



## REVIEW ARTICLE

### CLIMATE CHANGE AND MALARIA IN BENIN: WHEN GENDER ROLES DETERMINE WOMEN'S VULNERABILITY IN BENIN (BONO)

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#### ABSTRACT

This article highlights the link between climate change and malaria in Benin, focusing on gender differences related to the vulnerability of social categories. The research was conducted using a qualitative methodology in the municipality of Bonou, an agroecological zone exposed to the effects of climate change such as floods, rising temperatures, and irregular rainfall. Data collection involved 143 individuals engaged in two emerging economic activities: river sand mining and harvesting of palm nut clusters. The results demonstrate that climate change has led to a reconfiguration of economic activities and an uneven distribution of labour by gender, further exposing women to mosquito bites and the risk of malaria. Epidemiological data analysis of malaria in the municipality of Bonou from 2001 to 2020 revealed a higher prevalence among women than men. This is explained by the fact that in certain activities, the workforce is predominantly female. Women spend a significant time at their workplaces, exposing themselves to mosquito bites, as well as through domestic activities, increasing their vulnerability to malaria. Efforts to control malaria should consider social and cultural norms influencing the distribution of roles and remuneration of actors in these economic activities, as well as their perception of the risk of exposure to mosquito bites.

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## INTRODUCTION

Climate change poses a hindrance to the achievement of Sustainable Development Goals (SDGs) in developing countries, presenting subsidiary challenges to poverty and social inequality reduction. It represents both an economic, social, and health issue (Fraser, 2021). Severe floods, rising temperatures, irregular and poorly distributed rainfall negatively impact population health, especially among vulnerable groups (WHO, 2015). Africa is the most vulnerable region to climate change and appears to be the most affected (Zongo & Bétéo, 2016). Its populations face risks of malnutrition and other infectious diseases such as malaria (WHO, 2022). According to WHO (2023), in 2021, Africa recorded 95% of malaria cases and 96% of deaths due to the disease, with 80% of deaths affecting children under 5 years old. Malaria remains a public health priority. In Benin, it remains the leading cause of consultation and hospitalization, with nearly 3,163,648 reported cases of malaria and 2,956 deaths in 2021 (ALMA, 2023). In the ABD health zone, this disease remains endemic and stable with seasonal increases.

The evolution of malaria transmission incidences between 2011 and 2020 shows that the Bonou municipality is the most vulnerable to malaria among the three municipalities in the ABD health zone (Osse, et al., 2019). Through a vulnerability study, it is concluded that the Bonou municipality could be vulnerable to variability and climate change for structural and unusual reasons (OSSE et al., 2019). Increased temperature or humidity would influence the spread of malaria vectors (Diouf et al., 2017). Changes in hydraulic systems make certain areas more humid, favouring anopheles. As an agroecological environment, the population in this locality is more exposed to malaria risks, as well as a decrease in rural agriculture and fishing productivity, leading to a shift to other economic activities to mitigate the impacts on their livelihoods. This transition results in disparities in terms of working hours and workforce by gender, in environments conducive to malaria risk. Several studies show that vulnerability to the hazards of climate change is related to the population's sector of activity, social position in the community (Krist Janson et al., 2015), and gender (Akimabera and Dossou-Cadja, 2019). It appears that women are more vulnerable to the effects than men.

Faced with this risk, population vulnerability varies by gender. A study in agriculture shows a correlation between the disparity in malaria incidences and gender roles defined by the community (Woldu & Haile, 2015). Given sociocultural realities, women bear more of the burden of malaria due to their assigned roles and responsibilities (Burns, 2015). Climate change reinforces gender inequalities, making many women more vulnerable (Schalatek *et al.*, 2018), not only in terms of health but also in terms of access to care. These gender-specific impacts result from an unequal distribution of social roles (Becerra, 2012, p. 11) (Akimabera and Dossou-Cadja, 2019). The division of labour based on traditional gender roles may lead men to work in fields at night, and women to fetch water early in the morning, exposing them to periods when mosquitoes are most active (Cotter *et al.*, 2013). The objective of this research is to highlight the connection between climate change and vulnerability to malaria in the municipality of Bonou in Benin, with a particular emphasis on gender differences.

## METHODOLOGY

**Study Framework:** This work is conducted in the municipality of Bonou in the Ouémé department of Benin. A rural locality, it is situated in an agroecological zone of Benin where the effects of climate change are intensifying. The populations are exposed to floods, inundations, and erosions. Thus, this work targeted twenty (20) villages exposed to these effects. The choice of this municipality was based on certain indicators. It is part of a health zone endemic to malaria, with an incidence of 11.6%, representing one of the highest rates in the climate-sensitive zones of Benin. Through an analysis based on this incidence between 2011 and 2020, Bonou is the most vulnerable municipality to malaria among the three municipalities in the Adjohoun-Bonou-Dangbo health zone (ABD) (Osse *et al.*, 2019).

**Nature and Type of the Study:** It is a cross-sectional study based on a qualitative approach that drew from quantitative data from health statistics of the Bonou municipality.

**Study Population:** The target of this study consists of women and men, as well as associations and professional groups engaged in economic activities using natural resources. It includes community health workers, healthcare professionals, focal points for climate change and gender at the municipal level, agents from the territorial agency for agricultural development and health, opinion leaders, and a specialized entomologist. In total, 143 informants were mobilized for data production.

**Data Collection and Processing Method:** Data are collected using individual interview guides, and focus group discussions were conducted with community actors. Additionally, community observations and documentary reviews were employed. This review involves studying documents related to gender studies, policies, and strategies in the main sectors concerned (health, climate change, and gender).

## RESULTS

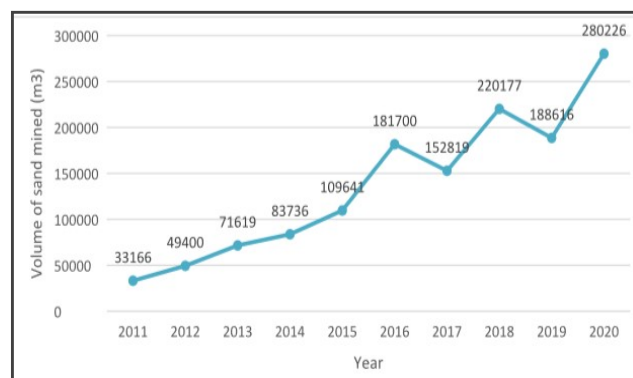
The results of this research describe emerging economic activities in the context of climate change in the Bonou municipality and the epidemiological situation of malaria by gender in the municipality from 2010 to 2022.

**Emerging economic activities in the context of climate change and work organization in Bonou:** The municipality of Bonou is characterized by a diversity of economic activities, with agriculture (market gardening, oil palm cultivation, cultivation of food crops, and others), livestock farming, fishing and fish farming, river sand mining, trade, and craftsmanship being the main ones (PDC, 2018-2022). The economy of the municipality was primarily based on agricultural production dominated by oil palm plantations, maize and cassava cultivation, and market gardening. With climate change, several activities have become flourishing in the Bonou municipality. The results of this study focused on river sand mining and the harvesting of oil palm bunches in Rural Development Cooperatives (CAR).

### River Sand Mining in Bonou

**Emergence of River Sand Mining Activity in the Bonou Municipality:** Nowadays the main activity of the municipality, river sand extraction was once a secondary activity carried out by about twenty women who gathered and sold sand along the Ouémé River bank. They were sought after in the community for construction needs. It was a makeshift activity that allowed women to meet their needs. As confirmed by statements collected in the field, "In the past, it was the women living along the riverbank who gathered and sold river sand (...), for a small amount of money" (community leader, Bonou, 2022). They "got up early and collected sand before going about their other activities (...)" (Local elected official, Bonou, 2022). They initially did this activity for the needs of their community and later to meet demands from neighbouring and even distant areas. With external demand, the activity gained momentum and led to the involvement of men in river sand collection. Notably, there was an increase in sand in the river due to recurrent floods around 2010. For several years, river sand exploitation remained informal and practiced by a minority of people. With the closure of marine sand quarries in the municipality of Sèmè-Podji in 2009 due to coastal erosion, river sand mining became an organized, formal activity in the Bonou municipality. Consequently, every operator became obliged to obtain authorization for the opening and artisanal or semi-industrial exploitation of quarries. It is from this period that data on sand production started to become available.

The following graph shows the evolution of river sand mining in Bonou from 2011 to 2020.

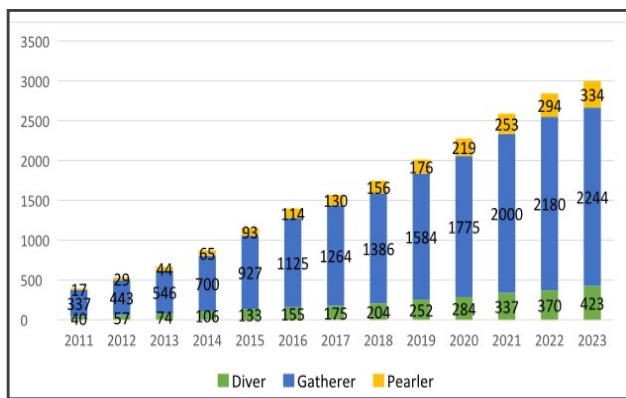


Source: Department of Planning, Local Development, Decentralized Cooperation, and Intercommunality (SPDLCDI) of Bonou

Graph 1. Evolution of river sand mining in Bonou from 2011 to 2020

This graph presents data on the evolution of river sand mining from 2011 to 2020 across 20 quarries. From the graph, it is evident that the volume of exploited river sand has evolved rapidly over time, increasing from 33,166 m3 in 2011 to 181,700 m3 in 2016, representing an average annual increase of 25%. From 2016 to 2019, there is a fluctuating trend attributed to disruptions resulting from reforms to regulate the sector. In 2020, the evolution reached its peak with a total volume of 280,226 m3. Thus, the river sand mining in the municipality of Bonou has experienced exponential growth over time. This growth is observed both in the number of quarries and the volume of sand exploited. As of 2023, there are twenty-two (22) quarries, with twenty-one operated artisanally and one operated by dredging.

**Organization of Work in River Sand Mining:** Similar to the evolution of the volume of exploited sand, the number of people working in this sector has exponentially increased. According to interviewed stakeholders, this increase is explained by the fact that many people have abandoned agricultural activities due to reduced yields caused by seasonal disruptions, opting for sand mining, which they consider a profitable activity that meets their needs. River sand mining in the municipality of Bonou has witnessed significant mobilization of the workforce (youth and women) and a distribution of labour based on gender. According to collected data, "divers" are responsible for going to the riverbed and extracting sand, filling the boats. The women, "gatherers," handle the unloading of sand-filled boats brought from the water by the "divers." The "pearlers," on the other hand, are responsible for loading the trucks. It is a chain of work that involves both men and women in most quarries. The number of workers in these quarries varies by gender (see graph 2).



Source: Field data, 2023

**Graph 2. Changes in the number of workers at sand quarries in the municipality of Bonou**

This graph depicts the evolution of the workforce on the twenty-one (21) artisanal sand quarries in the municipality of Bonou from 2011 to 2023. The graph illustrates that the workforce has evolved gradually over time and varies by gender. The number of gatherers significantly exceeds that of divers and pearliers. This disproportionality in the workforce is explained by the organizational structure established around the activity. When two (2) divers load the sand boat, at least five (5) women are needed to unload it. The loading time of a boat varies between 30 minutes and 50 minutes, depending on the size of the boat. To unload a boat, women may take 40 minutes to 60 minutes. The cost of unloading a boat depends on its size and ranges between 1400 CFA francs and 3000 CFA francs. On the sites, women organize into groups.

Each group can unload an average of 5 boats per day. The working time is approximately 12 hours per day. Workers are paid on a daily basis. The work usually starts at 7 am and ends at 7 pm. However, according to some respondents, they may stay on the sites until 9 pm while waiting for their due. The average daily income is around 3000 CFA francs for a gatherer and 5000 CFA francs for a diver. Work is done every day except Sundays and market days in each locality, resulting in 5 or 6 working days per week. Photos 1, 2, and 3 below showcase life on one of the river sand mining sites in the municipality of Bonou.



**Picture 1. Unloading sand boats by women, Madindé, 2022**

As observed in Photo 1, women can be seen in the water unloading sand boats. Photo 2 depicts gatherers with basins containing sand on their heads, heading towards the storage areas. As for Photo 3, it shows men with beads in hand loading a truck. These various photos partially depict the organization of work at a river sand extraction site

**Harvesting of Oil Palm Bunches:** Harvesting oil palm bunches, an activity of rural development cooperatives.



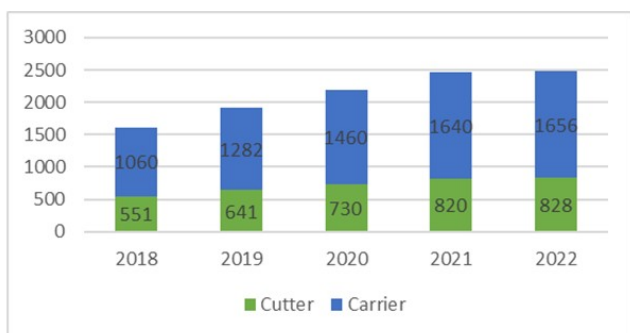
**Photo 2. View of a river sand extraction site, Madindé, 2022**



**Picture 3. Loading of a truck by men, Madindé, 2022**

**Activity Evolution:** The harvesting of oil palm bunches is organized by the Rural Development Cooperatives (CAR) known as the National Rural Development Company (SONADER), established in 1968. It involves cutting and gathering oil palm bunches in oil palm plantations. According to the data collected through interviews, this activity covers 10 out of the 12 months of the year, with two (2) harvesting episodes in one month.

**Work Organization in Harvesting:** The organization of this activity involves both men and women with a gendered division of labour. The cutting of oil palm bunches is done by men, referred to as "cutters," and the term "carriers" is used for women who are responsible for gathering and transporting the oil palm bunches to the station for easy transport to trucks. In most CARs in the municipality of Bonou, the harvesting of oil palm is done twice a month. The duration of a harvest is at least three (3) days and at most four (4) days in times of abundance, with ten (10) hours of work each day, as stated by a CAR director: "During periods of abundance, from January to October, we work from 8 am to 6 pm, Monday to Thursday" (cooperative director, Bonou, 2022). Workers are organized into teams of three (3) people, including one (1) man and two (2) women. The workday starts at 8 am and ends at 6 pm. Sometimes, men (cutters) finish their day a little earlier and may leave the palm groves around 4 pm. When men finish cutting the assigned bunches for the day, they can return home, leaving the gathering to women. Women may stay in the palm groves until 6 pm. Income is monthly and depends on the number of bunches harvested by the team. The amount paid per harvested bunch is 40 CFA francs. The cutter alone takes 50% of this amount, and the two carriers evenly share the remaining 50%. According to one of the CAR leaders, the monthly income of a team ranges between 35,000 and 40,000 CFA francs. This amount is shared among the team members based on the same principle. Harvesting oil palm bunches is the most sought-after activity of the CARs by the people of Bonou nowadays. Graph 3 presents the evolution of the number of workers over a period of 5 years.



Source: Field Data, 2023

**Graph 3: Evolution of the number of workers for the harvesting of oil palm bunches from 2018 to 2022**

This graph depicts the evolution of workers in four (4) Agricultural Cooperatives (CAR) (Bonou, Atchonsa, Adido, Affamè) out of the seven (7) in the municipality of Bonou from 2018 to 2022. The analysis of the graph shows an increase in the number of workers each year. Additionally, the number of "Carriers" (women) is twice that of "Cutters" (men). According to the respondents, this disproportionality in the workforce in this sector is explained by the fact that one "Cutter" is assisted by two "Carriers" during the harvest. This

means that women constitute the majority of the workforce. The involvement of actors in this sector is explained by the guarantee of a monthly salary and an additional source of income related to the sale of palm nuts that fall from the clusters during the harvest. Indeed, Agricultural Cooperatives are only interested in the clusters and not the fallen nuts. Therefore, workers benefit from these fallen nuts.

For each harvest, which lasts 3 to 4 days, the sale of these nuts can earn the team a sum of 15,000 CFA francs, distributed according to the principle mentioned above. The photos below illustrate the organization of work in one of the CAR plantations in the Bonou district.



**Picture 4. Women collecting palm nut bunches, Madindé, 2023**



**Picture 5. Women collecting palm nut bunches, Madindé, 2023**

Photo 4 shows a woman with a baby picking up bunches of palm nuts. Photo 5 shows a woman with a basin containing palm nut bunches on her head. According to the actors, the reason for their devotion to these activities is the recurrent poor or low production recorded in agriculture due to the disruption of the seasons. One of the respondents said:

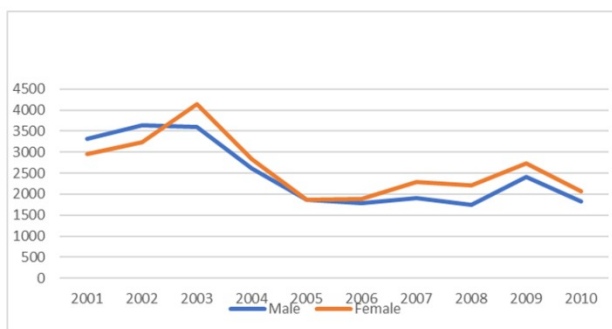
« I'm interested in this activity because our fields don't yield like they used to. You struggle to cultivate and sow, and in the end you have practically nothing to harvest because of the scarcity of rain. But here, you have the guarantee that at the end of the month you'll have something if you work (...) With what's happening now, if we don't find other alternatives, we'll starve to death. I didn't leave the field completely, but I devote a little time to it" (Farmer, Bonou, 2023).

### Another added:

« Because of the irregularity of the rain, the harvests no longer yield as they used to. We take out loans from CLCAM to work the fields. We grow a lot of sweet potatoes in Bonou and they used to do well. Today, because of the changes we've seen, our crops don't yield like they used to. As a result, many people have left the fields to go and work in the sand quarries. At least there, there are no losses like in production. You work well and you get your money, it's hide and seek. (Farmer, Bonou, 2023). From these comments, we can deduce that the precariousness of life due to repeated losses in agricultural production leads the players to prefer labour tasks to production. Most of the players in these two sectors of activity are farmers. They find themselves in these activities because agricultural production is no longer profitable. By acting in a logic of monitoring and profitability, agricultural production is not totally abandoned, but relegated to second place.

**Epidemiological Situation Related to Malaria in the Municipality of Bonou from 2010 to 2022:** The examination of healthcare records in the health facilities of the municipality of Bonou reveals variability between genders that can largely be explained by elements of the climate change context. Indeed, the comparison of the reasons for consultations between women and men, on one hand, demonstrates a range of health inequalities that does not appear identical for women and men, on the other hand.

**Distribution of Malaria by Gender:** Statistical data from health facilities present a disproportionate rate between men and women seeking treatment for malaria. The following figures respectively illustrate the evolution by gender of the number of malaria cases from 2001 to 2010 and from 2012 to 2022.

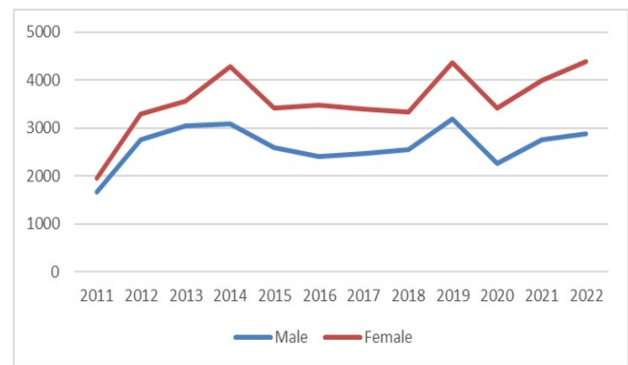


Source: field data, 2022

**Graph 4: Evolution of the number of malaria cases by gender in the municipality of Bonou from 2001 to 2010**

The graph above shows changes in the number of malaria cases by sex recorded in the municipality of Bonou between 2001 and 2010. It shows a decreasing trend in the two curves for both men and women. However, there was a peak in the number of malaria cases in 2003 for both sexes.

In 2009, there was also a small peak in the number of cases of malaria in both sexes. The graph above shows changes in the number of malaria cases by gender over the period 2012 to 2022. It can be seen that the number of malaria cases is relatively higher among women than among men. However, there are peaks in the number of malaria cases among both women and men in 2014 and 2019.



Source: field data, 2022

**Graph 5. Changes in the number of malaria cases by sex in the municipality of Bonou from 2011 to 2022**

## DISCUSSION

**Link between Climate Change and Socio-economic Activities:** In these two professional settings, social and cultural norms influence the organization of work and the remuneration of actors. Roles deemed risky are assigned to men. It takes a man to go underwater, extract sand, or cut palm fruit bunches. Women are tasked with carrying loads on their heads. During palm nut harvests, they are less remunerated than men. The lone man in the team earns double the income of the two women. This principle is also applied when sharing the sum from the sale of palm nuts collected during harvesting. The efforts of women are undervalued. Within the community, gender equality can be assessed through customary practices, respect for rights, as well as the differentiation of activities carried out by both sexes. Customary practices and customary law are based on cultural determinants that assign differentiated statuses and roles according to gender. The status and role of each individual, their relationships with others, and the opportunities offered to them are determined by their gender. The sociocultural norm that values this distribution of roles in terms of work is summarized by the phrase: "Sounou Glégbéno, Gnonou Houessi," which means: men are typically assigned roles in income-generating activities outside the family, while women are expected to manage household responsibilities. These sociocultural pressures, influencing education and the health of women and their children, undermine their access to paid employment, administrative, political, and economic responsibilities, and consequently, to a stable, substantial, and enduring income. Although these norms or practices are gradually weakening, numerous inequalities still persist in the relationships between men and women.

Indeed, the two main activities to which the populations devote themselves take place in environments conducive to mosquito proliferation. These two environments pose a risk of mosquito bites. In the quarries, the activity takes place on the banks of the Ouémé River, surrounded by weeds. They are therefore exposed daily to the risk of malaria. In the case of these two activities, both men and women in this community work in fairly strenuous conditions, with precarious tools. These conditions contribute to reinforcing the vulnerability of the workers. Although workers are aware of their exposure to mosquito bites, they do not perceive themselves as proportionally vulnerable to the risk associated with their work environments. According to the respondents, being mobile on the work sites reduces the risk of mosquito bites. They believe

that being frequently on the move at their workplaces makes them less prone to mosquito bites. In relation to this perception, an entomologist explains: "(...) it's true that when you are in motion, mosquitoes have a hard time landing easily on your body. But that doesn't mean it's impossible. Even while moving, you can be bitten by mosquitoes." (Entomologist, 2022). From this discourse, it emerges that this perception of the actors is not entirely accurate, and the risk of getting bitten is not entirely eliminated. The actors do not have a clear understanding of their level of exposure to mosquito bites. There is a minimization of the risk of exposure and their vulnerability related to their work environments conducive to mosquito proliferation. In comparison to their domestic environments, they perceive the risk of exposure to mosquito bites as greater. This perception is fuelled by the fact that they are less mobile at home than at their workplaces. Women feel they are more exposed at home than men because they are responsible for household chores in the domestic environment. They dedicate time to it in the evening after the day's activities. This is explained by a respondent, a mother and worker at one of the sand quarries:

"When we come back..., after a long day of work, we are tired, but the family has to eat, it's even more difficult for us who don't have a grown-up daughter. With this fatigue, it takes us more time to finish cooking, washing dishes, and cleaning; we do them half-asleep, and that's when mosquitoes really bite us. Sometimes, we even sleep outside because of fatigue to get some rest after finishing the household chores. During this time, dad is lying in the room after eating, you see that mosquitoes bite us more than them." (Sand gatherer, Bonou, 2023). In the performance of household tasks, women expose themselves to mosquito bites. A role that does not require them to be as mobile as on work sites. Therefore, most women believe that mosquitoes bite them more at home than at work. However, men, being minimally involved in household chores, expose themselves very little at home. Cultural norms assign household chores to women. Physically strained due to their activities at the end of the day, women claim to spend more time exposed outdoors. They fall asleep or doze off during these household chores and dinner.

In the domestic context, women are more exposed to mosquito bites than men. This disproportionate exposure between men and women is highlighted by the participants. In the context of two activities, the number of women involved exceeds that of men. The number of women is twice that of men during palm nut harvests, and in the quarries, the number of women exceeds triple that of men. Even if the risk of exposure seems equal between the two sexes, the number of exposed women in this context is higher than that of men. Thus, the number of women exposed to mosquito bites in the municipality of Bonou in both professional and domestic contexts is higher than the number of men exposed to mosquito bites. As evidenced by various studies, climate change reinforces the vulnerability of populations, especially women, to malaria due to the social roles and responsibilities imposed on them (Woldu, 2015; Quaresima et al., 2021). This research confirms this vulnerability among women in the municipality of Bonou, and the statistical data from health facilities demonstrate the burden borne by these women (Okiring et al., 2022). The incidences of malaria in the municipality of Bonou show that the number of malaria cases observed in women in the municipality's health facilities is higher than that in men. Furthermore, a significant gap is noted in the number of

malaria cases received in health facilities between women and men from the year 2012, which coincided with the official start of sand mining activities in the municipality of Bonou. This could imply that this activity also contributes significantly to the increase in the number of malaria cases in the municipality of Bonou.

## CONCLUSION

This research has enabled a better analysis of the link between gender, vulnerability to malaria and climate change. It has gone beyond a simple description of the vulnerability of the commune of Bonou to malaria in relation to climatic parameters to look at the social and cultural dynamics as they emerge within the deeper layers of social reality. Based on the theoretical corpus developed by theorists and a methodological approach largely inspired by socio-anthropology, it highlights the social practices and representations that contribute to the differentiated vulnerability of the men and women of Bonou to malaria. The results of this research highlight a number of factors. These factors are supported by individual and collective logics that explain the differentiated vulnerability to malaria in the context of climate change in Bonou.

## REFERENCES

- Akimabera, F., & Dossou-Cadja, S. C. R. (2019). Can you hear me? on climate change: inequality and gender vulnerability in Benin. *Annals of Urban Research*, 4(1), 34.
- African Leaders' Alliance Against Malaria. (2023). *Benin alma quarterly report, (2023). Benin Alma Quarterly Report 1st Quarter 2023: Scorecard for Accountability and Action.* [https://Alma2030.Org/WpContent/Uploads/2023/05/25-789\\_Q1-2023-Qr-Benin\\_French.Pdf](https://Alma2030.Org/WpContent/Uploads/2023/05/25-789_Q1-2023-Qr-Benin_French.Pdf)
- Becerra, S. (2012). Vulnerability, risks, and the environment: the chaotic Journey of a Contemporary Sociological Paradigm. *Vertigo*, Volume 12 Issue 1. <https://Doi.Org/10.4000/Vertigo.11988>
- Cotter, P. D., Ross, R. P., & Hill, C. (2013). Bacteriocins—a viable alternative to antibiotics? *Nature Reviews Microbiology*, 11(2), 95-105. <https://Doi.Org/10.1038/Nrmicro2937>
- Diouf, I., Rodriguez-Fonseca, B., Deme, A., Caminade, C., Morse, A., Cisse, M., Sy, I., Dia, I., Ermert, V., Ndione, J.-A., & Gaye, A. (2017). Comparison of malaria simulations driven by meteorological observations and reanalysis products in Senegal. *International Journal Of Environmental Research And Public Health*, 14(10), 1119. <https://Doi.Org/10.3390/Ijerph14101119>
- Fraser, S. (2021). Climate change is a health issue. *Canadian Family Physician*, 67(10), 720-720. <https://Doi.Org/10.46747/Cfp.6710720>
- Kristjanson, P., Bernier, Q., Bryan, E., Ringler, C., Meinzen-Dick, R., & Ndour, Y. (2015). *Implications of gender-focused research in Senegal for farmer's adaption to climate change gendered perceptions of climate shocks and climate change.*
- Bonou Municipality. (2018). *16- 3rd generation Communal Development Plan (Pdc3) 2018-2022 of the Commune of Bonou.*
- Okiring, J., Epstein, A., Namuganga, J. F., Kanya, E. V., Nabende, I., Nassali, M., Sserwanga, A., Gonahasa, S.,

- Muwema, M., Kiwuwa, S. M., Staedke, S. G., Kanya, M. R., Nankabirwa, J. I., Briggs, J., Jagannathan, P., & Dorsey, G. (2022). Gender difference in the incidence of malaria diagnosed at public health facilities in Uganda. *Malaria Journal*, 21(1), 22. <https://doi.org/10.1186/S12936-022-04046-4>
- WHO. (2013). Protecting health in the face of climate change: assessing vulnerability and adaptation. <https://www.who.int/fr/publications-detail/9789241564687>
- WHO. (2022). *World Malaria report 2022, fact sheet, key messages*, [https://cdn.who.int/media/docs/default-source/malaria/world-malaria-reports/wmr2022-global-briefing-kit-eng.pdf?sfvrsn=5ec7ec5c\\_5&download=true](https://cdn.who.int/media/docs/default-source/malaria/world-malaria-reports/wmr2022-global-briefing-kit-eng.pdf?sfvrsn=5ec7ec5c_5&download=true)
- Osse R., Tokponnon F., Okê M., Bokonon-Ganta E., Adjinda S., & Zounmenou A. (2019). *Sectoral vulnerability study to climate change in Benin*. <http://docplayer.fr/148735879-Sectoral-Vulnerability-Study-Face-Aux-Changevements-Climatiques-Au-Benin-Sector-Health.html>
- Quaresima, V., Agbenyega, T., Oppong, B., Awunyo, J. A. D. A., Adu Adomah, P., Enty, E., Donato, F., & Castelli, F. (2021). Are malaria risk factors based on gender? A mixed-methods survey in an urban setting in Ghana. *Tropical Medicine And Infectious Disease*, 6(3), 161. <https://doi.org/10.3390/Tropicalmed6030161>
- Schalatek, L., & Watson, C. (2018). *The green climate fund: 11 fundamentals of climate finance*.
- Woldu, D. O., & Haile, Z. T. (2015). Gender roles and perceptions of malaria risk in agricultural communities of mwea division in central Kenya. *Women & Health*, 55(2), 227-243. <https://doi.org/10.1080/03630242.2014.979968>
- Zongo, B., Diarra, A., Barbier, B., Zorom, M., Yacouba, H., & Dogot, T. (2015). Farmers' perception and willingness to pay for climate information in Burkina-Faso. *Journal of Agricultural Science*, 8(1), 175. <https://doi.org/10.5539/Jas.V8n1p175>

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