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COVID-19, the environment and animal life in Malawi compared to other countries: A brief scooping review for a research agenda in the developing countries

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ABSTRACT

The impact of COVID-19 on the human population in Malawi has been documented. However, its impact on the animal population and the environment has not been thoroughly researched. Because of the well-known inter-relationship between human and animal populations and the environment, a study based on a brief scooping review of previous related studies, media and survey reports, was conducted. The findings reveal that except for a few selected studies, the research gap on COVID-19’s impact on the environment and animals in Malawi is wide compared to other countries. Nonetheless, from the few identified related studies, this study has revealed that as the restriction of movement and closure of borders disrupted the supply chain of forest resources in the country, the COVID-19 pandemic has led to increased pressure on forests as a coping strategy due to significant loss of jobs in the informal sector. Although the quality of water and air improved in most parts of the globe due to reduced human activity, there is no substantial literature on the same in Malawi partly due to ineffective monitoring systems. However, COVID-19 has exposed the deficiencies in water security in Malawi, thereby creating opportunities to address them. Conversely, increased demand for water at household levels due to restricted movements contributed to environmental pollution at suburb levels. In particular, the less developed and overpopulated countries suffered from land pollution due to poor disposal of plastic generated from hospitals and personal protection equipment. Elsewhere, studies show that minimal human interference with animals outside homes resulted in an increase of fish and bird biomasses. But, unemployment rates caused by the pandemic have seriously contributed to illegal poaching in developing countries. Therefore, a rapid assessment of the impact of the pandemic on environment in Malawi, to generate the evidence needed for policy makers to use in support of the affected and also plan for the recovery and sustainability of wildlife, is recommended.

1. Introduction

Originating in Wuhan, China in December 2019 (World Health Organization, 2020), Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered novel strain of coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which is fundamentally a global crisis (Huang et al., 2020; Wang et al., 2020). This pandemic has presented a unique challenge, threatening the lives and livelihoods of millions of people around the world in particular the elderly and women (Liu et al., 2020; Yan et al., 2020). Being a novel virus, the coronavirus has raised innumerable questions and speculations among people about its nature, function, and effects on human beings and the environment (Rume and Islam, 2020; How has COVID, 2021; Komesaroff and Kerridge, 2020). Globally, registered effects of the pandemic include loss of lives, anxiety and mental distress (Asmundson and Taylor, 2020), loss of employment, and decline of the economy, among others.

Malawi, located in the south-eastern part of Africa (Fig. 2) with a population of approximately 17.5 million, a median age of 17 years and average household size of 4.4 (National Statistical Office, 2021), registered its first Covid-19 case on 2 April 2020 (Montsho, 2020), and as of 13 December 2021, it had confirmed a total of 62,000 cases and at least

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The rest of the paper is organized as follows. Section 2 briefly describes the methodology that was considered for this study. Study findings are presented and discussed in Section 3. Before conclusions are made in Section 5, areas of current and further research perspectives are described in Section 4.

2. Methodology

Related research studies, survey reports and media reports discussing the impact of COVID-19 on the ecosystem, in particular on the environment and animals were identified through Google search engine from significant scientific databases, including PubMed, Web of Science, Scopus, Science Direct and Google Scholar. Then the literature was sorted according to key thematic areas of interests; air, water, vegetation, animals and land. In reference to Fig. 1, a thematic review of the sorted literature was conducted. Finally, key literature findings in accordance with key themes were presented in comparison with findings from Malawi since the first cases were reported in the country in April 2020.

3. Findings and discussion

Since the COVID-19 pandemic disrupted everyday life worldwide, it may also have positively or negatively affected the environment and the animal life. For example, according to a study by Chakraborty et al. (2021) and others (Nigam et al., 2021; He et al., 2020; Sharma et al., 2020; Shi and Brasseur, 2020; Lokhandwala and Gautam, 2020), as human activity slowed globally, air pollution and water pollution decreased in many regions of the world, a situation called ‘anthropause’. However, for countries where no or only moderate lock-downs were implemented, human activity went on as usual and people disregarded stay-at-home orders, the impact is not well known. Specifically, taking Malawi as a case study, the question that is addressed in this paper is: “to what extent has the environment and animal life been affected by the pandemic with on-going human activity? In this section, the study findings from reviewed studies across the globe in relation to Malawi’s situation are presented according to the five key study themes.

(a) Effect of COVID-19 on Vegetation

Loss of vegetation due to deforestation negatively affects access to enough and portable drinking water (Mapulanga and Naito, 2019), a
situation which compromises the health status of the human population (Heneine and Stephens, 2020). This is because deforestation lowers water quality since soil infiltration of water lowers as well resulting into a higher level of turbidity in the water. Due to the sharp decrease in job opportunities during the pandemic, cases of illegal deforestation operations were reported throughout the world (Brancalion et al., 2020; Poaching), especially in the tropics. The reason is that as people experienced the decline in their incomes, communities heavily relied on forest-based tourism for jobs and risked their engagement with illegal timber production (MwAPATA Institute, 2021). For example, the Global Forest watch report (Attah, 2021) shows that between 2002 and 2020, Malawi lost about 420 ha (ha) of humid primary forest, which is approximately 8% decrease of its total (see Table 1). Of note is that from the reported 420 ha lost in the past 18 years, 146 ha were recorded in the year 2020 alone (Eastman and Toledano, 2021).

Unfortunately, with a lack of monthly data on Forest area estimates between 2020 and 2021, there is no direct link between the present state of deforestation and the COVID-19 pandemic. Nonetheless, Table 1 shows that Malawi has lost a large forest area since 1990 compared to the neighboring countries. While the changes in the forest area in other countries may be associated with wildfires and active mining sites, Malawi’s case is different. With the low registered incidences of wildfires and mining sites, the dependency of the human population on biomass fuel (Fullerton et al., 2009; Mabonga et al., 2021) is the cause. Perhaps, the continued dependency on biomass fuel as liberation to the high cost of living (Heneine and Stephens, 2020) or as a coping strategy due to job losses during the pandemic may have affected the tree and shrub population (Oranu et al., 2022).

In addition, such a decrease in woodland may be associated with non-employment caused by the pandemic. Such a hypothesis is supported by a study which was earlier done by International Labour Organization (ILO) which predicted that due to the pandemic, the hospitality industry anticipated to record the highest job losses amongst all sectors, potentially losing up to 14.0 percent of its jobs (Thula et al., 2020). As a result, most local employees were laid off (Kumwembe, 2021), becoming more vulnerable and thereby posing a serious threat to the environment (Oranu et al., 2022). Moreover, as the human population goes into the previously forested areas for settlement or arable farming, deforestation drives the current global environmental change, a forcing factor to the spread of infectious diseases, including Malaria, Ebola, and COVID-19 (Heneine and Stephens, 2020).

Conversely, as the vulnerability in Malawi pushed many indigenous communities to retreating deeper into forests for food, fuel, and shelter, and to protect themselves from the risk of COVID-19 infection (Attah, 2021), other countries such as Pakistan (Pakistan Hires Thousands of Newly, 2020) took advantage of unemployment caused by the COVID-19 pandemic to facilitate recruitment of laborers for afforestation. However, in Africa the pandemic contributed to funding challenges in the forest sector since more funding was allocated to the health sector to help curb the pandemic. Consequently, majority of national forest institutions have struggled to maintain their staff thereby creating more loopholes for illegal harvesting of timber and non-timber forest products (NTFPs) as monitoring exercises reduced.

Furthermore, a study by Waithaka (2020) has established that

![Fig. 2. Map of Malawi and its location in the south-east of Africa. Source (Gondwe et al., 2019).](image)

Table 1

| Year | Malawi (1000ha) | % change | Mozambique (1000ha) | % change | Tanzania (1000ha) | % change | Zambia (1000ha) | % change |
|------|----------------|----------|---------------------|----------|-------------------|----------|----------------|----------|
| 1990 | 3501.7         | 12.0     | 43378               | 5.0      | 53790.01          | 6.5      | 47412          |
| 2000 | 3081.7         | -12.0    | 41188               | -5.0     | 53670.01          | -6.5     | 47054          | -0.8     |
| 2010 | 2661.7         | -13.6    | 38972.14            | -5.4     | 49950.01          | -6.9     | 46696          | -0.8     |
| 2015 | 2451.7         | -7.9     | 37940               | -2.6     | 48090             | -3.7     | 45755.1        | -2.0     |
| 2020 | 2241.7         | -8.6     | 36743.76            | -3.2     | 45745             | -4.9     | 44814.03       | -2.1     |
ecotourism, especially in East and Southern Africa has grounded to a halt by the pandemic due to the ensuing movement restriction measures. For example, due to travel restrictions that were globally and regionally implemented, the tourism sector in Malawi was faced with reduced numbers of tourists from its source markets such as United Kingdom, United States, South Africa and Kenya, contributing to the country’s loss in revenue (Staff-Reporter, 2021). Of more affected was the conservation sector that includes wildlife parks, game reserves and forests (Mpaka, 2020), on which the communities living around them depend for survival (Attaah, 2021). Since a large percentage of the population living around conservation sectors relies more on subsistence farming, fishing, and bee keeping to make a living, in addition to working with the conservation sectors, the local communities depend on the tourists for their local market sales. Consequently, with a drop in sales at these local markets compounded by reduced numbers of tourists, many families resort into alternative sources of income, which often times involve the unlawful production and selling of charcoal and firewood (Kabango, 2021; Nkhulembe, 2017), thereby contributing to the reduction of the forest cover (Attah, 2021). Moreover, as studies argue for development of the inclusive policy response to ensure that even the informal sector is included in the formulation of crisis response (Petersen et al., 2021), the Malawi government’s COVID-19 preparedness, response, and recovery plan had no serious indications for funds set aside to cushion illegal charcoal producers and retail sellers.

(b) Effect of COVID-19 on Water Access & Quality

Several studies (Ezell et al., 2021; Campos et al., 2021; Pant et al., 2021; Dobson et al., 2021; Abu-Bakar et al., 2021; Menneer et al., 2021; Cherif et al., 2020) have made an assessment on how access to and availability of quality water has been affected by the pandemic. As the demand for stay-at-home orders increased, demand for water access also increased (Campos et al., 2021) due to the COVID-19 protocols such as frequent hand-washing with soap, disinfecting surfaces, and cleaning of food containers. As a result, majority of the households are reported (Abu-Bakar et al., 2021; Menneer et al., 2021) to have suffered from financial stress due to rising of water bills. In areas where water is generally scarce, the demand for water remained much higher than the supply since people were not allowed to travel far distanced places to fetch water (Irwin et al., 2021). Consequently, measures such as rationing of water usage as imposed by the state followed, thereby affecting other activities such as gardening leading to low productivity of domestic and arable crops (MwAPATA Institute, 2021). In addition, most suburbs experienced increased water pollution levels (Dobson et al., 2021).

On a positive note, serious lock-downs resulted into water quality improvement (Chakraborty et al., 2021a; Yunus et al., 2020; Liu et al., 2021), in particular along the streams within industrial areas because of minimal industrial wastewater dumping (Cherif et al., 2020; Chakraborty et al., 2021b; Mostafa et al., 2021). For example, as a result of India’s complete lock-down, waste inflow from the industrial area was reduced up to 50% (Balaramugan et al., 2021). Conversely, due to minimal industrial activities in some areas, industries that are part of the water supply chain experienced revenue losses as the industrial water demand declined (National Statistical Office, 2021). According to the recent 2021 Multiple Indicator Survey report, 87.9% of Malawi’s total population has access to drinking water. Nonetheless, the majority, living in rural parts of the country seek for water from common community boreholes or streams and rivers far away from their residences. Therefore, responding to the demands of COVID-19 stay-at-home orders can only aggravate the water crisis situation. Furthermore, during the dry season in Malawi, where piped water access becomes a challenge due to lowering of water levels in water reservoirs, having more household activities will entail more water demand. At the same time, the hand washing with soap requirements to prevent transmitting the virus also entails more portable water demand. These interfacing factors have both posed a burden on water resources. Just as in other under-developed countries (Wilson Center, 2021; Democratic Republic of the Congo, 2020), the pandemic in Malawi has led to increased cases of inequalities related to infrastructure and water access (Malawi, 2020). Limited access to water and sanitation has aggravated the impact of COVID-19 pandemic particularly in the largest urban centers where most of the public places, including schools and markets lack basic hygiene facilities (Malawi, 2020).

COVID-19 has exposed the deficiencies in water security in Malawi, thereby creating opportunities to address them. Unlike the negative impact on other sectors, the demand for water due to the novel coronavirus has boosted water supply to most rural and peri-urban areas. Since the availability of water promotes good hygiene practices, such as regular hand washing, to prevent the spread of COVID-19, with evidence from a few case studies, the rise of COVID-19 cases brought smiles to the faces of some residents. Relief organizations such as WaterAid, World Bank, and Global Communities scaled up their efforts to support the rural community and the COVID-19 treatment sites to access safe water and appropriate sanitation and hygiene facilities. The organizations rehabilitated the dilapidated boreholes and drilled new boreholes (Syder, 2021) or installed solar-powered water supply systems to provide a constant supply of water (Chavula, 2021; Global-Communities, 2021; WaterAid, 2021). With access to water, the sanitation and hygiene of the surroundings indirectly improved (Global-Communities, 2021).

(c) Effect of COVID-19 on Air Quality

Improved air quality is of much benefit to people’s socio-economic livelihood (Nie et al., 2021). For example, low carbon dioxide production contributes to low acidic rainfall formation since water particles in the atmosphere chemically react with carbon dioxide, sulfur oxides and/or nitrogen oxides (Atmospheric Water Pollution, 2018). In fact, from several instances, reductions in the atmospheric particulates lead to an improvement in both air and water quality (How has COVID, 2021; Coronavirus Is Improving Water Quality, 2020). So far, studies have revealed that lock-downs and quarantine measures which were implemented under the influence of the pandemic gave rise to clean air in most developed and highly populated countries such as China and India (Lokhandwala and Gautam, 2020; Zhang et al., 2020; Le Qu é r é et al., 2020; Kumari and Toshniwal, 2020; Bourzac, 2020). For example, a 20% increase in air quality due to the quarantine was reported in Los Angeles (The silver lining to coronavirus, 2020) and carbon dioxide emissions decreased in San Francisco Bay Area (Bourzac, 2020) as traffic slowed down by 45%. Similarly, a reduction in atmospheric nitrogen dioxide (NO₂) concentration levels in New York City (Kumari and Toshniwal, 2020) revealed that air quality significantly improved during the pandemic. In India, a study by Pal et al. (2020) revealed that carbon monoxide, ammonia, sulfur dioxide and NO₂ showed a significant reduction of 22.82%, 30.61%, 32.11% and 46.95% respectively. Because of such, quality of water in the rivers, lakes and oceans is said to have improved as well (Bourzac, 2020). On the contrary, due to high deaths related to the pandemic and shortage of hospital facilities, several dead bodies are reported to have been improperly disposed, thereby causing air pollution (Carrington, 2020).

In Malawi, the air is polluted by dust, gases, and car exhaust fumes in urban areas and by human activities such as bush fires, burning of tires, biomass burning, and dust in rural areas (Mapoma and Xie, 2015). Unfortunately, a setback in assessing air quality in Malawi is the lack of hourly or daily monitoring equipment and systems. Consequently, this review did not find pollution data directly linked to the pandemic. Moreover, the 2021 World Air Quality report (TheAir, 2021) found that only 13 out of 54 countries in the African continent have sufficient public air quality monitoring data, excluding Malawi. Nonetheless, the current (Mabonga et al., 2021; Rylance et al., 2020) and previous studies (Fullerton et al., 2009; Mapoma and Xie, 2013; Das et al., 2017; Wathore et al., 2017) in Malawi indicate that biomass fuel use is a significant factor contributing to the overall air pollution problem.
due to closure of most hotels and restaurants (Reiley, 2020), it is re
banned people from their consumption (McCall, 2020). In a related case,
through bats and pangolins, their biomass flourished as other countries
addition, due to the belief that SARS-CoV-2 transmitted itself to humans
pandemic introduced challenges in the management of Africa
2020). In

While it is known in some parts of Africa, for example Egypt (Mostafa
2021) and South Africa (Masindi et al., 2021), that due to
lock-down measures, quality of air improved, except for the recent study
which assessed air pollution caused by an increase in numbers of vehi

Another study by Tilley and Kalina (2020) indicates that the poor health care
hospital pose a big hazard to air pollution during this pandemic as most

45% of the country

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(d) Effect of COVID-19 on Wildlife and Domestic Animals

As people stayed at home due to lockdown and travel restrictions,
wildlife was rejuvenated in several parts of the world, especially in
developed countries. For example, due to the lowered levels of human
interference and light pollution, wild animals began to move into the
cities (While you stay home, 2020; Ormaza-Gonzalez I lez et al., 2021).
In addition, due to the belief that SARS-CoV-2 transmitted itself to humans
through bats and pangolins, their biomass flourished as other countries
banned people from their consumption (McCall, 2020). In a related case,
due to closure of most hotels and restaurants (Reiley, 2020), it is re
ported that the demand and prices for fish went down causing an in
crease in the fish biomass (Lombrana, 2020; Mantur, 2020). This was the
case because fishermen lacked markets and also resorted into withdraw
from fishing grounds (Korten, 2020). However, domestic animals suf
fered with the lockdown and travel bans. In most developing countries,
majority of the households haphazardly sold domestic animals for either
consumption or in exchange with cereals within the neighbourhood. In

(e) Effect of COVID-19 on Land Use & Waste Management

Due to the requirement of constant usage of face masks, substantial
increase of plastic waste during the COVID-19 pandemic remains a
major environmental concern (Peng et al., 2021; Benson et al., 2021;
Patricio et al., 2021). Poor disposal of used surgical face masks at both
individual and household level has led to constant littering of the envi

Development of the SARS-CoV-2 virus led to the temporary suspension
of commercial and recreational activities, which reduced the demand
for certain goods and services. As a result, businesses in the

Waste Management
Like in other African countries such as Kenya and Madagascar, the increased demand for herbal supplements and other medicinal plants as treatment for the COVID-19 virus (Chikowe et al., 2021; Malekmohammad and Rafieian-Kopaei, 2021) resulted into a surge of herbal productions in Malawi (Kapatuka, 2020a). While the situation brought a new window of herbal farming opportunity for farmers, land was anecdotally more stressed than before. For example, because of a steady rise in the price of the ingredients used (Kapatuka, 2020a), there was an increase in urban and backyard farming among urban dwellers to self-produce indigenous vegetables and spices such as ginger, carrots, turmeric and garlic (Kapatuka, 2020b). Local farmers, on the other hand, opened up more land to increase production and eventually make quick and large sales whilst meeting the demand. On a positive note, however, increased urban farming meant more opportunities for increase in land cover to serve as sink for the emitted carbon and biomass fuel (Mapoma and Xie, 2013).

4. Current and further research perspectives

This study has found that unlike in the developed world, studies that have focused on evaluating the impact of COVID-19 on the environment and animal population in developing world remain scanty, consistent with outcomes of another review study that was conducted elsewhere between December 2019 and April 2020 (Shakil et al., 2020). Although the current study review did not find studies that specifically assessed effects of COVID-19 on the environment in Malawi, unlike on people’s health and economy (UNDP, 2020; Alfonso, 2020; Thula et al., 2020; Bauchl et al., 2020; Mzumara et al., 2021; Mangal et al., 2021; Sonenthal et al., 2020; FEWS, 2020), the question that was posed by Shakil et al. (2020) on “whether or not the impact of COVID-19 on climate or environmental changes differ between more-affected and less-affected countries” has been partly answered by the current study. This is because, for the studies that were identified from the developed countries, the majority are based on the premise that the environment benefited more from the reduced human and industrial activity as caused by the total lock-down measures that were implemented. However, from the countries where business went on as usual such as Malawi and Tanzania (Buguzi, 2021), it is seen that the extent to which the pandemic affected the environment remains less known. Nonetheless, the study has empirically found that in Malawi, loss of jobs in the informal sector due to COVID-19 left forests reserves under pressure. The local communities, however, indirectly benefited from several relief organizations that addressed the perpetual challenge of water scarcity in Malawi through installation or rehabilitation of boreholes and water kiosks. In addition, due to the growth of urban agriculture to meet the demand for medicinal plants, land cover anecdotally improved, thereby creating a sink for outdoor carbon and indoor biomass fuel emissions. Such findings, however, require an in-depth validation. But, since the present study draws its findings from a scoping review of studies, news sources, and reports published between April 2020 and December 2021, it extends the previous related studies (Shakil et al., 2020; Mofijur et al., 2021) and therefore reports more recent findings. Moreover, in the previous reviews an assessment of the effects of COVID-19 on the animal (domestic and wildlife) population was generally not considered. Therefore, the current study findings and research gaps present an opportunity for further research in the developing world, particularly in sub-Saharan Africa (SSA) including Malawi.

5. Summary and Conclusion(s)

The worldwide pandemic of coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has brought both positive and negative effects on the ecosystem. While effects of COVID-19 have been more pronounced on human’s health and socio-economic status, its impact on the environment and animals is less known in particular for developing countries such as Malawi that have experienced moderate lockdowns. In order to understand its impact on the ecosystem, a brief systematic review of other related studies elsewhere and media and survey reports in Malawi was conducted. The review has established that, in heavily affected countries, full lockdown measures reduced human and industrial activities. Persistent lockdown measures resulted into reductions in wastewater dumping and road traffic, thereby contributing to improved air and water quality. However, in countries where lockdowns were moderately implemented, the impact of the pandemic on the environment is not clearly known. Therefore, this paper recommends that further studies be conducted to assess the impact of COVID-19 pandemic on the environment and animals for developing countries such as Malawi where lockdowns or stay-at-home orders were partially implemented.

Author contributions

Conceptualization, Elias; methodology, Elias, Alexander, Juba; literature review and formal analysis, Elias, Juba, Alexander; data curation, Elias; writing-original draft preparation, Elias, Juba; writing-review and editing, Elias, Juba, Alexander; Revisions, Elias, Juba, Alexander. All authors read and approved the final version of the manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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