by continued warming temperatures, rising sea levels and impacts associated with extreme weather and climate events. Agriculture represents the backbone of Africa's economy and accounts for the majority of livelihoods in the continent. Africa is therefore an exposure and vulnerability theatre for climate variability and change impacts [3].

Low-Middle Income Countries (LMICs) are highly affected by extreme weather and climate events and are often overrepresented in the number of individuals displaced by these events. On the other hand, the poorest continent, Africa with the most vulnerable populations to infectious diseases, is predicted to be significantly affected by the ongoing COVID-19 outbreak [4]. Currently there are no studies in the literature addressing the synergistic impact of climate change and COVID-19 on gut health in Africa.

The African Middle East Association for Gastroenterology (AMAGE) and the Clinical Research Committee of the World Gastroenterology Organization (WGO) had established a joint research group called Climate change in Africa Group (CCAG) to study this point.

## Aim of the Work

The aim of the current review is to study the synergistic impact of both climate change and COVID-19 pandemic on gut health in Africa.

## Methodology

Search was done on Embase® data base for articles in English language published in the last 10 years and containing the following words ('climate change'/exp or 'climate change') and ('africa'/exp or 'africa' or 'middle east'/exp or 'middle east').The search result was reviewed by two independent researchers of the group to retrieve the relevant articles. Data extraction was done by other 2 researchers. References included in the originally retrieved articles were retrieved and searching for full text was done on the PubMed Central® data base to increase the extracted data. Editing Committee of the group had prepared the preliminary draft of the review that was circulated to other members of the group to get their feedback that was included into the final version of the review.

We developed our own framework (Figure 1) to highlight the bidirectional impacts between climate change and COVID-19 from one side and their synergetic impact on the gut from another side. The discussion was written depending on this framework.

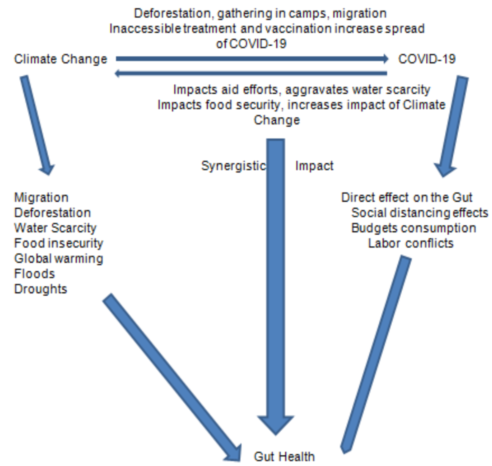


**Figure 1:** Suggested Framework for the Synergetic Impact of Climate Change and COVID-19 in Africa on the Gut Health.

## Results

The first search run yielded 80 articles from which twenty two relevant articles were retrieved. The second search run retrieved seventy relevant articles. Sixty one articles were actually used for extracting the data needed for writing this review.

## Discussion

### *Impact of COVID-19 on the gut*

Pan et al. reported that among two hundred four patients with COVID-19 who presented at three hospitals in Wuhan China, many patients complained of digestive symptoms, such as diarrhea [5]. Thus, diarrhea should raise awareness of the possibility of SARS-CoV-2 infection and should be investigated to reach an early diagnosis of COVID-19 [6]. Patients with COVID-19, specifically those with gastrointestinal symptoms, suffer for a longer time from onset to hospital admission and have a worse clinical outcome, compared to patients who did not suffer from these symptoms [5]. The patients with digestive symptoms had an average time of 9 days from the onset of symptoms until admission, while patients with respiratory symptoms had on the average about 7.3 days before hospital admission [5]. It was reported that patients with digestive symptoms presented clinical manifestations such as anorexia, diarrhea, vomiting, or abdominal pain. With the progress of the disease, gastrointestinal symptoms became more pronounced. About 80% of the patients were admitted with anorexia [5]. Another study reported that COVID-19 patients had gastrointestinal symptoms such as diarrhea (24.2%), anorexia

(17.9%), and nausea (17.9%) [7]. Xiao et al. reported that initial digestive symptoms preceded fever, and respiratory problems such as dry cough. Twenty six patients had with diarrhea, and the fecal test remained positive until 12 days after the disease onset. In 17 patients (23.3%), the stool test was positive despite negative respiratory tests [8].

This finding was confirmed by another study on 206 patients of COVID-19, including 48 presenting with digestive symptoms alone [9]. A systematic meta-analysis reported an incidence rate of diarrhea from as low as 2% and up to 50% of the positive cases in COVID-19 cases [10].

Golonka et al. indicated that gastrointestinal symptoms in COVID-19 are accompanied by inflammation or intestinal damage. The release of pro inflammatory cytokines into the circulatory system, leading to systemic inflammation, occurs due to the loss of intestinal barrier integrity and gut microbes that can activate innate and adaptive immune responses [11].

Fecal calprotectin levels increased in patients with COVID-19 add to the growing evidence that SARS-CoV-2 infection causes an inflammatory response in the intestine [12]. Calprotectin concentrations were significantly increased in COVID-19 patients who had diarrhea and with elevated serum IL-6 levels. Another analysis for 17 studies conducted in 3 countries had detected SARS-CoV-2 RNA in fecal specimens of patients at an average of 43% [13]. Xu et al. conducted a study involving 191 patients with COVID-19. They found that the median duration of viral shedding was 20 days in survivors (range, 8-37 days) [14].

A meta-analysis comprised of 60 studies with 4243 patients showed a pooled prevalence of gastrointestinal symptoms at 17.6% (95% CI, 12.3-24.5) [15]. In this study, anorexia was the most commonly reported symptom (26.8%, (95% CI, 16.2-40.8)), followed by diarrhea (12.5%, (95% CI, 9.6-16.0)), nausea and vomiting (10.2%, (95% CI, 6.6-15.30)), and abdominal discomfort (9.2%, (95% CI, 5.7-14.5)).

## Managing COVID-19 in Low and Middle-Income Countries (LIMCs)

The association of increased mortality with health care resources should stimulate resource-limited regions to prepare for possible local outbreaks [16].

The COVID-19 outbreak increased the need for more intensive care unit (ICU) beds [17]. General beds were rapidly converted to ICU beds and general hospitals were converted to critical care hospitals; physicians and nurses trained in critical care medicine were directed to the most affected area. In Africa, ICU beds and personnel trained in critical care are limited to tertiary hospitals, as assessed in the Republic of The Gambia; so, it is expected that the mortality associated with COVID-19 is likely to exceed the reported case fatality rate of 2.3% [18]. It is debatable whether low- and middle-income countries (LMICs) can fund the additional cost of critical care units by the use of their limited health budgets.

The World Health Organization (WHO) infection prevention and control (IPC) minimum requirements are standards that should be in place at both national and health facility levels to provide minimum protection and safety to patients, health care workers, and visitors [19]. The minimum requirements constitute the initial starting point for building additional critical elements of the IPC core components in a step wise manner based on the local conditions. The emergence of COVID-19 pandemic has again demonstrated the importance of basic IPC measures and the importance of having these minimum requirements in place. The disruption of supply chains and depletion of stock (such as medical supplies and equipment) in both high and low-resource settings negatively impacted IPC core component [19].

## Economic Impact of COVID-19 on Africa

The ongoing COVID-19 pandemic severely damaged the world's most developed countries and is becoming a major threat for low and middle-income countries. The poorest continent, Africa with the most vulnerable populations to infectious diseases, is predicted to be significantly affected by the ongoing pandemic [20].

Unfortunately most of the African countries fall into the low-middle income countries category, therefore it may be challenging for them to cope with the COVID-19 pandemic. It was predicted by experts that the growth of the African continent will be significantly impacted by the ongoing COVID-19 outbreak [21]. Owing to several reasons, Africa is found to be at high risk for COVID-19 pandemic, with relatively low capacity to manage the health emergency. Urgent attention, support and action are required to fight and control the further spread of the ongoing pandemic [20].

The efforts to mitigate the impacts of COVID-19 pandemic should be directed to the developing nations, and particularly to African countries which rely mostly on developed countries. The estimated Africa's growth in 2020, by economists, was 3.9%, which can now drop to 0.4% (in the best case) to -3.9% (in the severely hit case) [21]. Experts also believe that growth in Sub-Saharan Africa may fall to between -2 and -5% in comparison to 2.4% in 2019, with a risk of the first recession in the last 25 years [22].

The main factors that may affect the African economy with a relation to COVID-19 are:1) Reduction of importation of Chinese goods to the level that it inflates the African markets. 2) The decrease in oil consumption due to travel bans, border closures, social distancing and lock downs lowered down the demand for oil. The economy of some of the African oil-producing countries such as Nigeria, Angola, Algeria, Ghana and others is mainly dependent on crude oil pricing, which has been badly hit by this pandemic, thereby impacting the GDP of these countries [23]. 3) African mining industry: Travel restrictions, shutdowns and port closures have resulted in decreasing demand for steel, iron ore, lithium, and cobalt [24]. In South Africa alone, the mining industry employs around 420,000 people and thousands of them are working underground which suggests that the mining work environment is more exposed to pandemic and can become a catalyst for spreading the COVID-19 [25]. 4) The negative impact of the pandemic on tourism in some African countries such as Ethiopia, Kenya and Tanzania, which is negatively affected due to COVID-19, thereby affecting the economies of these countries [23]. 5) Withdrawal of investors: Developing markets already taste the bitterness where investors have already fled, with the largest capital flow ever recorded [23]. 6) The shift of budgets from other sectors to the health sector is a timely need, and this will cause a further decline in the economic growth of these countries. 7)The lower revenue will in turn reduce the tax rates; which will badly impact on the fiscal revenues of poor countries in Africa [23]. Experts are calculating around 20 million job losses, which will further increase the unemployment rates of African countries [23].

Concomitance of COVID-19 Pandemic and Global Warming

Scientists are giving opinions that both global warming and COVID-19 run parallel to each other. It was reported that SARS-CoV-2 virus is a zoonotic virus (bat species suspected to be SARS-CoV-2 virus reservoir) hence, there are several reasons to connect the COVID-19 pandemic to climate change. Global warming along with other associated factors such as habitat destruction, human encroachment, modernization of farming, etc., have been reported to drive the emergence of zoonotic diseases [26].

It was reported that climate changes impacts pathogens selection and resistance, hosts ecology and immunity, as well as vectors ecological niches and capacity;with more potential influence on vector-borne and zoonotic diseases [27]. In addition, glaciers which are hidden sources of numerous pathogens especially viruses, are melting due to globally increasing temperatures and the resident pathogens are therefore getting a wakeup call [28]. Melting glaciers are liberating these pathogens, including those which are new to science [29].

Climate change has been reported to be associated with deforestation and encroachment into animal habitats, which forced several wild species to migrate and thereby putting these species in close contact with humans and other animals [30]. Unplanned migrations also increases the stress levels in these species, leading to immunocompromised conditions, which subsequently increase the tendency of increased risk of infections and increased viral replication.

### COVID-19 is Currently Considered a Disease of the Anthropocene [31].

John Vidal, in a recent article, has cogently pointed out the link between COVID-19 and planetary health [32]. He suggested that COVID-19 is a paradigmatic example of an Anthropocene disease. It follows a complex sequence involving disruption of the natural, social, economic and governance systems.The destruction of natural habitats and the extinction of species, the poorly regulated capture, marketing and consumption of non-human animals and the influence of lobbies to nullify or delay measures to protect natural and social systems have all worked in an orchestrated sequence to facilitate the current COVID-19 pandemic.

This sequence of distal causes is closely related to the global climate crisis and the rest of environmental disruptions of the Anthropocene. Excess use of fossil fuels for energy, deforestation and the conversion of natural habitats into farmland or extensive livestock are among the main sources of greenhouse gas emissions, and at the same time facilitate the emergence of new zoonosis, such as SARS-CoV-2, with a pandemic potential. Oil and timber extraction in primary forest areas involves the opening of roads in hard-to-reach areas, encouraging contact between humans and wildlife, and facilitating hunting and bush meat consumption. Advancing the agricultural frontier to respond to current food systems increases the frequency of ecotones, key areas in the onset of infectious diseases [33]. At the same time, the destruction of habitats caused by these activities are the main causes of biodiversity loss, which is also associated with the emergence of infectious diseases [34].

We have to look at COVID-19 from the perspective of Planetary Health, that is, to understand that the response to the pandemic must not only be the right one for humans but also the right one for the Planet. This point is especially relevant when we understand that COVID-19 has the same origin as climate change and global environmental degradation. Evidence for increase cross-transmission of viruses from non-human animal species to humans becomes another compelling reason to urgently advocate for the preservation of natural ecosystems and stop the massive extinction of endangered species [31].

### Influence of Climate and Seasons on COVID-19 Spread

It was reported that most cases of COVID-19 linked with local transmission have been identified in countries located in the northern hemisphere, which are in the winter “flu” season. The same situation was reported during the SARS-COV global outbreak in February 2003 which did not affect Africa or South America on a large scale, suggesting that respiratory viruses spread more effectively in the winter hence, the southern hemisphere will be affected later in the year, if at all. Climate-specific cultural differences (living more outdoors than indoors), the effect of UV light on the survival of the virus on surfaces, immunological differences of the population (innate immunity), pre exposure with coronaviruses, or the higher temperatures could all have contributed. To date, all identified cases of COVID-19 in Africa originated from Europe and not from China [35].

### Spread of COVID-19 among Refugees and in Conflict Zones

According to estimates from the United Nations High Commissioner for Refugees (UNHCR), the United Nations refugee agency, there are more than 41 million internally displaced people and 25 million displaced refugees globally, many of whom are living in LMICs. Large-scale refugee camps are situated in countries at risk for COVID 19, and these countries have limited resources to increase preparedness measures. Known comorbidities for COVID-19,such as cardio vascular disease, diabetes, chronic respiratory disease, hypertension, and cancer, are often not properly controlled under these conditions. Health care systems in these camps are weak and access to health care facilities is limited [36]; thus, COVID-19 could have catastrophic consequences in these camps. Consequently, triage and the implementation of minimum WHO IPC requirements should be initiated as part of COVID-19 preparedness in the existing health care facilities.

### Water Scarcity and COVID-19 in Sub-Saharan Africa

Current evidence suggests that the COVID-19 virus is transmitted via respiratory droplets or contact. Direct contact transmission happens when contaminated hands touch the mouth, nose, or eyes. Consequently, hand hygiene (regular hand washing) is extremely recommended to control the spread of COVID-19 virus [37].

The corner stone in infectious disease control and prevention is access to water; thus, limited access creates a challenge for transmission control [38]. Nevertheless, across many Sub Saharan African (SSA) countries where inequalities in access to safe water is pervasive [39], there is a need to be worried in light of COVID-19 pandemic. About 300 million people in SSA live in water stressed environment [37]. This presents a major challenge towards controlling the spread of COVID-19.

So how do the recommended precautionary measures relative to COVID-19 fit within the everyday practices in SSA countries characterized by overwhelming water scarcity?. In response to the increasing threat from COVID-19, most SSA countries have instituted a lockdown (partial in most places). However, residents are concerned about a potential increased spread of COVID19 due to water rationing. In Ghana [40] and Kenya [41] for example, many households struggle to comply with the advice to 'frequently wash hands under running water' because of the water rationing. It is worth noting that social distancing is almost impossible as residents are likely to queue to access or buy water.

Some populations are living in water scarcity (living with less than 1000 $m^3$ per capita per year) and living in water stress (living with less than 1,500 $m^3$ per capita per year) in selected SSA countries. Water scarcity refers to the lack of sufficient available water resources to meet demand of usage within a region whereas water stress refers to the inability to meet human and ecological demand for water [42].

Notably, one of the key public health preventive messages for COVID-19 is:'washing hands with soap and water for 20 seconds, repeatedly throughout the day, is critical to prevent transmission of the virus' [43]. In many SSA countries, this is an unimaginable luxury due to the inequalities that characterize the provision of water services as well as the limited opportunity to wash hands regularly at home.

In the current circumstances, it is important to reflect on the water and sanitation services situation in the SSA region. The ongoing COVID-19 pandemic provides an opportunity to remind water authorities and the respective governments of the importance of improving water access for the vulnerable populations. To achieve this, good water governance and adequate investments are critical. Initiatives like the Water and Sanitation for the Urban Poor (WSUP) and the Water Aid's Low Income Customer Support Units [44] in countries like Malawi, Uganda, Zambia, and Kenya should be implemented as long-term measures geared towards upscale, resilience and sustainability of water services. Interventions should include strengthening policy, institutional and regulatory frameworks.

Green or nature-based solutions can help to improve water storage and supply, thus increasing water availability. This is particularly needed today considering expectations that water shortage will worsen in SSA due to climate change and risk of droughts causing the decline of water levels of dam and freshwater supply sources [45,46]. Water scarcity and security issues will be exacerbated by recent trends of climate variability and consequent rise in droughts. The poor access to water in SSA presents a major barrier to effective containment of the COVID-19 outbreak [42].

## Food Insecurity as a Result of Climate Change and COVID-19

The Global Nutrition Report stated that one in nine people are hungry or malnourished. It was reported that almost a quarter of the world's children younger than 5 years, 149.0 million children, were stunted and 7.3% (49.5 million children) were wasted in 2018. With the presence of current global pandemic, tackling malnutrition is expected to become harder. The 2020 Global Report on Food Crises, published On April 20, described the factors that have led to a perfect storm for a food crisis in sub-Saharan Africa [47]. According to the report, armed conflict remains a key driver of food insecurity in the region, disrupting agriculture and trade, blocking supply chains, and prompting mass population displacement. Another factor exacerbated the situation since last June. Unusually heavy rains have aggravated the development of locust swarms, devastating crops across east Africa. Another exacerbating factor was movement restrictions in response to the COVID-19 crisis that delayed the delivery of pesticides and stationing of staff to address the problem. Besides, reports indicate that, where farmers can grow crops, lockdown restrictions are regularly preventing them from transporting products and livestock to markets, and that rice imports to Sub Saharan Africa that were supposed to compensate for the shortfall have been disrupted or stopped, driving up prices of this staple food. In addition to wage losses resulting from government-imposed shelter-in-place orders are further restricting the purchasing power of many families who were already on the borderline of poverty [47].

The Global Report on Food Crises estimates that 135 million people were food insecure in 2019, but more recent World Food Program (WFP) projections indicate that, because of the economic effects and supply chain disruptions associated with COVID-19, this number could double in 2020, to 265 million people. Women and, particularly, children could bear the brunt of the effects of food insecurity, as well as COVID-19 associated health system disruptions. To face these impacts, the UN set up the US$2 billion COVID-19 Global Humanitarian Response Plan, to enable agencies such as WHO, UNICEF, and the WFP to provide food and budgets for water and sanitation projects, vaccinations, as well as COVID-19 testing materials and medical equipment, to the most vulnerable communities. Additionally, restrictions on transport and trade should be considered in the wider context of their potentially devastating effects on food supply chains [48].

## Climate Change and COVID-19: Reinforcing Indigenous Food Systems

Indigenous populations are subjected to higher risk due to COVID-19 because of factors such discrimination, social exclusion, land dispossession, and a high prevalence of forms of malnutrition [49]. Climate change is compounding many of these causes of health inequities, undermining coping mechanisms that are traditionally used to manage extreme events such as pandemics, and disrupting food systems and local diets [50]. Addressing underlying structural inequities and strengthening Indigenous knowledge systems offer opportunities for building resilience to compound socio-ecological shocks, including climate effects and pandemics. Food system of indigenous populations are affected by climate change making indigenous populations vulnerable to food and nutritional insecurity [51]. The nature and extent of the effects of COVID-19 on Indigenous food systems are still largely unknown, but the direct results include mortality from severe illness, reduced access to food, impact on changes in local diet, and economic losses resulting from lockdowns. These outcomes present impediments to the recovery of populations already facing substantial nutritional challenges [52].

Inadequate health service provision for Indigenous populations undermines Indigenous access to culturally safe services adds another layer of complexity in the face of the COVID-19 pandemic. On the other hand, disruptions to food and nutrition security and the resulting health implications for Indigenous populations during pandemics exacerbate their vulnerability to climate change [53].

However, food from the forest is being affected by biodiversity and vegetation loss: heat waves, precipitation variation, and more frequent and intense extreme weather events are all related to deforestation and climate change and are compounded by a weakening of traditional hunting and fishing skills as a result of climatic and societal changes [53].

Some Indigenous populations in Uganda (eg, Batwa) have adhered to COVID-19 measures, including physical distancing, staying home, and avoiding trading centers because of crowds, which challenge food and nutrition security by restricting access to markets. Besides, timely government food aid will not adequately reach Indigenous populations. The long period of lockdown in Uganda, particularly for border districts where many Indigenous populations live, has hampered their mobility to access forested areas for foraging, access to nearby communities to offer labor for food exchange, and access to agricultural fields for food production. These challenges are exacerbated by existing climate effects [54], including recent flooding in 2019 that damaged crops, compromised food production [55] and reduced the resilience of Indigenous populations when the COVID-19 pandemic hit. Climate change challenges impact the resilience of indigenous food systems with direct and immediate repercussions for the health and nutrition of local populations [56].

## Planning for Disaster-related Mass Gatherings during COVID-19 Pandemic

Whatever the nature of the disaster is, whether a slowly occurring process or an emergency, all disasters cause displacement, food crises, and diseases for people and livestock. Even in case of non-pandemic times and in high-income countries, disasters overwhelm national response systems. The outcomes of disasters, amid the COVID-19 pandemic, will be compounded mainly in low-income and fragile countries. Disasters represent situations similar to mass gatherings. The COVID-19 lockdowns in Southeast Asia, Africa, and Latin America resulted in mass gatherings of stranded workers who risked both starvation and transmission of COVID-19 [57].

Gatherings shelters and large-scale population movements-hallmarks of a natural disaster response-can determine the rate of COVID-19 transmission and challenge the physical distancing requirements of lockdowns. In the setting of a natural disaster, evacuees susceptible to COVID-19 will mix with asymptomatic carriers of the virus, and the prevalence of other air-borne, water-borne, and vector-borne diseases might add to comorbidities. Accessibility for hand washing and hygiene are severely disrupted during and in the aftermath of natural disasters due to breakage and lack or contamination of water and sanitation systems, if they exist in the first instance. In regions where open defecation is prevalent, which can range from 6% to 75% of the population, potential fecal–oral transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and exacerbation of the spread of endemic diseases should be a concern [58].

Additional challenges include cholera and other diarrheal infections, intestinal helminths that cause anemia, and soil-transmitted infections particularly among people who walk barefoot. Contact tracing would seem impossible when so many people are on the move and intermingling [59].

During this COVID-19 era, plans should identify facilities for phased relocation of hospitalized patients, or outline capacity arrangements for on-site emergency care, and special care options for people with pre-existing conditions. Local resources must be identified for disease outbreaks and post-disaster follow-up to counter the increased burden of infections, and crucial medical resources should be stockpiled [59]. Intensive care unit (ICU) capacity could be increased by making use of a range of hospitals and non-ICU staff under supervision [60]. Oxygen is a critical resource, and compressed gas cylinders are an option to ensure an uninterrupted supply [61].

## Conclusion

COVID-19 is considered as an Anthropocene disease as a result for drastic climate changes that occurred in the last decades. Malpractices as deforestation, the use of fossil fuels that leads to increase carbon emission besides the increase of greenhouse gases resulted into global warming, hurricanes and drastic droughts or floods. Climate change events lead to planned and unplanned migrations with emerging new zoonotic disease due increased exposure of humans to animals. Drastic overwhelming global events carry the risk of water scarcity, food insecurity and population gathering in camps which may increase the prevalence of water-born, food-born and vector-borne diseases. The low-middle income countries are highly affected by extreme weather and climate events and are often over represented in the number of individuals displaced by these events. Africa with the most vulnerable populations to infectious diseases is predicted to be significantly affected by the ongoing COVID-19 pandemic. Several factors may interfere with the efforts done in Africa for the prevention and the control of COVID-19 disease in Africa. These factors include drastic climate changes that interfere with supply chains for diagnostic and therapeutic materials for COVID-19 besides inequality in distribution of COVID-19 vaccines and unaffordability in many African countries for the high costs of the vaccine. Redistribution of the already low budgets in many African countries will compromise the efforts to face COVID-19 in the presence of an overwhelming climate change event. The current review stresses on the interactive relationship between climate change and COVD-19. Both syndemics have a synergistic impact on the gut health in Africa.

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## Conflict of Interest
The authors declare that there is no conflict of interests related to this manuscript.

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