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Dynamics of Communicable and Non-Communicable Health Shocks in the Campo Ma'an National Park: Implications on Natural Resources Dependent Livelihoods

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Issues of health shocks continue to gain traction in the global scientific discourse, with established evidence on its severe impacts on livelihoods and well-being especially in sub-Saharan Africa. However, the relative absence of a comparative analysis on the effects of communicable and non-

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communicable diseases on natural resources dependent communities still beg for scientific attention in the context of the Campo Ma'an National Park. This study sought to examine the determinants and dynamics of health shocks, and their implications on natural resource-dependent communities of the Campo Ma'an National Park. Data was collected through interviews with key informants, experts, and a survey of 200 households. The results indicate that health shock dynamics are primarily influenced by socio-demographic factors, followed by ecological and economic variables. Communicable diseases such as malaria and COVID-19, and non-communicable diseases such as cancer and hypertension, reveal distinct risk patterns. These diseases have affected more than 70% of the population over the past five years. These shocks exacerbate poverty, hunger, and economic stagnation, leading to death and job loss. Furthermore, health shocks have shaped livelihood strategies leading to diversification, intensification and business as usual scenarios. The logistic regression disclosed gender, education, age, income, occupation, proximity to park, as the variables that significantly predict livelihood dynamics during health shocks. The findings inform the vulnerability dimension of the sustainable livelihoods framework and underscores the need for policy interventions to develop resilient livelihood.

Keywords: Communicable disease; non-communicable disease; natural resources; households.

1. INTRODUCTION

1.1 Dynamics and Implications of Communicable and Non-Communicable Health Shocks on Livelihoods

Issues of global health security have gained international concerns and pertinence as the world's populations, recently, are more exposed to imminent threats from the emergence and re-emergence of infectious and chronic diseases (Slater et al., 2024; Mackenzie et al., 2013; Kuuwil et al., 2022; Lederberg et al.,1992; United Nations, 2023). The continuous and increasing dependence on natural resources especially forests lead to its transformation, a daunting challenge that has been documented extensively as a significant determinant for the spread of several zoonotic diseases especially Ebola and Covid-19 (Acquaah et al 2024; Gile-Vernick and Rupp, 2012). These exert significant impacts on the world economies and especially natural resources (Wang et al 2023; Nguyen et al 2021; Omotayo and Ogunniyi, 2024; Kim, 2021). The concept of diseases as well as the drivers of its emergence prime through microbial threat to human health, propagated through the consumption of bush meat as well as human – wildlife contact as triggers of COVID 19 and Ebola virus (Acquaah et al 2024; Wirsiy et al., 2021). The impacts of health crises on natural resources and livelihoods are also attributed to climatic shifts (Obame-Nkoghe et al., 2024; Nsabimana 2022). Drawing from the report of the Institute of Medicine's seminal 1992, diseases have the potential to cross the specie barrier between wildlife, humans and domestic animals, with over 70% of new emerging infectious diseases having origins in animal reservoirs (Mackenzie et al., 2013). Examples of these diseases have been documented by the institute of Medicine to include the H1N1 pandemic influenza virus, Nipah and Hendra viruses, the SARS coronavirus, avian influenza H5N1, Australian bat lyssavirus amongst others. This highlights the fact that there is a strong interconnection between the health of humans, animals and ecosystems (ibid). Contextually, these diseases are categorized as communicable and non-communicable diseases (Boutayeb, 2010; Ackland and Puska, 2003). Communicable diseases are caused by infectious agents such as bacteria, viruses, fungi, and parasites; examples, tuberculosis, malaria, hepatitis, HIV and AIDS, COVID-19, measles amongst others. Non – communicable diseases, on the other hand, are caused by non-infectious factors such as lifestyle, genetics, and environmental factors and include diseases like cardiovascular diseases, cancers, hypertension, blindness, diabetes, and various others (WHO Africa region, 2024; Alam and Mahal, 2014) having an unprecedented impact across the globe (WHO, 2023; Niohuru, 2023). An adequate and rapid respond to zoonotic diseases requires a holistic approach through effective coordination, collaboration, multidisciplinary, and cross sectional approaches especially at the human-animal-environment interfaces. This approach has been referred to as the 'One Health' which highlights the commonality of human and animal medicine and their

interconnection with the environment, building bridges that interconnect health in the global world. Through the Manhattan Principles, there are priorities and interdisciplinary strategies for combating threats to human health on earth.

In the developed world, increasing intercontinental mobility has triggered an upsurge of communicable diseases to Europe, North America and other parts of the world, where they have been absent or confined for decades (United Nations, 2020; Rights and Resources Institute, 2020). For instance, measles epidemics in Iceland reveals the effects of changing conditions for diffusion, introduced from abroad, usually from Scandinavia or Britain (Rights and Resources Institute, 2020), with severe implications on households. Several efforts have been made to share responsibilities and the coordination of activities at the human- animal – ecosystem interfaces like the FAO-OIE-WHO collaborations, the world bank, Institute of Medicine, Asian Development Bank, Global risk forum amongst others, to tackle disease spread, transmission and possible treatment especially the H5N1 (Avian influenza). This has led to the formation of GLEWS (Global Early Warning System for Major Animal Diseases and zoonoses), providing intelligence for the identification and amelioration of human and animal disease through information sharing on diseases outbreaks, analysis of epidemiology and risks assessments. It is worthy to note that linkages underlying environmental and socio-economic determinants of emerging diseases and the risk of pandemic emergence is essentially fruitful for rapid detection and improved predictive abilities to manage diseases (Mackenzie et al 2013).

In developing countries, health shocks are triggered by various factors, for example in the Americas, decreasing investment in public health due to economic recession and less efficient public sector diverting resources meant for disease management to other needs. Also, increasing human population becoming urban, creating problems like poor sanitation and portable water arising from inadequate housing, and commercial activities putting pressure on natural resources especially forest. This exposes the population to agents of disease transmission and zoonotic diseases like arenavirus, yellow fever, rabies transmitted through vampire bats. Human interventions tend to contribute to diseases in Peru leading to the spread of cholera. Also, deforestation and climate change are contributory factors (Pinheiro, 1996). Non-communicable diseases especially cardiovascular diseases are acknowledged as the primary determinant of death and disability with prospects of these diseases tripling in the nearest future especially ischemic heart disease as well as stroke in countries of Latin America (Pramparo et al 2007). Conversely, in southeast Asia, the extraction of natural resources are triggered by weather shocks and market shocks, low education and limited access to power supply, which trigger health shocks (Nguyen et al 2021).

In Africa, Communicable diseases constitute a fundamental impediment to the human health and development in Africa (Rweyemamu, 2006. Tackling this challenge would prosper the continents development. Others suggest the need for a step-change in approach or a quantum leap. The continent is acknowledged as having the heaviest burden of communicable diseases as a result of increasing urbanization, increase mobility of people, animals and agricultural produce, including aquaculture, increasing human wild and livestock contact as well as the impact of climate change on disease vectors. These diseases plunge the continent in a state of more future marginalization than the present. Ensuring a successful future for the African continent requires addressing the challenges posed by communicable diseases (Rweyemamu, 2006; Niohuru, 2023). Communities in several parts of Sub-Saharan Africa (SSA) host a significant proportion of global forest cover that supports about 80% of its population regarding natural resource use and livelihood sustenance (Kimengsi *et al.,* 2023). Heavy dependence and pressure on natural resources through international trade on natural products determine the prevalence of health shocks, especially in sub-Saharan Africa. This is grossly linked to poverty, market imperfections, and socio-ecological factors (WEF, 2023).

In Equatorial Africa, communicable and non-communicable diseases are triggered more by socio-economic factors like poverty, human-wildlife interaction, exposure to environmental hazards, hygiene and sanitation, migration and ecotourism (Giles-Vernick and Rupp, nd) with huge implications on individuals and communities (Dhanara, 2014; Walters *et al.,* 2021; Scottish government, 2021). For instance, in Ghana, it is reported that the Covid 19 pandemic caused over 1400 deaths, mostly

income earners (Kuuwill *et al.,* 2022) and the rural people, many of whom are in the primary sector and associated employment and enterprise activities for their livelihoods, are vulnerable to the broad food system context created by the communicable diseases (ibid).

In Cameroon, there have been great concerns especially in the context of communicable and non-communicable diseases over the past few decades (Brashares, 2006). Cameroon host over 30 protected areas which spans across the country covering over 4.4 million hectares including the Campo Ma'an National Park (Tchouto et al., 2006), highly exposed to health shocks such as malaria, sleeping sickness, tuberculosis, hepatitis and the COVID-19 pandemic (WWF, 2021). Malaria, HIV/AIDS, and tuberculosis, represent 23.66% of the Cameroon's morbidity burden (Ministry of Public Health, 2016). Studies argue that most communicable and non-communicable diseases originate from Cameroon's natural regions, such as Nature Reserves and National Parks (WWF,2021), while others attribute increase in mortality to non-communicable diseases (NCD), notably cardiovascular conditions, cancers, mental diseases and traumas due to road accidents and behavioral patterns (Ajonina et al., 2010). The communities around the Campo Ma'an National Park are natural resources dependent. That is, their livelihoods hinge on natural resources. With the occurrence of health related shocks, these livelihoods systems seem to have been affected by the shocks. Currently, the emergence of communicable diseases or infectious disease (EID) like corona virus disease COVID-19, malaria and some neglected tropical diseases has reshaped the Campo communities with prospects of continuity. It appears that some livelihoods activities in the Campo Ma'an National Park were suspended or communities decided to diversify further. Also, it appears some communities decided to intensify resources harvesting further. The extent, to which these livelihoods strategies were distorted, altered or modified remains incomprehensive in terms of assets, strategies and outcomes. Additionally, there appears to be spatial variations in the changes that occur around these livelihoods systems. Health shocks like the covid-19 pandemic, malaria are infectious diseases that spread over a wide geographical area affecting a significant proportion of the population. Despite their salience, micro-scale evidence on how these shocks (re)shapes the livelihood systems of natural resources communities in Campo Ma'an National Park is lacking. Also, very few studies have examined the role of health shocks in (re)shaping resources systems (assets strategies and outcomes) and livelihood strategies (diversification, intensification or business as usual) especially on resources exploitation choices in Campo Ma'an National Park. The dearth of scientific knowledge of health shocks implications on resources based livelihoods systems in the Campo Ma'an national park, begs for scientific edification and policy integration.

Varied opinions exist on drivers of health shocks over space and time. Some findings attribute health shocks to human wildlife interactions, pathogens coming from animals or products of animals origin (Lederberg *et al* 1992; Mackenzie *et al* 2013; Oppong and Harold 2014; report on health technical and ministerial, (2016), others to variations in landscapes, interactions and migrations (Rights and Resources Institute, 2020). Nsabimana (2022) attributes health shocks to drought, floods, climate change, affecting natural resources and livelihoods. With these diverse perspectives, little is known about the main drivers of health shocks in natural resources dependent communities like the Campo Ma'an National Park. This motivates the study as shocks affects livelihoods systems in terms of access, use and management, inducing difficulty in obtaining food and other livelihoods. These however, require the use of sustainable health and livelihoods frameworks. Also, the extent to which livelihoods in the Campo Ma'an National Park are reshaped by health shocks remains incomprehensive. That is, whether it let to resources intensification, extensification or business as usual. Therefore an understanding of the potential to provoked in-depth continuous ramifications on the health and welfare of the populations' adjacent natural resources based areas such as the Campo national park is unclear. Biodiversity, human health and animal health in these areas have been greatly affected by the emergence and re-emergence of pandemics. The lack of integration between these three concepts triggers the spillover of zoonotic diseases, a critical challenge that requires convergence.

2. CONCEPTUAL FRAMEWORK

The study is embedded in the framework of the socio-ecological health perspective, adapted from the Eco-health theory and sustainable livelihood framework which uncovers the

determinants of communicable and non-communicable diseases in natural resource-dependent communities of the Campo Ma'an National Park. The ecohealth theory traditionally views ecosystems and human disease interface focuses on social, cultural and biophysical environments. These factors play a significant role in addressing health issues, especially on human-environment interaction and influence on human health. Based on the economic determinants the closers is the critical Ecohealth theory which considers resources users adapting to every day realities. Based on this theory, communicable and non-communicable diseases deteriorate human health through social, cultural and biophysical environments as a result of direct and indirect human-environment interactions. Though the theory recognizes that human health depends on healthy environments and prosperity also depends on health people and ecosystems, it does address the "sustainability criterion" to achieve tri-objective of healthy environments, human prosperity and human health. This study provides insights in this light through the range of determinant of health shocks, comparative analysis between communicable and non-communicable disease emanating from resources landscapes prone to health shocks such as the Campo Ma'am National Park.

3. MATERIALS AND METHODS

3.1 Study Area

The Campo Ma'an National Park is located in the southern Region of Cameroon, covering a surface area of approximately 771,668 hectares as integral part of the TOU-Technical Operation Unit (CMNP, 2014). The park was created by decree No 2000/004/PM of 06 January 2000 as compensation for the chad-Cameroon pipe line. The park is found within the ocean division of the south region including the Campo and Akom II subdivisions and involving the Valley of Ntem – Ma'an subdivision. The Campo Ma'an National Park existed since the colonial period from 1932 with the appellation "Campo Fauna Reserve". It extends from latitude 2°10'-2°52'North of the Equator and longitude 9°50'-10°54'. The park is within the forest belt of the Congo Basin involving villages like Nko'elon, Akak, Mabiogo, Ebianemeyong, Campo Beach, Niete, Akom II, Nyabissan, Kwadjap Ebodje amongst others. These villages were selected for the study due to high exposure to diseases, the risk of contamination and spread of diseases through human-wildlife contact, consumption and trade in dead and living species of wildlife (Wirsiy et al., 2021). Fig. 1 illustrates the location of the Campo Ma'an National Park in the South region of Cameroon.

3.2 Data Collection, Data Treatment and Analysis

Four instruments were designed to carry out the research namely, key informant interview guide (5 items), expert interview guide (4item), a focused group discussion guide (4 items) and semi-structured questionnaire (n=200). The research instruments captured questions about disease prevalence and perceptions of drivers of disease and household socio-demographic and economic characteristics. This information was complemented by hospital records of diseases over the past five years. The key informant interview guide consisted of eight main questions focused on the identification of social and demographic characteristics of communities exposed to health shocks, issues of well-being, vulnerability to health shocks and links to natural resources with a focus on ethnic and livelihood differences. The next section of the interview guide captured the natural, human and economic determinants of health shocks (communicable and non-communicable diseases) in the resource landscape. This was preceded by mapping the health infrastructure and areas of intervention. For the expert interview guide, emphasis was laid on the typology of communicable and non-communicable diseases in communities of the Campo Ma'an National Park. Regarding focused group discussions, the seven questions revolved around participants' views on health shocks' contributions to socio-demographic changes and perceptions, which are linked to resource diversity, ethnic affiliations, and healthcare access. It equally captured perspectives on dealing with health shocks. These instruments were carefully reviewed and pilot tested (N= 6), and based on the feedback, the instruments were revised and translated into French. Before data collection, the data collection team explained the research objectives to the respondents, and they were assured through the research objectives, that the study was intended purely for academic purposes. Thus, the free prior informed consent of the respondents was sought, and participants were assured of confidentiality in their responses. In the four zones- Campo, Ma'an, Niete and Akom II-villages were selected depending on their population size, proximity to the park and the risk

of spreading diseases. Two field assistants were employed and trained to facilitate the data collection process. A field guide/translator was recruited to gain access to the communities and supported in the selection of respondents. Regarding key informant and expert interviews, 12 were conducted in the four communities. A purposive selection was employed, targeting traditional authorities, doctors, patients, foresters, hunters, fishermen, and farmers. The respondents were selected considering their length of stay in the communities. All respondents had lived in the communities for at least 8-10 years, and thus this period was considered sufficient enough for the respondents to respond to the determinants of health shocks in the communities. The interviews lasted between 40 and 50 minutes. The expert interviews were conducted with civil society actors, health personnel, traditional healers, and state officials in forestry and agriculture. To further generate data, 6 focus group discussions were carried out with women groups, mixed groups, and youth groups in each zone. The focus groups ran between 50 to 60 minutes. Recorders were used to collect the data, and field notes supported the data acquisition process. Through the assistance of field guides/translators who were natives of the communities, it was easy to organize meetings with respondents as trust was easily established. The theme and objective of the research was explained to the participants and their consent was sought before recording the data. The instruments were designed and validated between October and November 2023, while the entire data collection process was accomplished between December 2023, January and August 2024.

To obtain essential information and provide equal chances for sample representativeness, a total of 200 natural resources dependent households were randomly sampled through a raffle draw. By this method, the total populations of selected villages within the four zones (Campo-Ma'an-Niete-Akom II) surrounding the Campo Ma'an National Park were obtained and the questionnaires administered were in accordance with the population of the selected villages. Also, the total number of households in each selected village were obtained and from this, each household was attributed a number and mixed in a pool to give each household an equal chance

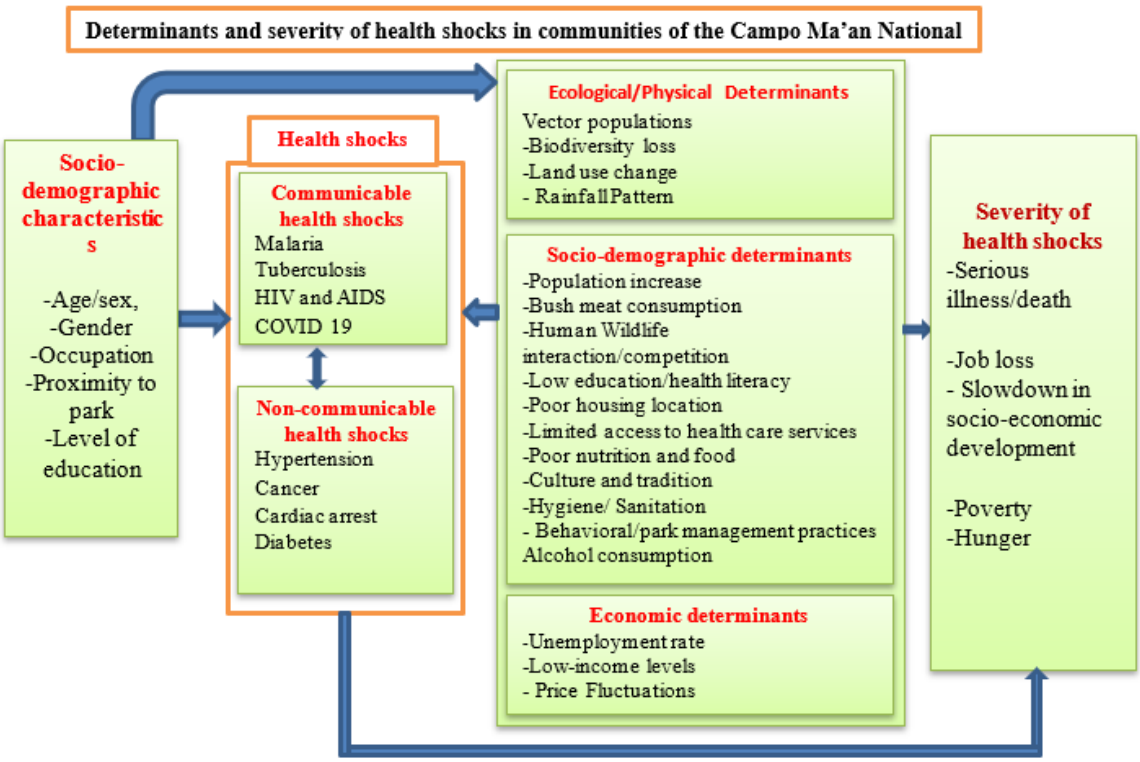


Fig. 1. Framework on socio-ecological health perspective around the Campo Ma'an National Park (Adapted from DFID 2000, Ellis 2000, and IDRC 1994)

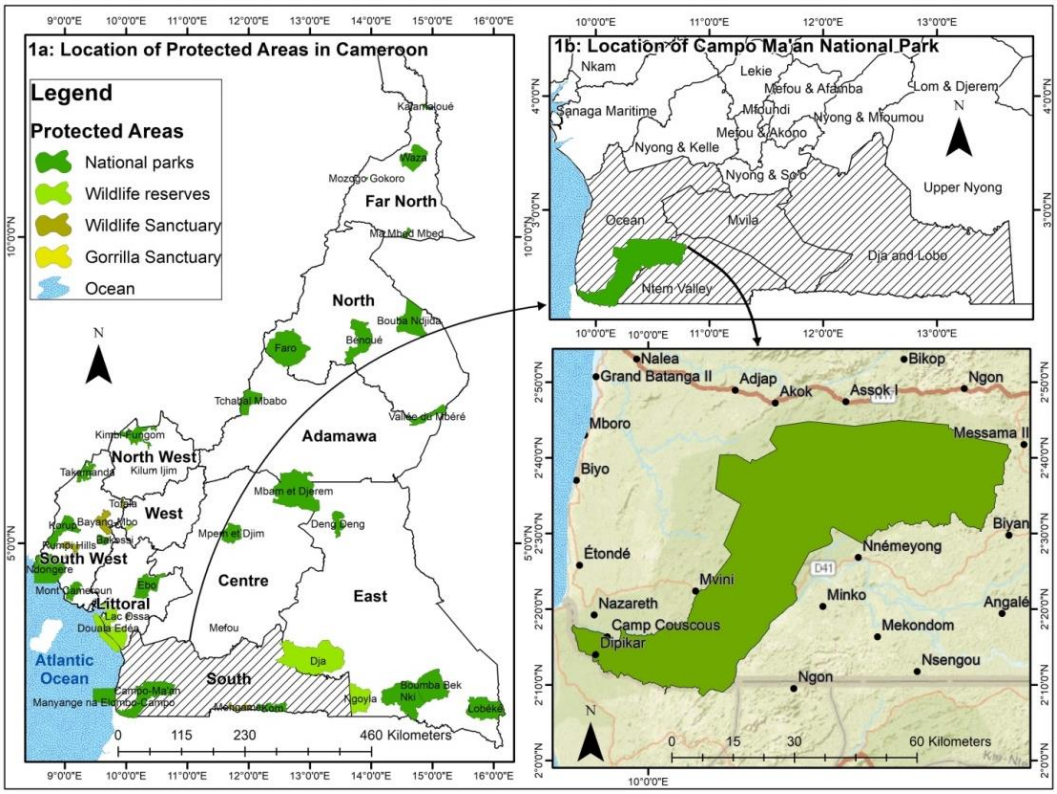


Fig. 2. Location of Campo Ma'an National Park in Cameroon

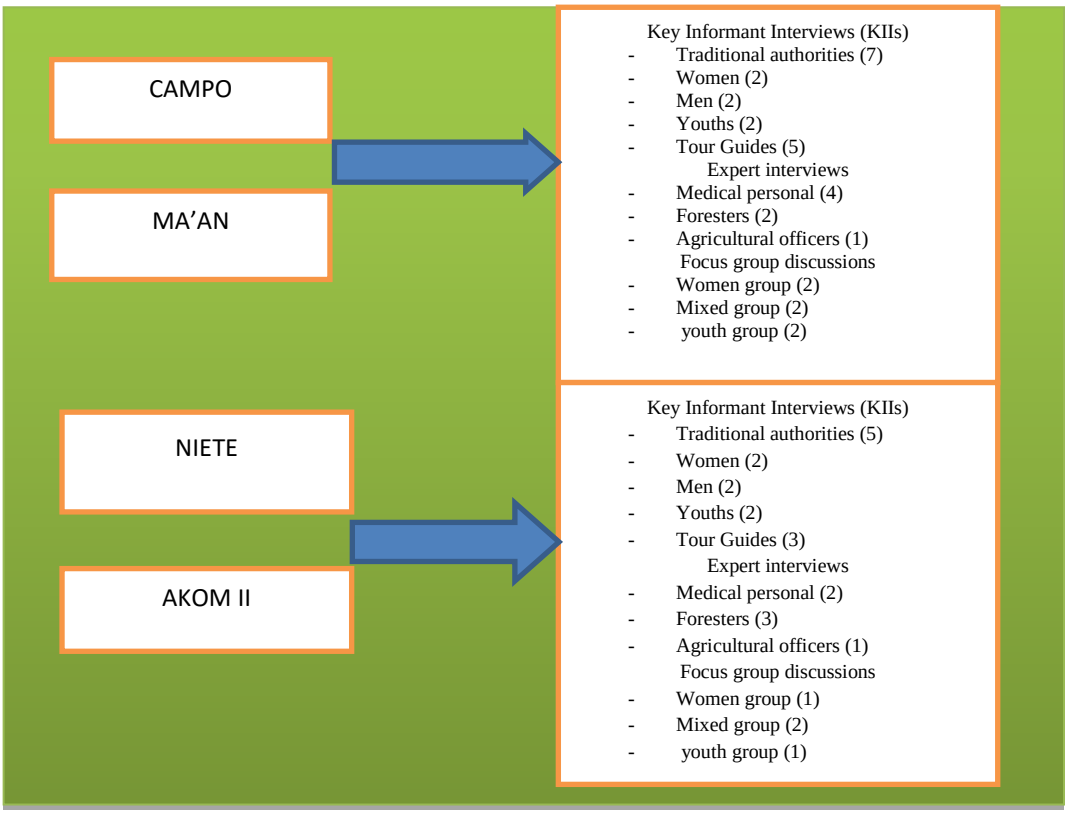


Fig. 3. Data collection chart

Table 1. Study communities, population and sample selected

S/N	NAMES OF SELECTED VILLAGES	NUMBER OF HOUSEHOLDS	Households SAMPLED
1	Nkwadjap	20	10
2	Campo Beach	98	52
3	Nazareth	07	4
4	Ebodje	60	32
5	Ebianemeyong	30	16
6	Mabiogo	19	10
7	Mvini/Akak	24	13
8	Nkoelon	22	11
9	Niete (Nyamabande/Ngock)	50	27
10	Ndageng (Akom II)	42	25
Total	**12 villages**	**372 households**	**200 respondents**

Table 2. Socio-demographic characteristics of Campo Ma'an Communities and selected health shocks

Socio-demographic characteristics	Selected communicable health shocks
Gender	COVID 19
Age/sex	HIV and AIDS
Proximity to park	Malaria
Education	Tuberculosis
Health shock determinants	**selected non-communicable diseases**
Pathogen presence	Hypertension
Vector population	Cancer
Biodiversity loss	Heart disease
Land use change	Cardiac arrest
Health system predictor	
Limited health facilities	

of being selected. Thus, more than 10% of the populations in each zone were sampled in order to ensure high explanatory power of the results and robustness. Therefore, based on the sampling Unit (N=200), and the total number of household in the selected zones, the percentage of questionnaires per village were obtained. This was complemented by the number of interviews per village (N=12). The collection of data was principally during the evening periods, the period when most household members returns from their job sites. A recall period of five years was established to obtained data on the evolution of health shocks and 23 years for the determinants of health shocks since the creation of the park in the year 2000 to reduce data inconsistency. Health shocks (communicable and non-communicable diseases and the socio-demographic characteristics of the population exposed to health shocks were ranked using the spear Man Rank correlation coefficient**.**

The quantitative data obtained through semi-structured household interviews were coded in the Statistical Package for Social Sciences SPSS version 20.

The Binary Logistic Regression Analysis was used because the independent variable is binary in nature. This implies that the use of linear regression model will not produce correct results and since the logistics regression is non-linear: capturing indecent variables that are binary in nature, it was selected as the fitting model for the study. The model is given as:

$$Logit(P) = ln\left(\frac{P}{1-P}\right) = \propto +\beta 1X1, \beta 2X2 \ldots BnXn + \varepsilon 1$$

In the model, P represents the dependent variable's probability where 1 denotes communicable diseases and 0 denotes non-communicable diseases. $\propto$ is the constant term if all the independent variables are stationary. Further, $\beta 1$ represents the slope coefficient of the first independent variable $X1$. Similarly, $\beta 2X2$ reprsent the second slope coeficienct and the second independent variable w. At the same time, Bn denotes the coefficient of the last independent variable Xn used in the model. At the same time, e ε accounts for all possible

factors that may likely influence the model but are not captured in the analysis.

Three separate models were tested (one for ecological determinants with 6 explanatory variables; one for human drivers with 11 explanatory variables and one for economic drivers with 3 explanatory variables), all following the Logit Model specification of equation 1. The results of the regression analysis have been presented in the Table 5. The data contain no missing values as all respondents completed the survey section and provided answers to all questions. Also, the vif values were less than 10, implying that none of the Variance inflation factors values is more than 10. This means that no cases of multicollinearity in the analysis.

The data obtained qualitatively through expert and key informant interviews were transcribed and further translated in to English language. The data was assigned codes and themes for the subsequent elaboration in natives especially on the typology and determinants of communicable and non-communicable diseases experienced over the past five years. In addition, the socio-demographic characteristics of the population like literacy levels, income level, age and occupation were examined.

4. RESULTS

4.1 Characteristics of the Respondents

Table 3 presents the socio-demographic characteristics of communities exposed to communicable and non-communicable health shocks in the Campo Ma'an area.

The socio-demographic characteristics of communities exposed to communicable and non-communicable health shocks of the Campo Ma'an National Park are presented on Table 3. From the sample Unit, 58.9% of the respondents were household heads while 41.1% were family members. In terms of literacy level, 39.5% of the respondents had no education, while 18.9% had primary education. Also, 24.2% had secondary education while 12.1% had vocational training. However, only 5.3% of the respondents had Bachelor's degree or equivalent. In terms of income, 51% of the respondents earned from 50.000 franc CFA and below while 33.2% earned between 90.000 and 50.000 franc CFA. However, only 13.7% of the respondents earned more than 90.000 franc CFA. In terms of proximity to the park, about 87.3% of the respondents live between 0-3km to the Campo Ma'an National Park, while 12.7% of the respondents live between 4km to more than 6km from the park. In terms of occupation, 15% of the respondents were involved in farming, 20.5% in NTFP collection, 18.9% in fishing, 13.7% were involved in hunting, 4.2% were tour guides, 13.2% were involved in bush meat trade, while 9.5% were beach workers and 4.2% were involved in plantation work.

The education levels in the Campo Ma'an landscape are mostly made up of primary education, with the highest percentage in the Ma'an area at 45%, and the lowest is the Campo area at 26%. Secondary education is predominantly in the Ma'an area at 35%, the lowest percentage is in the Niete area at 5%. The Akom II area has the highest percentage of high school education at 20%, the lowest at 8.45%. Regarding Bachelor's degrees or equivalent, the Campo area has the highest percentage at 8%, while Niete has the lowest at 4%. A significant proportion of the population in the Campo Ma'an landscape is uneducated, with the highest percentage in the Niete area at 33% and the lowest in the Ma'an area at 6.52%.

Communicable diseases are unevenly distributed around the Campo Ma'an National Park. While some communities are significantly affected by communicable health shocks, others are less affected. For instance, malaria significantly impacts the communities surrounding Campo Ma'an National Park in Cameroon more than other diseases. Non-communicable diseases also significantly impact the population of the Campo Ma'an National Park (CMNP). The most prevalent non-communicable diseases in this area are hypertension, rheumatism, rabies, heart disease, mental ailments, and blindness. Households face enormous economic challenges in managing and coping with health shocks in the region. Fig. 5 presents the spatial distributions of communicable and non-communicable diseases in the Campo Ma'an National Park communities.

4.2 Determinants of Health Shocks in Communities of the Campo Ma'an National Park

Several determinants contribute to emergence and re-emergence of health around the Campo Ma'an National Park. These include economic, ecological and socio-demographic.

4.3 Ecological Determinants

The ecological determinants of health shocks in communities of the Campo Ma'an National Park include the presence of pathogens, such as bacteria, viruses, protozoa, and fungi, in the landscape. In Campo Ma'an National Park, pathogens and vector-borne agents like mosquitoes and tsetse flies are present in water, forests, and land leading to the transmission of diseases. This exposes the population to lots of diseases. In an expert interview in Mabiogo, it was reported as follows:

> "malaria is the most common communicable disease here. We also have diseases like hepatitis. For non-communicable diseases, we have prostate cancer, cardiovascular diseases and stroke. Mental illnesses are relatively rare".

Another testimony from a focused group discussion in Ma'an area on disease prevalence in the Campo Ma'an National Park communities recounts that:

"We have a lot of diseases here. Some are influenced by natural phenomena like insect bites while others are triggered by environmental factors. For example, Campo and Ma'an have a significant problem with HIV and AIDS. However, in the southern region, Campo has the highest number of infected people. In fact, in every group of five people, there are at least four infected people from Campo. The constant movement of people in and out of Campo especially the non-permanent settlers have contributed to the presence of HIV/AIDS in the region".

Soil contamination accounted for 33.6%, followed by pathogen presence. Changing rainfall pattern stood at 12.1%. Flooding accounted for 10.7%, while pathogen presence stood at 8.1%. Also, biodiversity loss was recorded at 7.6% and lastly vector population at 4.5%. The pattern of rainfall in communities of the Campo Ma'an National Park is declining compared to past decades. This decrease is linked to increased deforestation, which reduces the amount of water vapor in the atmosphere through transpiration. As a result, waterborne diseases become more prevalent during the rainy season due to contaminated water sources from rainfall and flooding, leading to a higher risk of diseases such as typhoid, hepatitis, and diarrhea. Fig. 7 provides a visual representation of the rainfall pattern in the communities of the Campo Ma'an National Park over the past decades.

Table 3. Socio-demographic characteristics of communities of Campo Ma'an National Park exposed to health shocks

Respondents' status		**Gender of respondent**		**Gender of household head**	
Household head	**Family member**	**Male**	**Female**	**Male**	**Female**
58.9%	41.1%	63.2%	36.8%	71.1%	28.9%
Literacy rate	No school	Primary	Secondary	Vocational	B.Sc. and above
Respondent	39.5%	18.9%	24.2%	12.1%	5.3%
Household head	33.7%	29.5%	21.6%	10%	5.3%
Age of respondents/years	20-30	31-40	41-50	51-60	60+
	17.4%	25.8%	26.8%	18.4%	11.6%
Income of respondents/FCFA	10,000-30,000	31,000-50,000	51000-70,000	71000-90,000	90,000 +
	19.5%	33.6%	19.5%	13.7%	13.7%
Proximity to park	<1km	1-2km	2-3km	4-5km	6+km
	26.8%	36.3%	24.2%	7.9%	4.8%
Main occupation	Farming	NTFPs collector		Fisher man	Hunter
	15.8%	20.5%		18.9%	13.7%
	Tour guide	Bush meat trader		Beach work	Plantation work
	4.2%	13.2%		9.5%	4.2%

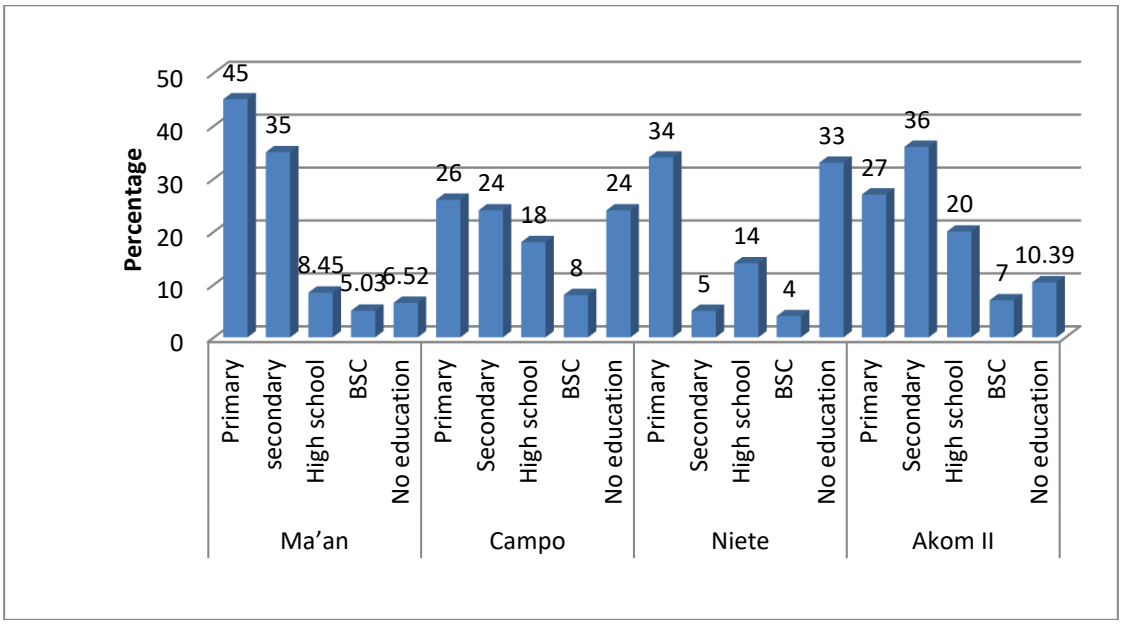
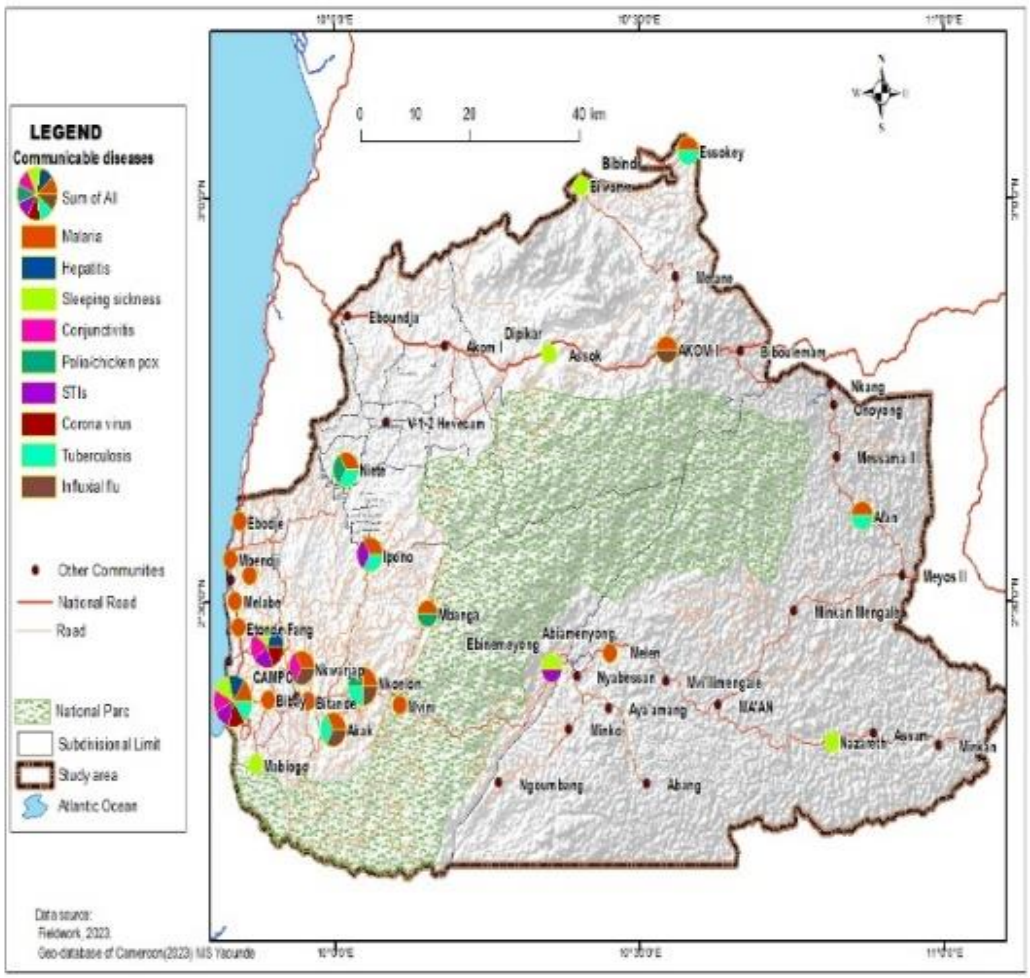


Fig. 4. Level of scholarisation around the campo Ma'an national park



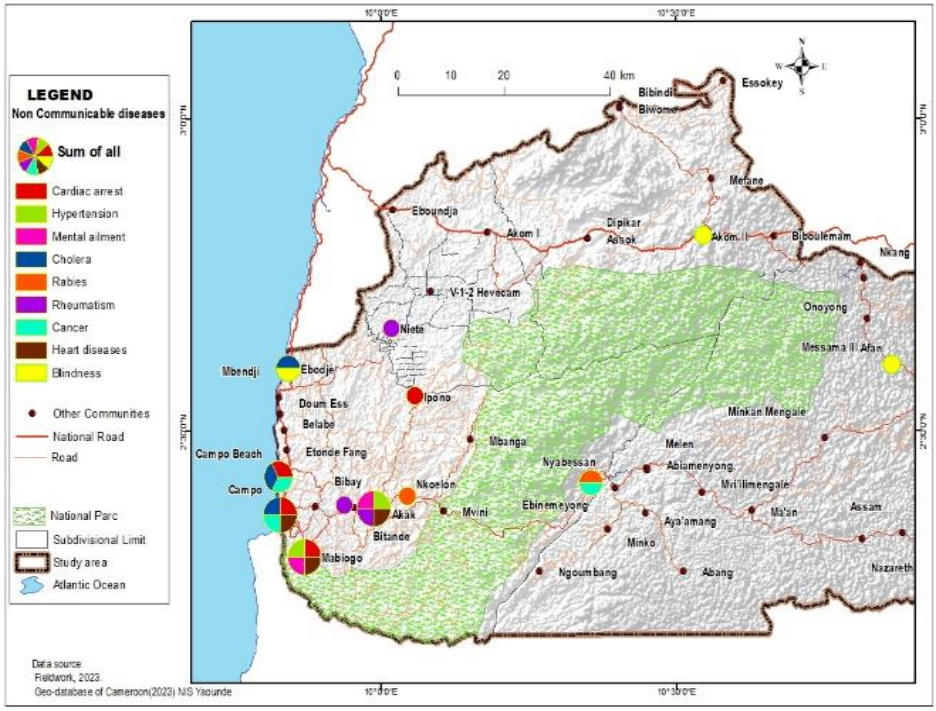


Fig. 5. the spatial distribution of communicable and non-communicable diseases in the Campo Ma'an National Park communities.

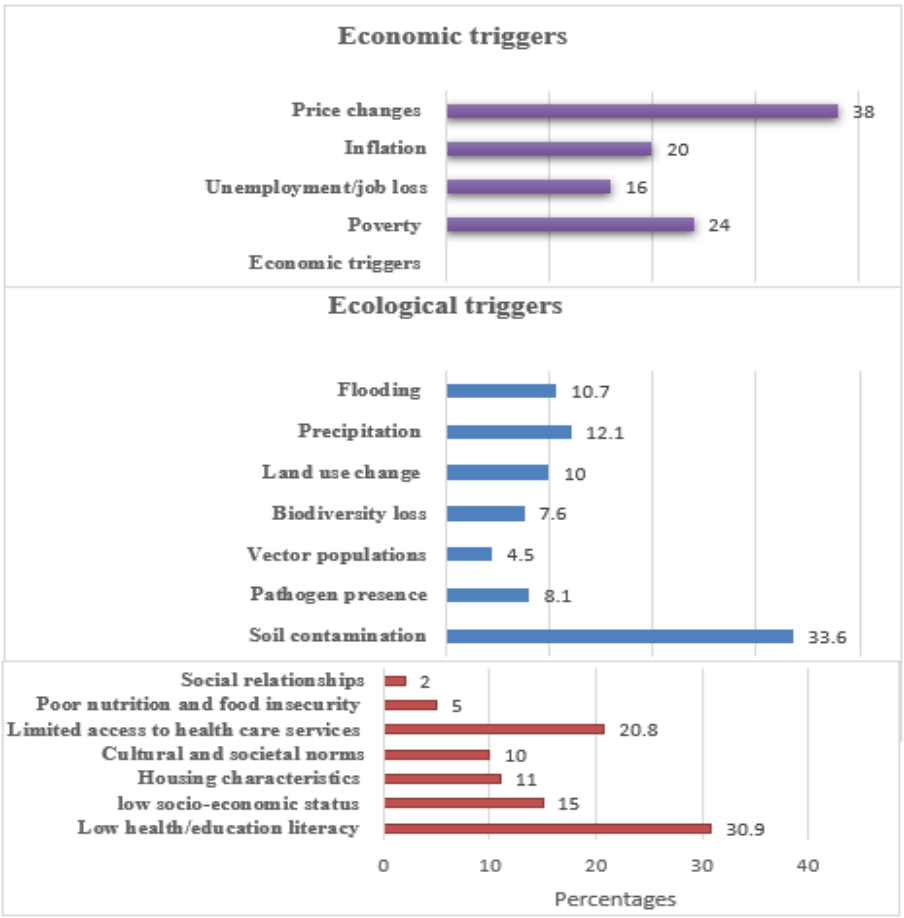


Fig. 6. Perceived triggers of health shocks in Campo Ma'an National Park communities

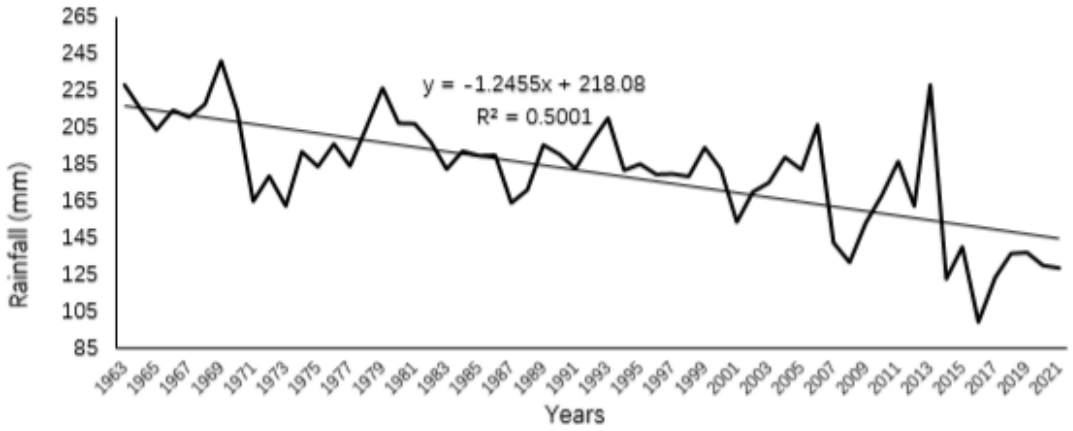


Fig. 7. Changing pattern of rainfall in the campo Ma'an landscape (1963-2021)
Source: Regional Meteorological Service, Ebolowa

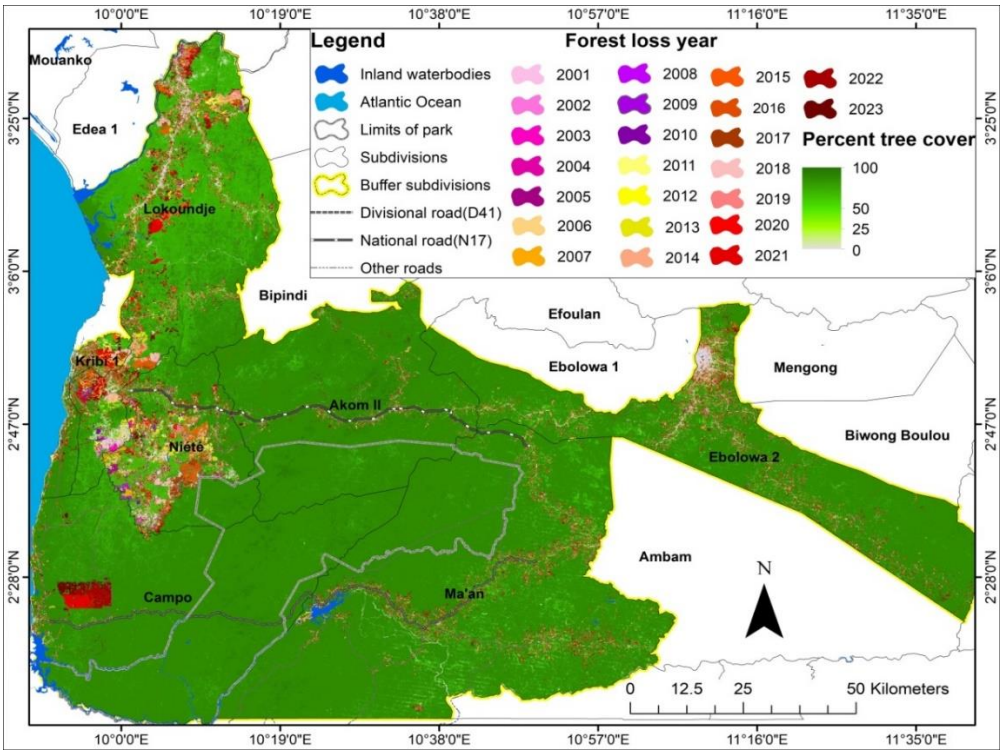


Fig. 8. forest cover change from the year 2000 to 2023 in and around the Campo Ma'an National Park.
Source: Developed based on geospatial tools 2024

Continuous and large scale deforestation of forests in the region for agriculture, especially agro-industrial plantations contributes to climate change as rainfall amounts dwindles and habitats altered and disrupted, resulting to increasing prevalence of communicable diseases in the region. Figuer presents a representation of the state of deforestation around the Campo Ma'an National Park.

The Campo Ma'an landscape is experiencing severe impacts from health shocks as a result of various socio-demographic and economic factors. Current and future projects tends to destabilize the ecological health and services provided by the park.

There is an unequal spatial distribution of ecological determinants of health shocks in

communities of the Campo Ma'an National Park. Some of these determinants were more in some communities making them more susceptible to disease transmission. Generally, villages with closer proximity to the park (1-3km) were exposed more to disease-carrying vectors and pathogens, contaminated water sources, and wildlife that easily transmit these health risks to humans. This includes villages like Nkoelon, Mvini, Ebianemeyong, Niete, and Akom II. On the other hand, communities located farther away from the park have a lower prevalence of certain diseases, especially those linked with ecological triggers.

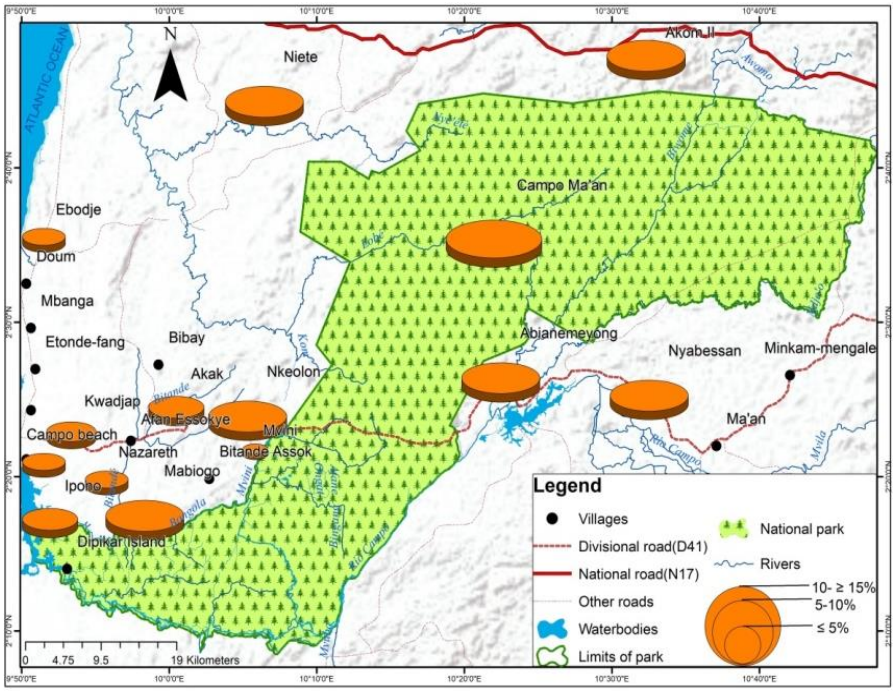


Fig. 9. The spatial distribution of ecological determinants of health shocks in communities of the Campo Ma'an Man National Park

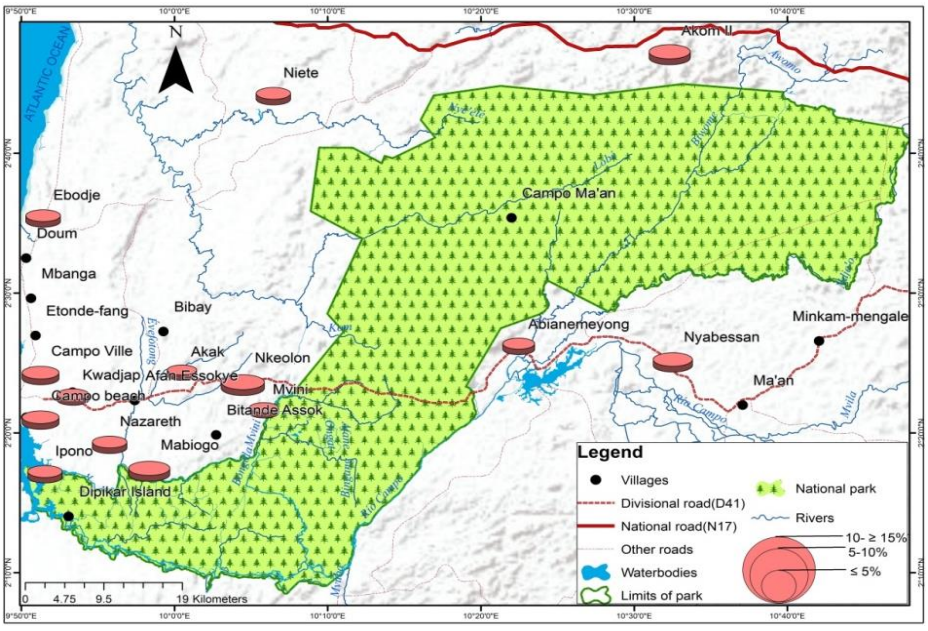


Fig. 10. The spatial distribution of socio-demographic drivers of health shocks around the Campo Ma'an National Park

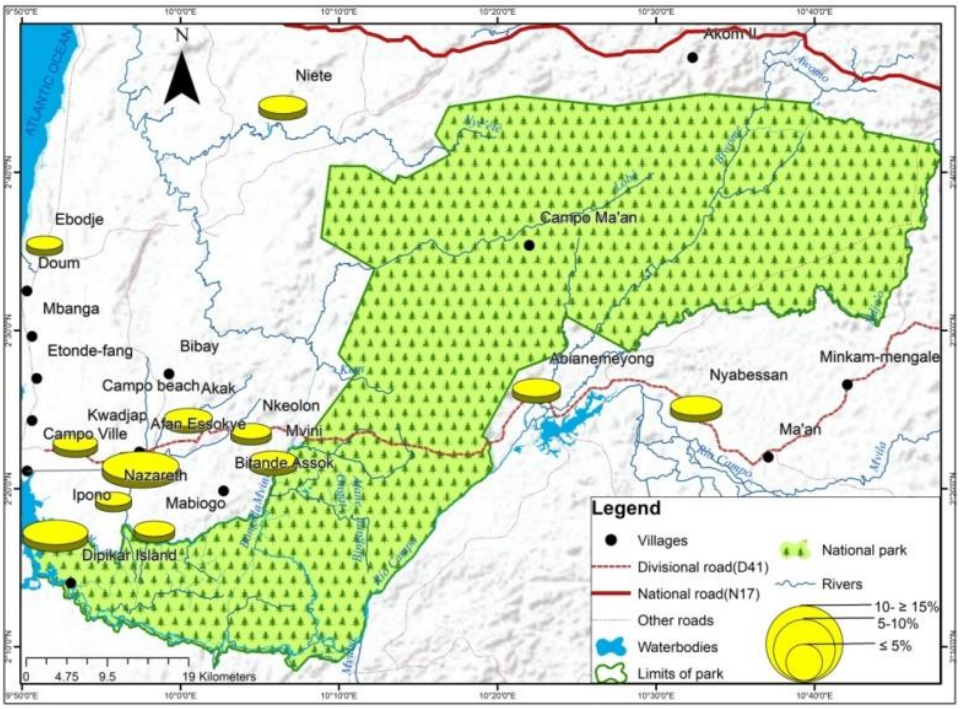


Fig. 11. the spatial distribution of economic drivers of health shocks in communities of the Campo Ma'an National Park

4.4 Socio-Demographic Determinants of Health Shocks Around the Campo Ma'an National Park

The Campo Ma'an National Park communities were also affected by health shocks due to socio-demographic determinants. Over 70% of the populations in the Campo Ma'an area have limited access to healthcare and no formal education, contributing to the development of chronic illnesses that impact mental health and overall well-being. The communities most affected by health shocks caused by socio-demographic determinants were Akak, Mvini, Bibay, Ipono, Mbanga, Niete, Nkeolon and Ebianemeyong. The distance between villages and healthcare facilities in the area exacerbates typically the situation**.** Socio-demographic determinants of health shocks in and around the Campo Ma'an National Park include low education and health literacy, limited access to health facilities, poor housing characteristics, poor nutrition and food scarcity, cultural and societal norms and limited social support networks to the region. These determinants are the major factors that cause health shock in communities of the Campo Ma'an National Park. Health statistics from the Campo Ma'an Landscape indicate an upward trend in communicable and non-communicable diseases over the past five years in communities at Campo Ma'an National Park. Malaria is the most significant communicable Disease in the region, affecting a majority of the population. Close to 70% of the landscape is affected by infectious diseases such as malaria. In terms of non-communicable diseases, hypertension tends to affect a portion of the population.

In the Campo Ma'an area, we experience both communicable and non-communicable diseases. The most widespread communicable diseases include Malaria, followed by STDs, typhoid, dysentery, and rheumatism. There have been numerous cases of Covid-19 due to movement in and out of Equatorial Guinea. As for non-communicable diseases, there are many cases of hypertension, some instances of mental illnesses, and hepatitis. Additionally, cases of gastritis, cardiac arrest due to lack of treatment follow-up, and even strokes have been reported.

Generally, over 70% of the population in the communities of the Campo Ma'an area has limited access to healthcare Table 4. The population of Campo Ma'an has a high percentage of individuals with low educational literacy, accounting for 40.9% of the population. This leads to difficulties in understanding health information, resulting in poor health decision-

making, non-adherence to medical treatments, and increased health risks. In addition, the region lacks adequate access to health facilities, as illustrated by 22.8% of the population. Most villages are situated several kilometers away from health facilities. This distance challenge makes it extremely challenging and frustrating to the population to access healthcare, especially for indigenous groups such as the Bagyeli settlements, the Mvae, and Mabeas, where traditional healing practices are often relied upon due to the absence of healthcare infrastructure in their villages.

Most village communities are far from healthcare units near the Campo Ma'an National Park. Nkeolon village is about 40km from the nearest functional health unit (CMA Campo, St Joseph, or the Military hospital). Afan Essokye and Ebianemeyong are approximately 35km away. On the other hand, inhabitants of Campo ville only need to travel a few meters to get treatment at the CMA Campo, and St Joseph. The military hospital treats mostly children. These distances deviate from the WHO/Cameroon standard of 5km to a primary health care facility. Each village has non-functional clinics, and the distance from the health units contributes to the increased prevalence of health shocks around the National Park.

Moreover, poor housing characteristics around the park alongside cultural and societal norms constitute other determinants of health shocks. Many huts in the heart of the rainforest have roofs made of mud, sticks, and grass. Additionally, the situation is exacerbated by the lack of sanitation and limited access to health facilities within the park communities.

4.5 Economic Determinants of Health Shocks Around the Campo Ma'an National Park

Economic determinants of health shocks in the Campo Ma'an National Park communities include unemployment, low-income levels and price fluctuations in the region. The economic impacts of health shocks vary among the Campo, Ma'an, Niete, and Akom II zones. The unemployment rate is highest in Akom II at 46%, followed by Campo at 44%. Niete has the lowest income level in the region at 60%, followed by Ma'an at 50%, and then Akom II at 41%, and finally Campo at 38%. In terms of price changes, the Campo area has the highest at 20%, followed by Ma'an at 18%. Akom II has experienced a price change of 13%, while Niete has only experienced 8%. Income levels in the Campo Ma'an area are low, especially for the indigenous population. Areas around Campo Ma'an Park where economic factors significantly influence health issues are illustrated by Fig. 11.

Villages closer to the park tend to experience low economic power due to limited markets. This reduces their income levels, increases unemployment, lower prices for natural and agricultural resources. Thus, making them vulnerable to health shock repercussions. Limited income in the region limit out of pocket expenses for the treatment of health shocks. These involve communicable and non-communicable diseases as presented on Table 4.

In the Campo Ma'an landscape, malaria is the most common disease compared with other communicable disease, also, hypertension is the most common non-communicable disease in the communities of the Campo Ma'an National Park, compared to other non-communicable diseases. The combine impacts of communicable and non-communicable diseases in the region put the communities in an epidemiological transition. These diseases are triggered by several factors as presented on Table 5 using the logistics regression analysis. At 10% significant level, a 1% increase in pathogenic presence tend to increase communicable diseases by about 11.5% higher more than non-communicable health shocks.

5. DISCUSSION OF FINDINGS

The debate on the emergence and reemergence of communicable and non-communicable Disease continue to attract much attention. This paper attempts to shed light on the determinants and socio-demographic catalysts of health shocks in natural based dependent communities.

5.1 Ecological Determinants

From the results obtained in model 1, four ecological determinants significantly contribute to the emergence and re-emergence of communicable and non-communicable diseases in Campo Ma'an National Park communities. These include vector population, soil contamination, biodiversity loss and flooding. The Campo Ma'an National Park's vector populations are organisms that transmit contagious pathogens between humans and animals to

humans. The presence of pathogens in wildlife is transferred to humans through carrion flies, biting flies, ants, termites, moths, and attacks on humans. In the domain of pathogen sharing, molecular analyses are done at the WWF office in Campo to identify infectious pathogens found in great apes like "Akiba" and "Taraba," for example, by using insects conserved in ethanol, dried and stored in test tubes containing silica gel at WWF biobank. Disease spread is significant, especially within the range of the Dipikar Island of the Campo Ma'an National Park. This area has a dominant great ape population due to abundant food, water, and reduced poaching pressure. Some diseases in the Campo Ma'an landscape include malaria, dengue, schistosomiasis, human African trypanosomiasis, and yellow fever. These vector-borne diseases affect a significant proportion of the population each year. In an expert interview in Campo, the following report was recorded.

Table 4. Comparative analysis of communicable and non-communicable diseases in communities of the Campo Ma'an National Park

Communicable shocks	Rank			Non-communicable shocks	Rank		
	F	%	R		F	%	R
Malaria	55	29.1	1	Hypertension	82	43.4	1
Tuberculosis	28	14.8	3	Cancer	27	12.3	3
Sleeping sickness	13	6.9	7	Cardiovascular diseases	30	15.9	2
COVID 19	9	4.7	8	Chronic respiratory diseases (chronic obstructive pulmonary Disease, asthma)	14	7.4	4
STIs	39	20.6	2	Mental health ailments	10	5.3	6
Negligible Tropical Disease	15	7.9	5	Blindness	19	10.1	5
Influenza (flu)	19	10.1	4	Diabetes	7	3.7	7
Poliomyelitis	11	5.8	6				

Source: Fieldwork, 2023

Table 5. The regression results of the determinants of communicable and non-communicable diseases in communities of the Campo Ma'an National Park

Category	Determinants of health shocks	Beta (B)
Physical drivers	Pathogen presence	.115 (.325)
	Vector population	.467* (.329)
	Biodiversity loss	-.458* (.322)
	Land use changes	-.400 (.326)
	soil contamination	.887*** (.339)
	Flooding	.870*** (.329)
Human drivers	Low socio-economic status	-.313 (385)
	Low education literacy	.126 (.347)
	cultural and societal norms	.166 (.323)
	Poor housing conditions	-.557 (.353)
	Limited access to health care services	.291 (.333)
	low health literacy	-.759** (.327)
	Poor nutrition and diet	.470 (.340)
	Limited social support	.567* (.354)
	Human-wildlife interactions	-.179 (.386)
	Road network accidents	.367 (.376)
	Alcohol consumption	-.565* (.346)
Economic drivers	Unemployment	-.118 (.326)
	Price fluctuation	.996*** (.331)
	Low income status	-.363 (.318)

*t statistics in parentheses * p < 0.05, ** p < 0.01, *** p < 0.001*

Flooding constitutes another significant contributor to non-communicable disease in Campo Ma'an National Park communities. In the Campo Ma'an National Park context, direct contact with contaminated water causes skin rashes, infected cuts, and wounds. Also, stomach illnesses such as vomiting and diarrhoea are the greatest risk from swallowing contaminated flood water. Thus, flood water contaminated with sewage continues to pose a higher risk to individuals' health as many communities rely on steams and brooks for domestic use. However, the pattern of rainfall in the Campo Ma'an National Park is declining compared to past decades. This is attributed to increasing and continuous deforestation, which results in waterborne and/or vector-related diseases, especially during the rainy season. Diseases prevalent are due to contaminated water sources and flooding, leading to a higher risk of diseases such as typhoid, hepatitis, and diarrhoea. This finding contradicts Obame-Nkoghe (2024), who observed that the ecological determinant of health shocks in Africa is climate change. Also, in Europe, the European Environment Agency attributes ecological determinants of diseases to heat waves. However, it is consistent with findings in other contexts. For example, in equatorial African forests, ecological changes, wildlife population movements, and shifts within animal reservoirs contribute to health shocks (Giles-Vernick and Rupp, 2012; Oppong and Huddleston, 2014; UN, 2021; Fiorella *et al.,*2020; WWF, 2020) especially as the study identifies disease threads posed by bacteria and viruses as well as protozoans and Fungi.

Moreover, rainfall patterns in the Campo Ma'an National Park are declining compared to past decades. This is attributed to increasing and continuous deforestation, which results to waterborne and/or vector-related diseases, especially during the rainy season. Diseases prevalent are due to contaminated water sources and flooding, leading to a higher risk of diseases such as typhoid, hepatitis, and diarrhea. An unequal spatial distribution of ecological factors contributes to health risks. These factors affect some villages more, making them more susceptible to disease transmission. Generally, villages closer to the park (1-3km) were more exposed to a higher presence of disease-carrying vectors and pathogens, contaminated water sources, and wildlife that easily transmit diseases to humans. This includes villages like Nkoelon, Mvini, Ebianemeyong, Niete, and Akom II. On the other hand, communities located farther away from the park have a lower prevalence of certain diseases, especially those linked with ecological triggers like ebodje, Mbanga, Etonde fang etc. This finding corresponds to Oppong and Harold, 2014; UN, 2021; Fiorella et al 2020 especially as the study identifies disease threads posed by bacteria and viruses as well as protozoans and Fungi.

5.2 Human (Socio-Demographic) Determinants of Health Shocks Around the Campo Ma'an National Park

The results (Model 2) indicate that socio-demographic characteristics contribute much to the emergence and re-emergence of communicable and non-communicable diseases in Campo Ma'an National Park communities. The respondents argue that socio-demographic factors significantly determine health shocks in Campo Ma'an National Park communities, including cultural and societal norms, low literacy level, low socio-economic status, poor housing conditions, human-wildlife interaction and alcohol consumption. The most significant socio-demographic determinant of health shocks in communities of the Campo Ma'an area is low literacy level. Education and health care have a negative bidirectional relationship in Campo Ma'an National Park communities. Lower educational level in the region leads to lower incomes, less options for investing in healthcare, less knowledge about medicine, and greater vulnerability as lower education and health literacy in the region continue to trigger poor health and underdevelopment.

In addition, human-wildlife interaction constitutes another significant problem, leading to health issues among human populations. In the Campo Ma'an area context, Humans and wildlife, such as gorillas, chimpanzees, and elephants, are major players in the evolutionary history of health issues, sharing frequent and close contact patterns. This means that the prevalence of health issues in the Campo Ma'an National Park is increasing. This is because transmission between humans and wildlife occurs through contact with meat and bodily fluids during hunting, trapping, and butchering. It also occurs during scientific research and human-to-human interactions, especially in healthcare settings. The forest was the major source of livelihood before the park's creation. Additionally, oral historical testimonies from pygmies highlight past

relationships between humans and wildlife, including ancestral connections with chimpanzees. Despite the passage of time, the human population continues to occupy and compete for the same ecological space as before.

Furthermore, alcohol consumption constitutes another determinant of health shock in the region. Statistics from the Delegation of Commerce at Campo revealed the quantity of alcohol imported from Equatorial Guinea on a monthly and yearly average. In the Campo Ma'an National Park context, metabolic risk factors are the major contributors to the emergence and prevalence of diseases within the landscape. Age and level of education were found to increase the incidence of disease emergence in communities of the Campo Ma'an area. This means that some non-communicable diseases are triggered by alcohol intake. Some major non-communicable diseases include hypertension, heart disease, cardiovascular issues, mental health ailments, and cancer. Several thousand cases of Non-Communicable Diseases (NCDs) emerge each year around the CMNP, some of which are recorded while others go unrecorded. These diseases trigger severe health conditions in the area, affecting livelihood systems and shifting supply chains within the population. This finding is consistent in different contexts. For instance, Oppong and Harold (2012) use the concept of vulnerable places in Africa to argue that health shocks involve risk behaviours, population or place characteristics, and vulnerability to diseases then inevitably tied to specific places and the behaviours and choices of vulnerable people create vulnerable environments that weaken or undermine resilience and result in poor health. Moreover, Wirsiy et al., 2021 also established that education was the leading cause of the cause of Ebola virus in West and Central Africa as their source of information was mostly informal discussions and misconceptions in their communities. Generally, the level of education, occupation, and ethnic group significantly affected the health of the region's population. By contrast, findings from the Amazon revealed that socio-demographic determinants of health shocks are linked to environmental modifications like road building, the building of large dams, and expansion for agriculture (Confalonieri *et al*. 2014). Thus, communicable diseases like malaria and cutaneous rapidly change in response to environmental modifications. Furthermore, determinants like precarious housing and working conditions in the Amazon region are the leading determinants of communicable diseases like malaria (Tauil 2009). Similarly, in the United States of America, socio-demographic determinants of health shocks were found to include the youth population ratio, and residents' average health risk factors (Ying *et al.,* 2022)

Socio-demographic factors also significantly determine health shocks in com munities of the Campo Ma'an National Park. Limited access to health care units contributed significantly to health shocks in the region. For instance, over 70% of the population has limited access to healthcare services. Road accidents, food insufficiency, inadequate social support and wildlife destruction of crops and farmlands have led to stress and trauma, contributing to the development of chronic illnesses that impact mental health and overall well-being of the population around the Campo Ma'an National Park. The communities most affected by socio-demographic stressors leading to diseases are Akak, Mvini, Bibay, Ipono, Mbanga, and Ebianemeyong. Access to healthcare services by some villages is extremely difficult as more than 60% of the population of Campo Ma'an National travel an average distance of 10km before they can access health care. This is contrary to 5km rule by WHO on healthcare access. Most villages are situated several kilometers away. The population experienced delayed diagnoses and treatment for health conditions affecting a greater majority of the population. This distance makes it extremely challenging to access healthcare, especially for indigenous groups such as the Bagyeli settlements, the Mvae, and Mabeas, thus traditional healing practices are often preferred, practiced and relied upon for centuries due to the inadequate healthcare infrastructure available. Moreover, there is a significant proportion of individuals with low educational literacy, accounting for 40.9% of the population. This leads to difficulties in understanding health information, resulting in poor health decision-making, non-adherence to medical treatments, and increased health risks. Oppong and Harold (2018) uses the concept of vulnerable places to argue that health shocks involve risk behaviors, population, or places characteristics, vulnerability to diseases then inevitably tied to specific places, and the behaviors and choices of vulnerable people create vulnerable environments that weaken or undermines resilience and result in poor health. Moreover, Wirsiy et al., (2021) also established that education was the leading cause

of the Ebola virus as their source of information was mostly informal discussions and misconceptions in their communities. Generally, the level of education, occupation and ethnic group significantly affected the health of the population of the region.

It has been highlighted that these facilities have limited healthcare resources to handle emerging and re-emerging health crises in the area. Consequently, critical cases are often referred to the District Hospital in Kribi, which is 75km away from Campo. In addition, housing characteristics are a significant factor that triggers health shocks within the Campo Ma'an region. Many structures in the heart of the rainforest are made of thatch, sticks, and grass. This is exacerbated by the lack of sanitation, good quality water and limited access to health facilities within the park region, leading to longer distances to health services, higher transport costs, and financial challenges for the population, particularly the indigenous people of Campo Ma'an landscape. Access to health services is limited in the Campo Ma'an area. FAO, (2021) is in conformity with this finding. However, the study emphasized growing recognition of the diverse ways that environmental degradation, such as deforestation and climate change, triggers health shocks.

5.3 Economic Determinants

Economic determinants, presented by Model 3 have a significant contribution to the emergence and re-emergence of health shocks in the communities of the Campo Ma'an National Park. In all, price fluctuations contributed more as community supply and demand interactions in the region led to losses, due to low bargaining power, thus, limited income for household healthcare management. This is prominent is rich agricultural villages like Mabiogo, Afan Essokye, hunting villages like Nko'elon, Akak, fishing villages like Campo Beach, and Ebodje. Average monthly and yearly incomes in the region are influenced by changing market conditions which most often negatively affect the prices of goods and services, affecting livelihoods and income brackets in the resources dependent landscape. Household responds to these dynamics have been worthwhile, though limited to a range of income sources like savings, borrowing, loans, or mortgages, and even the selling of livestock and assets to meet up with health expenses. As a consequence therefore, communities reported a significant reduction in labour supply, affecting production levels, worsened by low price changes mostly to their disadvantage. The immediate consequences are felt more by vulnerable households, a major trigger for increased poverty and underdevelopment of the region. Low income leads to unmet needs which triggers stress and sometimes trauma and in some cases death, particularly when healthcare expenses are limited. This findings aligns with the findings of (Kim 2021; Ouadika et al.,2020) who argued that poverty status primarily trigger health shocks, impoverishing households in Africa and households cope with health shocks borrowing from various sources. Conversely, the findings contradicts with the scenario in South East Asia, where Islam and Parasnis, (2021) established that health shocks are triggered by population growth and economic development. Other findings suggests that most households in low and middle income countries bear a heavy burden of health shocks and responses strategies are often in terms of income, savings, borrowing, loans, or mortgages selling of assets and/or livestock to manage health shocks. This significantly leads to reduction in labour supply among households in low and middle income countries (Alam and Mahal, 2014).

To conclude, communities of the Campo Ma'an National Park have been significantly affected by communicable and non-communicable health shocks especially over the past five years. Malaria is the most common and prevalent communicable disease in the region, impacting more than 70% of the population with short and long term implications on human health, livelihoods and the environment. The COVID-19 Pandemic was the least communicable diseases in the region over the past five years. In terms of non-communicable diseases, hypertension was the primary while blindness was the least prevalent. The southern section of the Campo Ma'an National Park experienced higher risk of disease prevalence than the northern and eastern sections. This is primarily as a result of increasing human interference through contact with wildlife, consumption and trade in bush meat, deforestation and agro-industrial plantation establishments in former wildlife habitats, exposing humans to wildlife attacks. Several factors determined health shocks in the communities of the Campo Ma'an National Park, with the most significant determinant being socio-demographic factors, with education/literacy level playing a fundamental role, while limited social support was recorded as the least significant. Ecologically, soil contamination was the most

significant while land use change was the least significant. in addition, price fluctuation was the most significant economic determinant of health shocks while low income status was the least economic driver.

Every year, several cases of Non-communicable diseases like hypertension, heart disease, cardiovascular diseases, and cancers emerge in the communities of the Campo Ma'an National Park. Unfortunately, significant proportions go unrecorded through traditional methods of treatment while others are recorded through hospital records. Their impact is long lasting especially on livelihood systems and supply chains within the region. This finding is consistent with Oppong and Harold, (2018) who argued through the concept of vulnerable places in Africa, that health shocks involves risk behaviors, population or place characteristics and also the vulnerability to diseases. These diseases are tied to certain places and the behavior and choices of the population creates an environment that weakens or undermines resilience and finally result in poor health. In similar context, Wirsiy et al (2021) established that education was the leading trigger of the Ebola virus in central and West Africa as information sources were informal discussions and misconceptions in communities. Other factors included occupation and ethnicity. In addition, socio-demographic determinants of health shocks on the Amazon are linked to environmental modifications like road buildings, construction of large dams and agricultural expansion (Confalonieri et al 2014). This study argues that communicable diseases like malaria and cutaneous undergo changes in direct respond to environmental changes. This is different from the findings of Tauil, (2009) who rather argued that precarious housing conditions as well as working conditions in the Amazon region are the main determinants of malaria. In the United State of America, Ying et al established that socio-demographic determinants of health shocks include youth population ratio and residents' average health risks factors. In the case of Latin America and the Caribbean countries, cardiovascular diseases primarily increases the mortality rate due to cardiovascular risk factors like tobacco, diabetes, physical inactivity, hypertension, and obesity, and in some case death (Pramparo et al., 2007).

6. CONCLUSION

The Campo Ma'an National Park communities are exposed to health shocks. These include communicable and non-communicable diseases. Communicable diseases like malaria, tuberculosis, COVID-19 19 and STIs are more prevalent than non-communicable diseases like hypertension, cancer, cardiovascular diseases, and mental ailment. Furthermore, the prevalent of health shocks is triggered more by socio-demographic factors than by ecological and economic factors. Based on the analysis, over 70% of the Campo Ma'an National Park population have limited access to basic health care, low education and health literacy level, accounting for 40.9% of the population, thus hindering basic understanding and adherence to medical knowledge and instructions. Poor housing characteristics, food availability and nutrition issues, customs and traditions, human-wildlife interactions and/or conflicts, and consumption habits constitute the socio-demographic factors triggering health shocks in the CMNP. These factors contribute directly and indirectly to the emergence and re-emergence of health shocks affecting livelihoods and overall wellbeing in the region. Malaria for instance, affects all communities in the landscape. Ecological determinant associated with health shocks were linked to soil contamination, forest/biodiversity loss, changing rainfall pattern, flooding, pathogen presence and vector populations. Continuous deforestation and reducing precipitation levels exacerbate communicable diseases in the region, thus, climate change is a contributory factor to these dynamics. Economic determinants of health shocks were associated with unemployment and price fluctuations.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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