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Study of Incidence and Prevalence Rate of Three Water-Related Diseases in the Beninese Mono Basin

Amoussou Yvon Lionel[1,2], Djaouga Mama[2], Kpokpo Roche[2], Late Enoc[2], Senou Rodrigue[4], Thomas Omer[4], Agbahungba Georges[1], Avahounlin Fernand[1,5], and Vissin Expedit[3]

1. International Chair in Mathematical Physics and Applications, Benin

2. Laboratory of Cartography, University of Abomey-Calavi, LaCarto, Benin

3. Pierre PAGNEY Laboratory, Climate, Water, Ecosystems and Development, Cotonou, Benin

4. Faculty of Psychology, University of Abomey-Calavi, Benin

5. National University of Sciences and Techniques of Engineering and Mathematics (UNSTIM), International Chair of Mathematical Physics and Applications (CIPMA, UNESCO Chair), Benin

Abstract: The issue of health in the basins is a concern of the various political and administrative leaders and development partners. A study of the incidence rate of diseases commonly encountered in the Mono Basin shows that several diseases are caused by the water of the basin and its tributaries and effluents. The Benin basin of Mono subject to several hydro-climatic risks has its populations that are facing these evils. Our study involved collecting statistics on the incidence and prevalence of disease from primary and secondary health center in the basin's cities, the first results showing in order of recurrence the following diseases: malaria, onchocerciasis and cholera according to the seasons. Through a socio-economic survey, we analyzed the strategies of adapting its population to these three diseases.

Key words: basin, prevalence and incidence rate, adaptation strategy, health

1. Introduction

The impact of climate dynamics on health is demonstrated in several studies [1]. According to Catherine Simonet [2], climate and health are very much linked so rainfall shocks have adverse consequences on the health of children under five years and pregnant women. This fact can be attributed to the absence, scarcity, excess, or poor spatio-temporal distribution of rainfall [3]. These impacts are manifested in the Mono basin particularly in the health zone of Athieme and Lokossa by various pathologies in the rainy season with a peak in the months of June and July on the one hand and October and November on the other. In 2017 we reached nearly 30742 cases of malaria in this health zone. Regarding the pathology of onchocerciasis we reached 52726 cases for the same year 2017. The frequency of these diseases shows the limits of adaptation strategies. Our methodology consisted in identifying, characterizing and mapping the pathologies in some cases and then, from the central trend parameters, determining the coping strategies for the pathologies and proposing adaptation measures.

2. Material and Methods

2.1 Watershed Delimitation

To delineate the watershed, we downloaded a high resolution (10 m) DEM image of the study area. Then we proceeded to extract the streams from the DEM image. After generating the hydrographic network, we

Corresponding author: Amoussou Yvon Lionel, Dr.; research areas: geomatics and Hydroclimatic risk management. E-mail: yvonci@yahoo.fr.

created a vector "point" file, switched it to edit mode and pointed to the outlet of the Mono watershed.

2.2 Delimitation of the Study Area and Mapping of the Spatial Distribution of Onchocerciasis in Athieme and Lokossa

The methodology was based on two parts. The first part consisted of integrating the geographic information into a GIS, such as: the administrative division plan of the municipalities in study zone, the SRTM Digital Terrain Model (DTM) image. It will be useful to determine the rate of vulnerability in the second part, the last part can be divided into 7 subparts [12].

The processing was done in 7 steps:

Step 1: Acquisition of the image produced by OSFACO

Step 2: Extraction of the study area

Step 3: Altimetric processing

Step 4: Classification by elevation level

Step 5: Vectorization

Step 6: Dressing and layout

The last part consisted in georeferencing the maps and adding GPS and socio-economic data.

2.3 Collection of Climate Data

Climatological data were provided by METEO BENIN on the basis of rainfall stations in the cities selected for the study. These data concern the rainfall stations of Athieme, Grand-Popo, Lokossa and Bopa over the period 1989-2009. The temperature, air humidity and evapotranspiration of the synoptic stations of Cotonou and Bohicon. These data were collected at daily, monthly and annual time steps [9].

2.4 Collection and Processing of Epidemiological Data

Epidemiological data were collected in two stages. First, we received the epidemiological data from the ministry of health, and then we collected the data in the field through direct, semi-structured interviews and socio-economic surveys [10]. Moreover, the central tendency and dispersion parameters (average and standard deviation) were used at this level and allowed to have illustrative diagrams completed by affection rates of some years according to their availability.

2.6 Treatment of the Incidence Rate

The incidence rate is calculated according to the formula [4]:

I.R = (Number of patients/total population) * 100,000 inhabitants.

The data received on malaria did not provide information on age, gender, economic activity and origin.

3. Results and Discussions

3.1 Physico-Geographic Location

Located on the Togo-Benin border, the Mono River extends 560 km from North to South and more precisely between 06°16' and 09°20'N and 0°42' and 2°25'E [5]. It drains a watershed of about 30,000 km² and flows into the Atlantic Ocean and a vast lagoon system. The Nangbeto dam was built in 1987, drastically modifying the natural hydro-sedimentary regime in the valley and at the mouth of this river [6]. The analysis of the state of land use has shown a marked change in land use units over several years, with a significant regression of the beach, natural plant formations (forest and savanna) and an increase in anthropized formations (mosaics of crops and fallow land under palm groves, plantations and settlements) related to population growth that generates land pressure [7].

3.2 Predominance of Malaria and Onchocerciasis in the Lokossa-Athieme Health Zone

The average malaria incidence rate in the Athieme and Lokossa health zone is 18,636 over the period 2011-2021 for an average population of 186,183 over the period with a peak of approximately 28,272 cases in 2019.

Concerning onchocerciasis, the topographic background used does not take into account all the geographic data for the districts in the Athieme health coordination database. We have attached to the curve a histogram.

At the end of the socio-economic surveys and semi-direct interviews, it was noted that the communes of Adohoun, Kpinnou and Ouedeme-Adja are the most flooded and the ones that suffer the most from ailments such as malaria and onchocerchosis, especially women, because of their proximity to the water of the rivers

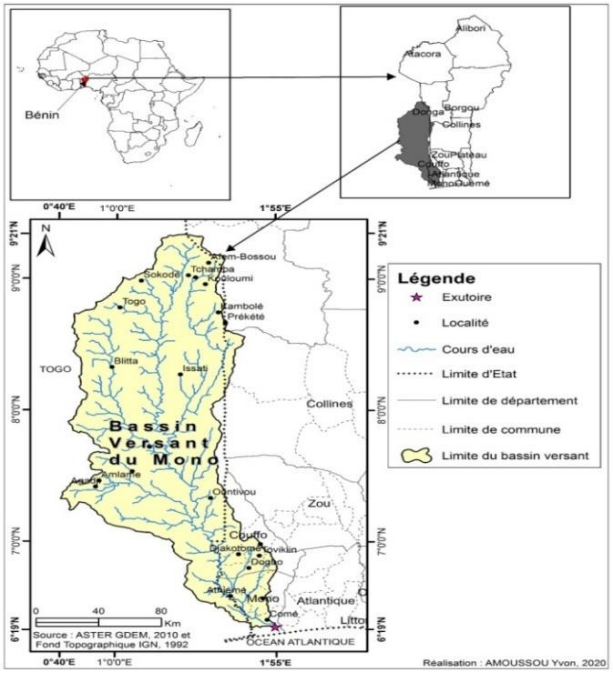

Fig. 1 Location of Mono Basin.

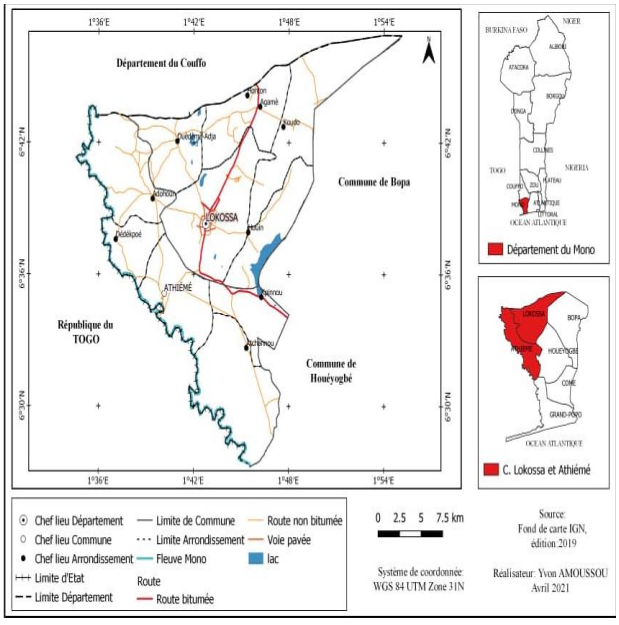

Fig. 2 Location of the Lokossa-Athieme health zone.

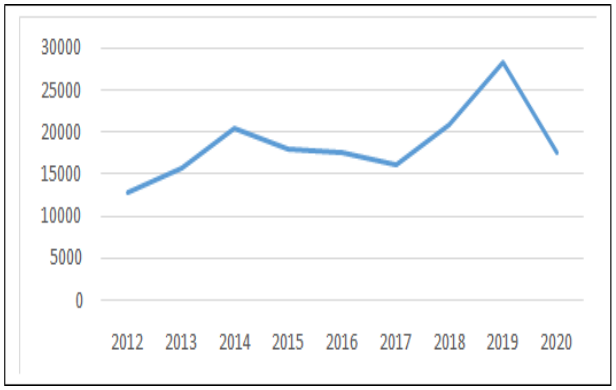

Fig. 3 Evolution of the annual incidence rate of malaria in the health zone of Lokossa and Athieme (Mono basin).

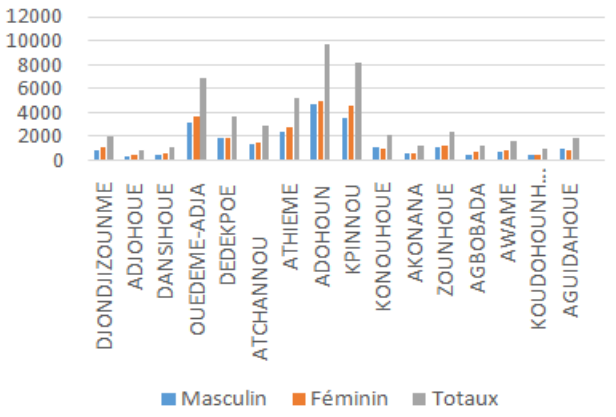

Fig. 4 Number of individuals affected by onchocerciasis.

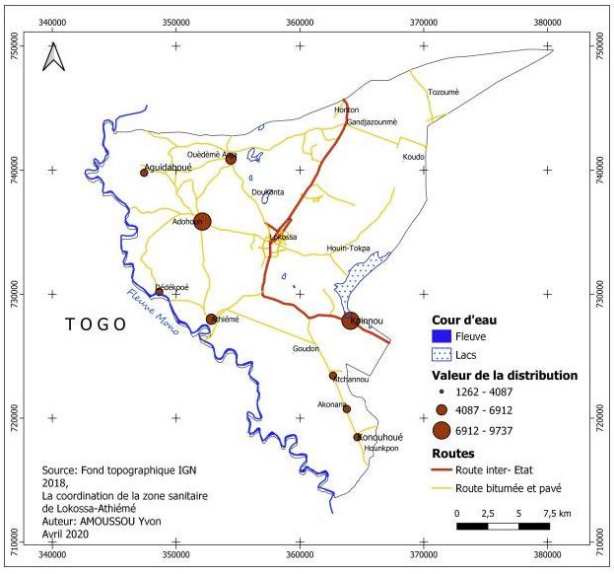

Fig. 5 Spatial distribution of onchocerciasis in Athieme and Lokossa.

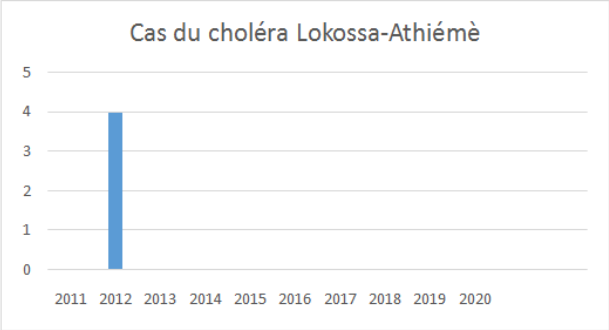

Fig. 6 Prevalence of cholera in the Lokossa-Athieme health zone.

where they do their laundry and draw water for their household chores. The combined actions of water releases from the basins with the rainfall cause recurrent flooding in the lower valley of the watershed with the succession of waterborne diseases including malaria, onchocerciasis, intestinal parasitosis and cholera. These surveys allowed us to identify and classify pathologies in the Mono basin by season. Thus we have in the rainy season:

- Malaria
- Oral candidiasis
- Intestinal parasitosis
- Onchocerciasis.

In the dry season:

- The common cold
- Coughing
- Asthma attacks
- Some infections
- Reptile bites
- Diarrhea problems due to drinking improper water

3.3 Adaptation Strategies and Waterborne Diseases

The strategy to control onchocerciasis or river blindness is the use of Ivermerctin (tablet) on an individual basis to prevent this serious disease causing irreversible blindness. Ivermerctin paralyzes and kills the microfilariae, relieving the intense itching on the skin and stopping the progression to blindness. Infected individuals can be treated with one dose every 12 months. It is necessary to associate corticoids to the treatment to limit the inflammatory reactions induced by the death of the microfilaria [11]. Let us also note that the commune is hit in case of a big flood as it was the case in 2017. This situation indicates an insufficient follow-up of preventive measures. The fight against onchocerciasis at the environmental level consists of killing the larvae with insecticides, including the dispersion of insecticides on rivers and streams. To this end, it is necessary to clean up the living environment of the populations while reinforcing preventive measures. Against malaria, there is a follow-up committee at home to take care of children from 0 to 5 years old who suffer from malaria in the commune of Bopa, which considerably reduces the prevalence among children and women in this area. Training on hygiene and sanitation is provided to women to fight malaria and other water-related diseases. These two solutions must be developed in addition to the spraying of chemical insecticides such as pyrethroids, which are effective and less toxic in the communes of Athieme and Lokossa, where the population, especially women and domestic animals, are vulnerable to onchocerciasis. General hygiene measures such as systematic hand washing, wastewater treatment, and the construction of latrines in areas where people gather and which are isolated from water points have helped reduce the prevalence of this disease in Mono.

4. Conclusion

This study highlights the importance of climatic parameters and flooding in the appearance and spread of waterborne diseases. Indeed, in the rainy season the appearance of diseases is certainly explained by the stagnation of rainwater or the increase in the level of the river, but especially by the strong anthropization of the natural environment. However, the results show that it is necessary to plan very thorough investigations in the direction of some target sectors for a better adaptation of stakeholders in the management of pathologies.

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