

Socio-environmental impacts caused by tropical cyclones Idai and Eloise in Sussundenga District, Mozambique

Os impactos socioambientais provocados pelos ciclones tropicais Idai e Eloise no Distrito de Sussundenga, Moçambique

Impactos socioambientales causados por los ciclones tropicales Idai y Eloise en el Distrito de Sussundenga, Mozambique

Received: 03/01/2023 | Revised: 09/17/2023 | Accepted: 12/18/2023 | Published: 12/18/2023

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Abstract

Mozambique is greatly endowed with a diverse potential of natural resources, most of which are still unexploited or in an exploration phase. However, the country faces major challenges to make better use of the resources to feed the population and reduce poverty. The country is prone to recurrent natural disasters, such as: flooding and cyclones (north) and droughts (south). Between 2019 to 2021, Sussundenga District was punctuated by two severe tropical cyclones – Idai and Eloise – leaving immeasurable destruction of unprecedented magnitude in its wake. Worth mention that cyclone Eloise hit the country when it was coping with the harmful effects of the Covid-19 pandemic. To date, there has been little research that has been conducted on socio-environmental impacts of cyclones in this region. Furthermore, climate change is projected to increase the frequency and intensity of tropical storms. Thus, this study has been designed as initial step towards filling that knowledge and evidence gap. The objective of this research was to investigate socio-environmental impacts caused by tropical cyclones in Sussundenga District. Preliminary, a desk-based study was made, followed by main data collection phase through in-depth interviews and participant observations. The results mapped which areas were the most affected within the district. It was observed that awareness of climate change is low in rural areas and women were more vulnerable to the effects of cyclones Idai and Eloise. Also, it was found that the lack of investment in climate change adaptation actions still pose a great challenge for the country.

Keywords: Climate change; Cyclone; Environment; Idai; Eloise.

Resumo

Moçambique é dotado de um potencial diversificado de recursos naturais, a maioria dos quais ainda por explorar ou em fase de exploração. No entanto, o país enfrenta grandes desafios para aproveitar melhor os recursos para alimentar a população e reduzir a pobreza. O país está sujeito a desastres naturais recorrentes, tais como: inundações e ciclones (norte) e secas (sul). Entre 2019 e 2021, o distrito de Sussundenga foi pontuado por dois ciclones tropicais severos – Idai e Eloise – deixando uma destruição imensurável de magnitude sem precedentes em seu rastro. De referir que o ciclone Eloise atingiu o país quando este enfrentava os efeitos nefastos da pandemia de Covid-19. Até o momento, poucas pesquisas foram realizadas sobre os impactos socioambientais dos ciclones nesta região. Além disso, prevê-se que a mudança climática aumente a frequência e a intensidade das tempestades tropicais. Assim, este estudo foi concebido como um passo inicial para preencher essa lacuna de conhecimento e evidência. O objetivo desta pesquisa foi investigar os impactos socioambientais causados por ciclones tropicais no distrito de Sussundenga. Preliminarmente, foi feito um estudo documental, seguido da fase principal de coleta de dados por meio de entrevistas em profundidade e observações participantes. Os resultados mapearam quais áreas foram as mais afetadas dentro do distrito. Observou-se que a consciência das mudanças climáticas é baixa nas áreas rurais e as mulheres eram mais

vulneráveis aos efeitos dos ciclones Iдай e Eloise. Além disso, constatou-se que a falta de investimento em ações de adaptação às mudanças climáticas ainda representa um grande desafio para o país.

Palavras-chave: Alterações climáticas; Ciclone; Ambiente; Iдай; Eloise.

Resumen

Mozambique está muy dotado de un potencial diverso de recursos naturales, la mayoría de los cuales aún no han sido explotados o se encuentran en una fase de exploración. Sin embargo, el país enfrenta grandes desafíos para aprovechar mejor los recursos para alimentar a la población y reducir la pobreza. El país es propenso a desastres naturales recurrentes, tales como: inundaciones y ciclones (norte) y sequías (sur). Entre 2019 y 2021, el distrito de Sussundenga estuvo marcado por dos ciclones tropicales severos, Iдай y Eloise, que dejaron a su paso una destrucción inconmensurable de una magnitud sin precedentes. Vale la pena mencionar que el ciclón Eloise azotó al país cuando estaba lidiando con los efectos nocivos de la pandemia de Covid-19. Hasta la fecha, se han realizado pocas investigaciones sobre los impactos socioambientales de los ciclones en esta región. Además, se prevé que el cambio climático aumente la frecuencia e intensidad de las tormentas tropicales. Por lo tanto, este estudio ha sido diseñado como un paso inicial para llenar ese vacío de conocimiento y evidencia. El objetivo de esta investigación fue investigar los impactos socioambientales causados por los ciclones tropicales en el distrito de Sussundenga. Preliminarmente, se realizó un estudio de escritorio, seguido de la fase principal de recolección de datos a través de entrevistas en profundidad y observaciones de los participantes. Los resultados mapearon qué áreas fueron las más afectadas dentro del distrito. Se observó que la conciencia sobre el cambio climático es baja en las zonas rurales y las mujeres fueron más vulnerables a los efectos de los ciclones Iдай y Eloise. Asimismo, se constató que la falta de inversión en acciones de adaptación al cambio climático aún representa un gran desafío para el país.

Palabras clave: Cambio climático; Ciclón; Ambiente; Iдай; Eloise.

1. Introduction

Mozambique, a country long scarred by poverty, is amply endowed with abundant, high quality natural resources, but still faces a difficult challenge to meet the growing demands of the population for food, water and natural energy resources (Cristóvão et al., 2021; Chichango & Cristóvão, 2022). This demand has steadily worsened consequences for biodiversity (Ganje et al., 2021; Macanguisse et al., 2022). Approximately 66.6% of the population is rural and have long coped with the risk by generating their incomes from several natural resources - agriculture, livestock, hunting and silviculture – activities often affected by climate change (Chapaga et al., 2021; Shenga et al., 2013). In the rural area, basic services are very scarce and material deprivations were already high even prior to Cyclones.

Despite the evidence of multiple income-earning activities from natural resources, much development policy continues to view rural families as solely agricultural, being this activity often affected by climate change and consequently promotes a farm agenda. However, the agriculture sector is still dominated by peasant family production; 95% of the cultivated area is traditional rainfed farmed by families cultivating an average of 2 hectares, with low productivity. The sector employs more than 90% of Mozambican women and girls of working age.

Mozambique ranks among the top three African countries most vulnerable to the risk of natural disasters, since the cyclones events in 2019 (Lequechane et al., 2020; Mavume et al., 2021). Contributing to its vulnerability and low adaptive capacity, among other factors, is poverty, limited investments in advanced technology and the fragility of infrastructure and social services, with emphasis on health and sanitation.

The history of these phenomena in Mozambique has left sad memories, since, from 1980 to 2019, the country was devastated by 85 natural disasters, which have left serious impacts in the entire socioeconomic system. Its impacts include the loss of human lives, agricultural crops, domestic animals and wildlife, destruction of social and economic infrastructure, increased dependence on international aid, rising prices of agricultural products, deterioration of human health, environmental degradation and loss of ecosystems. Cyclones normally occur along the coast of Mozambique due to tropical depressions that originate in the Indian Ocean, but have also affected some inland areas, as is the case of Sussundenga District (Pekka et al., 2022). On average, three to twelve cyclones form in the Mozambique Channel per year (Mavume et al., 2009). Even worse, the frequency and severity of natural disasters have been projected to increase in the future because of climate change.

Prior the Covid-19 pandemic and cyclones (Idai in March 2019 to Kenneth a month later, to Chalane in 2020, and Eloise January 2021), concerns have been raised in academia about the extent to which sustainable development can eradicate poverty (SDG 1) and hunger (SDG 2) in Mozambique, when the country survives with the excessive use of natural resources. Added COVID-19, political instability and cyclones to the mix, the prospects seem even bleaker. In contexts where the impact of Covid-19 pandemic is present, natural disasters (Eloise) puts even more pressure on limited resources, creating an even more challenging scenario for the health sector.

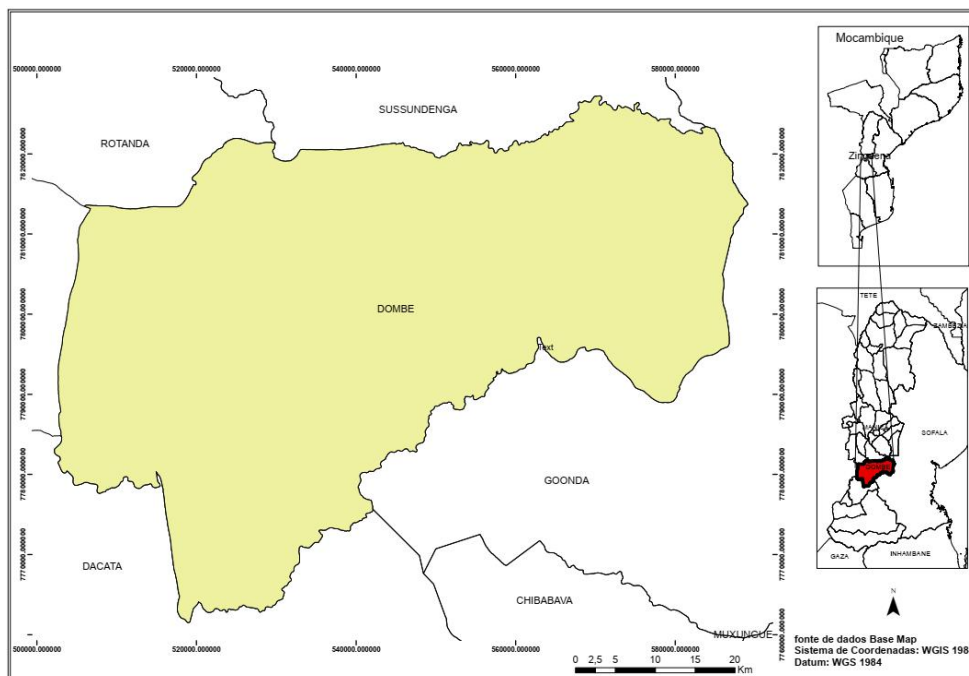
Tropical cyclones and floods are increasingly frequent problems in Sussundenga District, often configuring themselves as disaster situations. In this way, it is worth mentioning the episode of tropical Cyclone Idai and Eloise that occurred in March 2019 and January 2021 respectively, and which caused great damage and losses. Thus, the purpose of this study was to investigate socio-environmental impacts caused by tropical cyclones Idai and Eloise in Sussundenga District.

2. Methodology

Technical procedures for data collection in this study are bibliographical research, documental research, direct observation and case study in the Dombe administrative post. Thus, as mentioned by Gil (1995), bibliographic research is the one that develops trying to explain a problem, using the knowledge available from the theories published in books or similar studies.

The research was carried out in the Dombe administrative post, which is in the central region of the Province of Manica, in the District of Sussundenga, 86 km from the district headquarters, see Figure 1.

Figure 1 - Map showing Sussundenga district in Mozambique and the study area Dombe administrative post.



Source: Authors (2023).

In 2021, the Dombe administrative post had approximately 36,324 inhabitants. Its hydrographic network makes the land more fertile and conducive to the development of agricultural activity, which is important for the survival of the population. The Dombe administrative post is a region rich in forest resources, where men practice their activities, such as:

cutting wood, stakes, and grass to build houses, barns and corrals. Still in the forests, the women and children are dedicated to collecting wild fruits for their food and looking for thread to make food and sell it. The study area was chosen because it was one of the hotspots of the Cyclones disaster in Manica Province. Table 1 shows the characteristics of tropical cyclones Idai and Eloise.

Table 1 - Characteristics of tropical cyclones Idai and Eloise.

	Tropical Cyclone Idai	Tropical Cyclone Eloise
Category (SSHWS)	3	2
Landfall	Near Beira in 2019	North of Beira in 2021
Wind speed	195 km/h (10 min. sustained) 205 km/h (1 min. sustained)	150 km/h (10 min. sustained) 165 km/h (1 min. sustained)
Rainfall	More than 600 mm in 7 days	250mm in 24h

Source: Adapted from Celia Macamo (2021).

According to Anderson et al. (2011) defines that systemic sampling involves randomly electing one of the first elements from the list of the population, being considered a fast and effective method. Barbetta (2010) claims that this type of sampling (n) can be treated as a simple sample if the elements of the population (N) are randomly classified. The selection range calculation relationship can be treated as N / n . In the research, a population of $N = 33$ from the Dombe administrative post was used. Systematic sampling was applied to obtain a sample size of $n = 11$.

Researchers came up with a set of questions that developed into the main questionnaire. The information that was collected ranged from household demographics, awareness and knowledge of climate change, impacts of the cyclones, exposure, vulnerability conditions and gender, and capacities for mitigation, coping mechanisms, and adaptation.

Given the ethical implications of interacting with people who were affected by a disaster, participants' consent was first obtained after explaining the purpose of the study and how they were expected to participate. Confidentiality and anonymity were maintained throughout the study. Each interview generally lasted around twenty-five minutes, with the proceedings being noted and transcribed for analysis.

3. Results and Discussion

The study findings were arranged under four major sub-headings: Areas most affected by cyclones, Environmental impacts, Disaster preparedness and gender and access to safe and dignified WASH facilities.

The demographic data shows that there were more male participants than female 64% who attended the questionnaire.

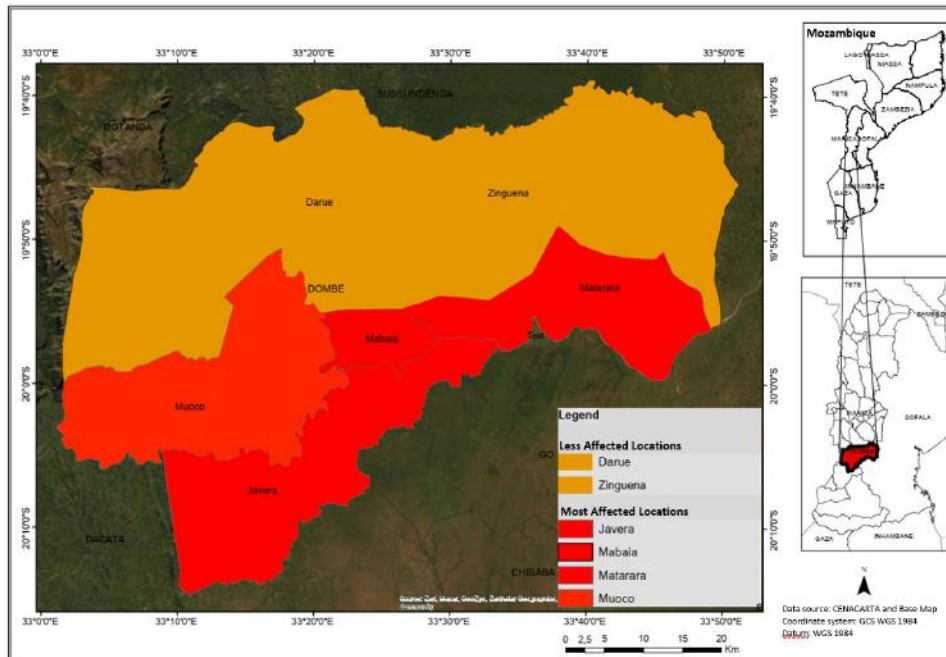
3.1 Areas most affected by cyclones in the Dombe administrative post

Figure 2 illustrates locations that were most severely affected by the cyclones were: Javera, Mabaia, Matarara and Muoco. Furthermore, it was reported that Cyclone Idai displaced 35% of the population and Cyclone Eloise only 3%. Heavy rains created mudslides and landslides in the mountainous areas. The powerful storm caused flooding, damaged homes and public infrastructure, including bridges, power lines, schools, water systems, and health facilities. Both cyclones produced similar effects, but with greater intensity for IDAI. One of the respondents stated:

(...) Cyclone Idai woke many of us up, as nobody knew anything about cyclones. Therefore, this phenomenon was very devastating. Regarding Cyclone Eloise, there was some disclosure for protection, despite being late, and the cyclone did not have as much intensity when compared to Idai(...) [Interview Participant]

After the cyclones passed, the devastation continued. Standing water created the spread of disease, and transport and communications infrastructure was destroyed, delaying cleanup and rescue efforts. The recorded human damages in the administrative post of Dombe due to cyclones Idai and Eloise were eight and zero, respectively. Despite their devastating effects, tropical cyclones are also beneficial, potentially bringing rain to dry areas and moving heat to higher latitudes.

Figure 2 - Locations most affected by cyclones in Dombe administrative post.

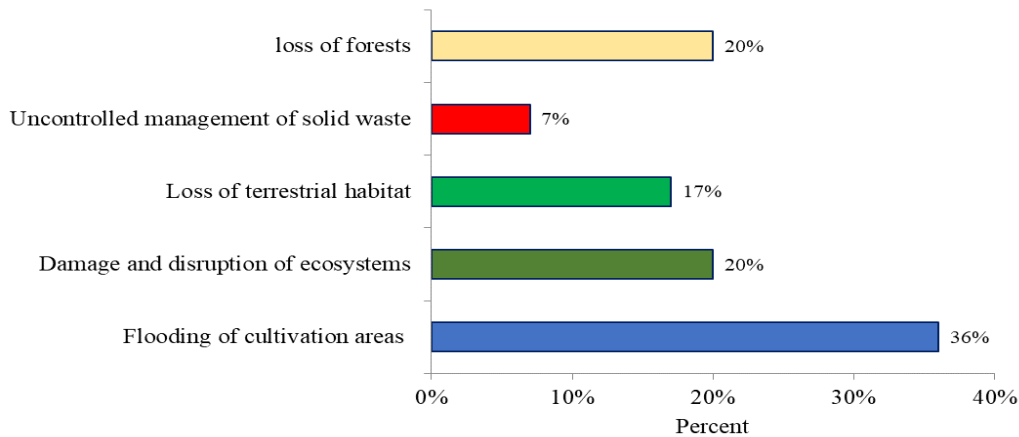


Source: Authors (2023).

3.2 Environmental impacts recorded because of cyclones in the Dombe administrative post

Figure 3 shows the environmental impacts that hit the Dombe administrative post the most. From the study sample, there is evidence that cyclones cause torrential rains and consequently floods, the biggest environmental damage (36%) was the flooding of the cultivated areas. Excess moisture interfered with soil aeration, reducing the availability of oxygen to the plant. The reduction of oxygen in the soil causes functional disturbances throughout the plant, mainly affecting the absorption of water and nutrients by the roots, which would lead to reduced food production, with a risk to food security. Note that agricultural productivity and production for the 2018-2019 main season was already expected to be quite low due to drought conditions in central areas of the country.

Figure 3 - Environmental Damage recorded because of cyclones in the Dombe administrative post.



Source: Authors (2023).

The ecosystem was disturbed (20%) making access to wood and traditional medicines impossible. Loss of important nurseries and breeding sites for birds, mammals, fish, crustaceans, molluscs, and reptiles, crucial for the subsistence activities of communities. Damage to sediment, nutrient and contaminant accumulation sites, which will impact fish availability. There was loss of terrestrial habitat (17%), loss of important sites for birds and other species that are important to communities' livelihoods in terms of income or indirect ecosystem goods and services. Also, there was uncontrolled solid waste management (7%) after the cyclones, but with a higher incidence for IDAI which caused health risks to local populations, including the spread of disease and infection. Ashraf and Azad (2015) stated that there are many factors such as poverty, environmental degradation and unequal power relations that influence the extent of disaster impacts.

As a positive effect of tropical cyclones, it was noted that local government started to get awareness of issues related to climate change: the importance of planning and territorial ordering and building resilient houses to face these adverse events; Furthermore, tropical cyclones allowed for greater unity among local communities.

3.3 Disaster preparedness and gender

Disaster Preparedness is the stage involving pre-disaster preparation efforts and many mitigative actions. Disaster preparedness gives room to operative, accurate and synchronized planning that complements the efforts of national societies, household and community members while increasing their overall effectiveness (Sibanda et al., 2022). Mozambique is among the most vulnerable and least prepared countries with regards to disasters, mainly those triggered by hydro-meteorological hazards such as cyclones, floods and droughts. It is ranked 159th out of 181 nations on the Global Adaptation Index (ND-GAIN 2017). Most of the population (69%) was not aware of the cyclones until the arrival of Idai and Eloise. Study findings show that the state of preparedness on the landfall of Cyclones was a bit late, leaving mainly women, children and elderly not prepared for the disaster. INAM and INGC did not publicize these phenomena. For cyclone Eloise, the warning was not given weeks in advance, but only on the eve of cyclone. As narrated by this woman:

(...) the warning was not made a week in advance, but only on the eve of the passage of Cyclone Idai, that is, too late, we were warned and the next day cyclone hit. Not even to go and remove the corn (...) [Interview Participant]

Thus, a lack of financial resources, human capacity and lack of investment in climate change adaptation actions still pose a great challenge.

Dijkhorst and Vonhof (2005) said that it is important to note that a gender perspective not only addresses women's

practical needs before, during and after disasters, but also looks at the responsibilities of men and women and the relations between them. Although the impact of the cyclone is widespread in affected areas, there are particular social groups that demonstrate especially high levels of vulnerability. It was noted that women are the most vulnerable because of their gender roles and responsibilities - collection, treatment, and household management of water in their communities. Also, this is a direct result of greater exposure of women and girls to distant and unsafe locations, such as water collection points, sanitation facilities and health centers. Thus, for country like Mozambique, is vital to increase awareness, develop action plan, training and practicing for successful disaster management.

Enarson, and Chakrabarti (2009) said that the needs of women are generally overlooked in the relief and recovery processes and their capacities and skills are not used as a resource in emergency management and planning. Also, it was pointed out that central role in everyday life on the one hand and lacking decision-making power and access to resources on the other, make women to a great extent vulnerable to natural disasters (Dijkhorst & Vonhof, 2005).

3.4 Access to safe and dignified wash facilities

In Mozambique, it is well known that even before the cyclones, there were large gaps across the country in clean water supply and access to improved sanitation facilities. In the study, 90% of those surveyed reported that there was a critical shortage of safe and accessible latrines and bathing facilities. Also, there was no lighting, this made it difficult for people to use the latrines, particularly for women and girls and with increased barriers for persons with physical impairments. It was pointed out that women took on the role of cleaning, including common areas such as latrines, shelters, and kitchen spaces.

Women and girls are mainly responsible for the carrying, collecting and management of water. It was noted lack of drinkable water across the assessment sites. Simba et al. (2022) reported that scarcity of safe drinking water and damage to sanitation facilities remain a challenge, leaving women with the burden of looking for alternative water sources. Hence, discrimination against women does not only accentuate women's vulnerabilities during disasters- it also wastes women's potential as source of resilience.

4. Conclusion

Based on investigation about socio-environmental impacts caused by tropical cyclones in Sussundenga District, it was possible to conclude that:

- Cyclone Eloise was not as severe as Idai, but it still wrought significant devastation. The locations most affected by tropical cyclones were: Javera, Mabaia, Matarara and Muoco;
- Part of the area affected by Cyclone Eloise was affected by Cyclone Idai in 2019;
- cyclones destroyed schools, hospitals, water supply, sanitation and hygiene infrastructure resulting in crippled access to these services. The environment was affected, namely agricultural production, fauna, vegetation, air, soil, climate and animals;
- women were the most vulnerable as a result of their gender roles and responsibilities, during and pos-disaster;
- lack of financial resources, human capacity and lack of investment in climate change adaptation actions still pose a great challenge.

As perspectives, the authors propose a study on Gender equality and decision making in disaster situations.

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