

Food environments in contexts of disasters in Mozambique

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Abstract

Purpose – This paper aims to examine relationships between disasters and food environments. Despite expanding theorisation of food environments, current thinking falls short by missing the temporal intra- and inter-annual dynamics of food environments, which are critical in disaster-prone countries. Furthermore, existing conceptualisations of food environments miss a critical discussion on the role of the humanitarian food environment. Both the timescale and the role of humanitarian aid in shaping food environments are critical for disaster prevention and management in the short and long run.

Design/methodology/approach – The research used a multidisciplinary socio-ecological approach by which nature and humans are treated as a continuum of existence (re)shaping each other over time. The study used geographical information systems and applied surveys, focus group discussions, key informant interviews and observations.

Findings – The study shows that complex disasters and an unfit environment, marked by limited and decaying ecosystem services, are forcefully pushing people to be integrated into inexpensive and unhealthy food markets. We also find that agriculture is not being pressured and influenced by the climate crisis alone; it is also being reshaped by the influx of aid and humanitarian actors who provide seeds, pesticides, fertilisers, production tools, extension services and link their “beneficiaries” to markets for their outbound products.

Originality/value – This research is a novel attempt to link disasters and food security by using the food environment framework alongside multiple research methods from social sciences to biophysics. It is additionally original by examining food security dynamics across time scales.

Keywords Food environments, Dynamics, Humanitarian aid, Buzi, Mozambique

Paper type Research article

1. Introduction

The global population is experiencing increasing Food Security and Nutrition (FSN) challenges. Adult obesity has grown from 12.1% in 2012 to 15.8% in 2023, with projections of 19.8% by 2030. Additionally, 152 million more people were hungry in 2023 compared to 2019 (FAO *et al.*, 2024). Evidence suggests that efforts to address these issues have been largely ineffective, with some arguing that the world is off track to meet the sustainable development

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goal two targets on food and nutrition by 2030. Systemic changes at all levels are needed to accelerate progress (Rural 21, 2021; FAO, 2023). A key recommended shift is a redefined global approach for tackling food poverty (FAO, 2015; Thompson *et al.*, 2019). A global approach to food poverty was preliminarily based on the entitlement theory which suggests that starvation results not from a lack of food but from inadequate purchasing power, driven by social inequalities and exclusion. Hence, addressing this requires pro-poor, inclusionary policies (Sen, 1981).

Despite the robustness of the entitlement theory, by the late 1980s and throughout the 1990s, the FAO expanded the understanding of famines and malnutrition by developing the FSN framework, defined as “the physical and economic access to sufficient, safe and nutritious food . . . that meets dietary needs and food preferences for an active and healthy life” (FAO, 1996, p. 5). This framework outlined food availability, access, utilisation, and stability as the four pillars addressing hunger and malnutrition, moving the conceptualisation of food poverty beyond the entitlement theory, acknowledging persistent food insecurity even with adequate purchasing power, especially in the face of climate change. Climate change related extreme weather events such as drought, cyclones, floods, tend to disrupt the entire food supply chain, from production to consumption (FAO, 2015; Zurek *et al.*, 2022). Climate change is also challenging the use of FSN framework as it fails to capture, in depth, how climate impacts affect the FSN of small-scale farmers, who make a living from a diverse and complex environment, appealing for both -nature and society and following the dynamics of both (FAO *et al.*, 2021; Fanzo *et al.*, 2018).

To tackle this, the concept of food environments has emerged over the past few years as an alternative to FSN. It describes the complex set of physical, economic, policy and socio-cultural conditions that influence people’s food and beverage choices and nutritional status (Herforth and Ahmed, 2015; Lytle and Sokol, 2017). Food environment concept recognises the relevance of the FSN framework but goes a step further by questioning the whole environment that permeates hunger and malnutrition (Doherty *et al.*, 2019). Given its holistic approach tackling the food poverty discussion, the concept of food environment responds better to the demands for a systemic shift on academic thinking (FSIN and Global Network Against Food Crises, 2023; Downs *et al.*, 2020; Turner *et al.*, 2018; FAO, 2016).

Downs *et al.* (2020) have considered different definitions of food environments and developed an analytical framework that identifies 4 food environments: (1) the *wild food environment* that comprises foods and beverages from forests, jungles, natural rivers, lakes, seas, ponds, open pastures; (2) the *cultivated food environment* that tackles foods and beverages from fields, orchards, gardens, aquaculture, pastures; (3) the *informal market food environment* that deals with foods and beverages from kiosks, street vendors, wet markets, mobile vendors, and (4) the *formal markets food environment* that looks at foods and beverages from supermarkets, hypermarkets, restaurants. Similarly, Turner *et al.* (2018) have identified 4 food environments that have been labelled as: (1) *market-based food sources*; (2) *own production*; (3) *wild harvested foods*, and (4) *transfers including gifts and humanitarian aid*.

This paper uses this conceptualisation from Downs *et al.* (2020) and Turner *et al.* (2018) to describe the functioning of five food environments (wild, cultivated, informal markets, formal markets and gifts/humanitarian aid) in the district of Buzi in Mozambique. Then it discusses the role of humanitarian aid in shaping these food environments. Finally, the paper analyzes the temporal intra and inter-annual dynamics of people’s access to these five food environments. This research is distinct as it does not look at the food environment in a normal setting but in a context where disasters strike, and an influx of NGOs and government actors meet local communities. Despite ever-growing interest on FSN in the context of expanding disasters and dependency on humanitarian aid, there has been no explicit research on how and when people access the different food environments outlined above in contexts of disasters. There is also no explicit research on the role of aid in framing food environments in disaster contexts. Addressing these gaps may shed a light on the global, national, and local food and disaster policies and practices.

2. Methodology

2.1 Research site

The results of this paper are from research carried out between 2022 and 2023 in Buzi district, located in Sofala province, central Mozambique (Figure 1). Buzi occupies around 7.5 thousand Km² with a population of nearly 212.3 thousand (INE, 2024).

Situated along the Buzi river and the Indian Ocean, the district is encroached between rich resource assets; it has gas deposits yet to be pumped by the Indonesian owned Buzi Hydrocarbons company; it has both fresh and marine water resources and extensive fertile lands which used to be part of the dormant “Companhia do Buzi” that, in the past, produced and processed sugar cane, rice and cotton for domestic use and export [1]. Despite its richness it was estimated that 98% of the population was below the poverty line by 2011 data (Fobra *et al.*, 2023) and 75% by 2019 (INGD, IFRC and OCHA, 2019).

Buzi ranks as one of the most vulnerable to climate extremes (INGD, 2024). In 2019 cyclone Idai and associated flooding inundated 75% of the district, killing 108 people and affecting 154,300 people, almost three-quarters of the population (INGD, IFRC and OCHA, 2019). Over the past 5 years, the area has been hit by 4 different tropical storms and cyclones impacting local capacity to meet basic food needs. Due to this, humanitarian aid has become an important food environment.

2.2 Research methods

The research used a multidisciplinary socio-ecological approach by which nature and humans are treated as a continuum of existence (re)shaping each other over time (Berker and Folke, 1998). Five different research methods were applied: semi-structured and informal interviews, focus group discussions, field observations, Land Use and Land Cover (LULC) analysis, and surveys. The research began with 22 key informant’s interviews (17 semi-structured and 6 informal). The main objective was to get an overview of local livelihoods, disaster impacts and food environments. Additionally, 7 focus group discussions were held with various

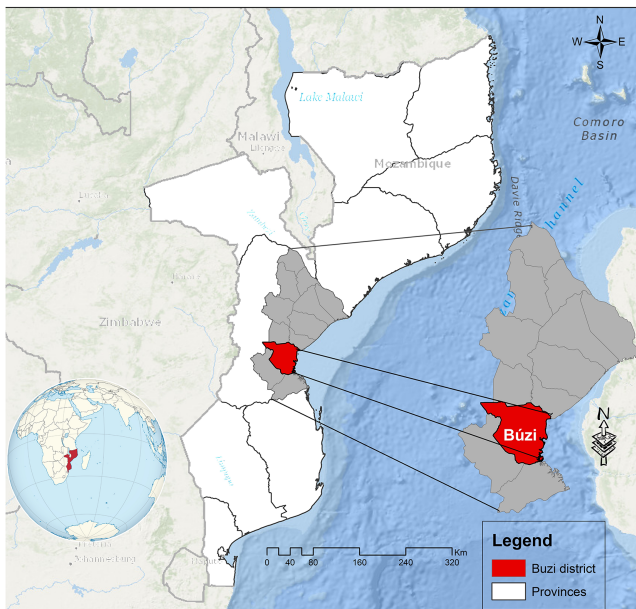


Figure 1. Research site. Source: Authors' own work

community segments such as the elderly, extension officers, and street vendors, to get their views on the functioning and dynamics of the food environments. The groups ranged from 7 to 15 participants. We also visited and observed, different infrastructures and livelihood sources to enrich and confirm information coming from the interviews and group discussions. Preliminary data analysis from the interviews, group discussions and field visits demonstrated the need to apply additional research methods for a comprehensive analysis.

Based on interviewees' insights and observations of significant environmental changes affecting the wild food environment, we mapped LULC over a 10-year period (2013–2023) using Geographical Information System (GIS). The year 2013 was identified as a turning point due to a famine that forced local communities to rely on wild food sources, while 2023 was the closest year to the research timeline. Satellite images from Landsat 8 (available at www.glovis.usgs.gov) were used, as Sentinel-2 images (with higher resolution) were only available from 2015 onward. For consistency, we compared Landsat 8 images from 2015 to 2023 with Sentinel-2 images from the same period, following the approach of [Chaves et al. \(2020\)](#). After pre-processing (including atmospheric correction and clipping), a supervised classification using the Random Forest algorithm was conducted in ArcGIS 10.5 software. For the classifier training, samples obtained from visual interpretation were used. Validation was performed with an independent set of reference points, using the confounding matrix to calculate global precision (Kappa index).

Finally, the research applied surveys to 615 households (246 female headed and 369 males headed) selected randomly across the 10 *localidades* (localities) comprising the district. A sample of 610 households is recommended for populations of around 200,000 as our case for a confidence level of 99% and margin of error of 5%. [2] The total sample was divided by the 10 localities based on proportions. Within each locality households were picked randomly from a list of households provided by the administrative authorities whenever available or by randomly selecting the houses for interviews as the enumerators passed across the communities in each of the localities. The survey provided quantitative data that allowed us to estimate, quantitatively, the performance of the different food environments and livelihood sources.

The quantitative data was analysed by using the STATA 17 software. Tables and graphs were later generated by using Excel sheets and R-studio software. The information gathered through qualitative tools such as key informant's interviews, visits to markets and focus group discussion was analysed by using content analysis and pattern matching ([Trivinos, 1987](#); [Kothari, 2017](#)).

3. Results and discussion

3.1 Livelihoods and food environments

Households in Buzi rely on a wide range of activities to make a living. This includes agriculture, petty trading, harvesting and processing wild products, wages, mining, remittances and through food aid. Diversification of livelihood has been recommended and promoted as an adaptation strategy in disaster risk contexts ([FAO, 2008](#)). Quantitative analysis ([Figure 2](#)) shows that people make a living by providing different off-farm services such as casual labour (17%), being a business intermediary/dealer (8%) or by engaging in petty trading (7%), among other means. In total, off-farm activities are the main livelihood source for 41.36% of the respondents followed by agriculture (36.16%). This finding reignites an ongoing discussion as to what extent agriculture remains the main source of income and food in Africa and Mozambique in particular, especially in contexts such as Buzi where climate change has expanded the uncertainties of food production ([Badiane et al., 2023](#); [ILO, 2023](#)). As put on a group discussion with a group of 11 men: “*we all do agriculture but if we depended entirely on agriculture, we would be dead by now. Agriculture used to be good in the past, no longer now. We do it, but we also learned the value of diversification*”. Similar perceptions echoed in the other group discussions. In the women group discussions, for example, the sense

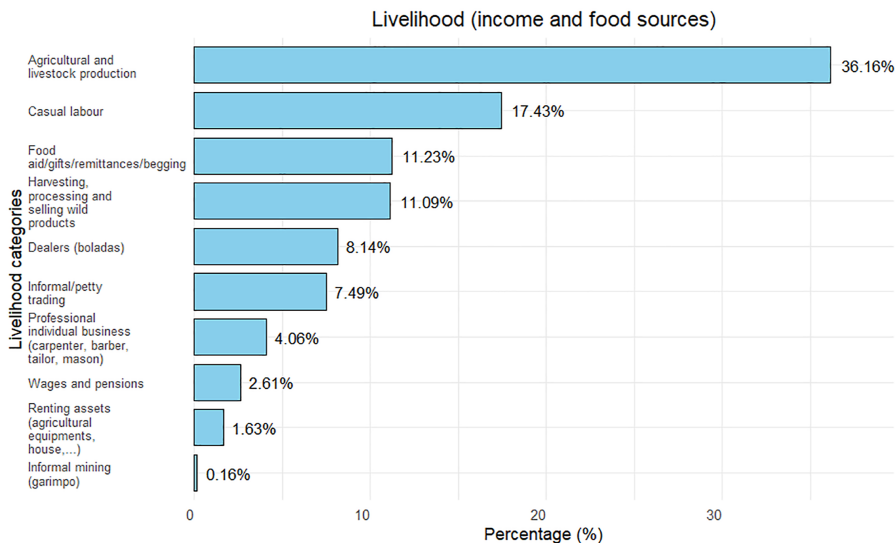


Figure 2. Income and food sources in Buzi. **Source:** Authors' own work

of hopelessness was quite strong due to declining agricultural productivity and their limited off-farm livelihood options.

[World Bank \(2013\)](#) states that, over the past 40 years Africa has been steadily losing its share of the global agricultural market. [Badiane et al. \(2023\)](#) were more positive on the agricultural transformations in Africa, but they also agree that people are leaving agriculture in Africa but not necessarily for better opportunities, but rather for the informal setting where opportunities are underpaid and uncertain. [Dadá \(2024\)](#) found that 37% of farmers in Buzi were willing to leave agriculture for the first job opportunity they were presented while only 15% rejected all possibilities of leaving agriculture. A recent report by the [World Bank \(2023\)](#) found that service provision is the milestone for growth and job creation in Mozambique, as agriculture, despite being the largest employer, is the least productive sector. In short, the built (market-based) is one of the key food environments in Buzi.

Besides relying on service provision to get food purchasing power, households also rely on agriculture (36%); on aid/gifts (11%) and on wild natural resources (11%) as their primary source of food. In the section that follows we shall look more closely at each of these food environments.

3.2 The wild natural food environment: the dying of a saviour?

Buzi comprises multiple natural wonders from forest to fertile agricultural lands, to rivers and ocean. All of which has been a source of food and income. 53% of the respondents use the wild environment to fetch food and/or raw materials for different purposes, including trade. The wild environment has been relevant not only for food security but also as an important ecosystem-based disaster risk reduction defence; the wild provided protection against sea level rise, from flooding and from heat waves. During the civil war (1976–1992) the wild was a saviour for communities fleeing the armed conflict and was extensively used as a guardian of the ancestors' spirits [3]. Over the past decade, indeed, the ecosystem services have been in peril. Our LULC analysis have shown that over the past 10 years (2013–2023) Buzi lost around 30% of its forest cover moving from 323,436 ha to 225,234 ha; that is, around 3% forest loss per year. Bare land has jumped from just around 384 ha–7813 ha ([Figures 3 and 4](#)). On the

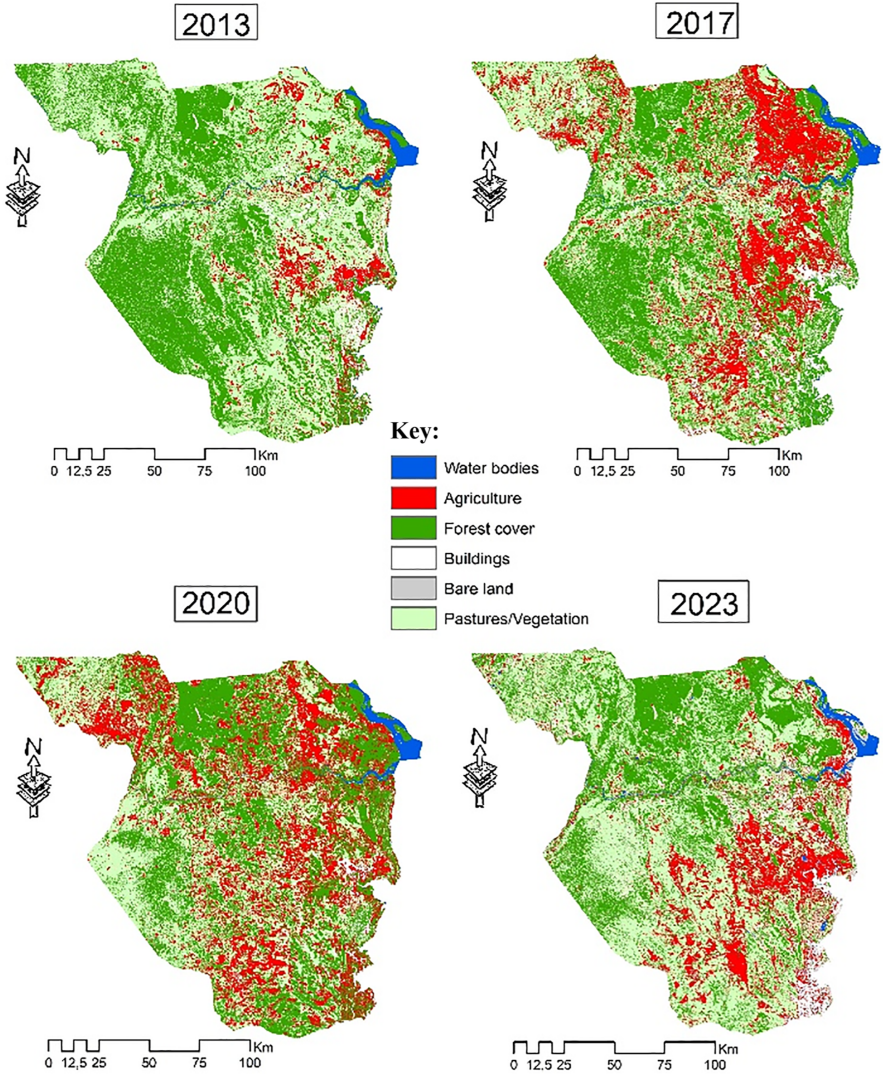


Figure 3. Land use and land cover changes in Buzi 2013–2023. **Source:** Authors' own work

other LULC shows a shrinkage of agriculture activity towards the central-eastern part reflecting resettlement programs that took place over the past years because of the intense cyclone activity (see [Figure 5](#)).

The destruction of the forest meant also the loss of critical ecosystem services which are important for food and nutrition. Although people still use forest and forest products, it was unanimously claimed during the focus group discussions that some fauna and flora species have disappeared in the area, thus reducing the quantity and diversity of wild products. The distance travelled to forests has also increased, adding time and effort, particularly on women and kids that represented 58.94% of the harvesters. As noted by a woman informant: “We spend a lot of time bringing nearly nothing from the forest. There are no forest products

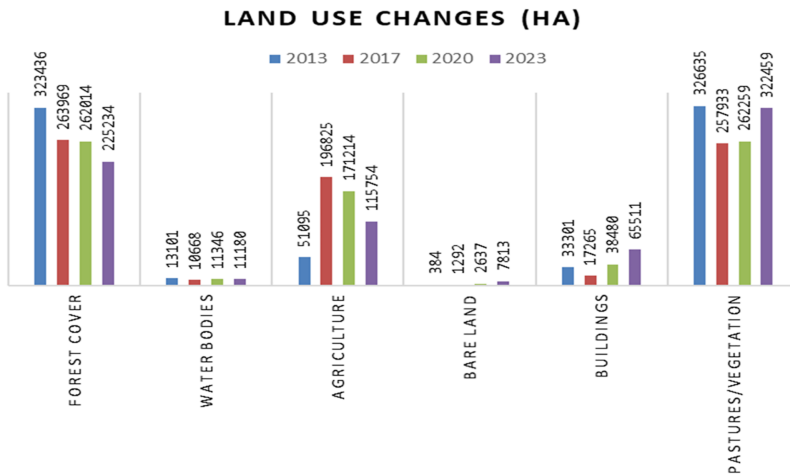


Figure 4. Trends in changes in land use and land cover classes in Buzi 2013–2023. **Source:** Authors’ own work

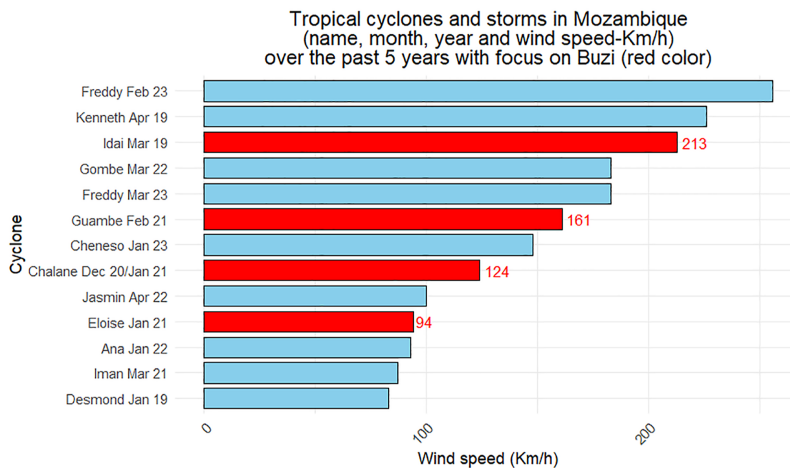


Figure 5. Tropical cyclones and storms in Mozambique with focus on Buzi. **Source:** Authors’ based on WorldData.info and INAM (2024)

nowadays; even rats and birds are disappearing. In the past when things were bad in agriculture we would turn to the wild as our saviour; but now our saviour is also dying![4]”. Population growth, limited land use planning, climate change, disasters and related displacement and resettlements, limited livelihood alternatives beyond natural resources are all push factors for ongoing deforestation and land degradation in Buzi. In short, wild food environment remains critical for making a living in Buzi, but very stressed.

3.3 The cultivated natural food environment. Building resilience in midst of disasters
Agriculture is, by far, the main employer in Buzi. 94% of our sample are engaged in agriculture as one of their sources of food and/or income. 47% have more than one field, and more than 70% use multiple crops as part of diversification and risk reduction. 98% of those engaged in

agriculture are small-scale farmers exploring less than 2 hectares. The majority (81%) have either no schooling at all (33%) or just primary/elementary school (48%) and have limited access to modern inputs and extension services. Nationwide, including Buzi, less than 5% of farmers have access to extension services and improved seeds; less than 1% access formal credit services; only around 15% have access to market information, while more than 70% of all properties have been affected by climate related disasters and post-harvest losses reaches around 30% (own data and [MADER, 2019](#)). Illiteracy and limited access to extension services and to modern inputs all lead to low productivity ([Jorge et al., 2024](#); [FAO, 2023](#); [Cavane et al., 2013](#); [Dada and Mosca, 2024](#)). The overall yields are very low with maize, the main staple crop, reaching just around 1 tonne/ha far beyond the average global yield of 5.8 tonnes/ha, 2.1 tonnes/ha yield average in Africa and 10.8 tonnes/ha in the USA ([Woomer et al., 2023](#)).

Agriculture in Buzi has been severely impacted by recurring climate risks. In 2019, tropical cyclone Idai, for example, led to just 20% of yields of the already barren crops. Maize dropped from officially expected 2.1 tonnes/ha to just 0.8 tonnes/ha and rice from the expected 3 tonnes/ha to just 0.7 tonnes/ha ([Governo do Distrito de Buzi, 2021](#)). The government and partners have been embracing smart agriculture and providing various aid and development schemes for resilience building. These include sensitisation for land, crop and livelihood diversification, adoption of a new agricultural seasonal calendar, adoption of new crops or new varieties and embracing new agricultural practices such as the use of irrigation, pesticides, fertilisers amongst other inputs being promoted by the government extension services and NGOs alike; unfortunately, too little for the challenge. Anticipatory action agenda is also emerging as part of the current thinking on disaster risk reduction and Buzi is considered by the government on the top of beneficiary districts ([INGD, 2024](#)).

Despite all these attempts the cultivated food environment is yet, marked by very low yields in all crops farmers are engaged in. These low yields push people to get into the wild, the markets or search for aid to support and meet their food needs. Our research found that, on average, food reserves from own production lasts from 3 months (for the most vulnerable ones) to around 5 months for the better off; the remaining time of the year people will depend heavily on other food environments.

3.4 The aid environment: shaping the present and the future of food environments

Over the past 5 years Buzi was affected by 4 tropical cyclones and storms (see [Figure 5](#) above), the Covid-19 pandemic, market prices increase, and expanding deforestation and degradation, which eroded the asset base people rely on for making a living and pushed a lot of households to rely on humanitarian aid. 13% of our sample depended on aid for their food needs. Aid comes in different formats and from different sources. In our focus group discussions people mentioned family members, friends and neighbours as their primary sources of aid but as claimed by most respondents, increasingly these sources are also pressured and squeezed to a point that the majority depend on the government and NGOs for aid. Multiple and recurring hazards have put households in Buzi at the brink of collapse.

The government and the World Food Program (WFP) have been critical actors in providing immediate support but also long-term livelihood recovery. For example, in response to Cyclone Idai in 2019–2020, these actors have spent more than USD two million in food aid in Buzi targeting 203,615 people in 2019 and 281,390 people in 2020 ([WFP, 2022](#)). There has also been in-kind support for livelihood recovery especially on agriculture, livestock and fisheries. In 2019 and 2020 different actors [government, World Food Program (WFP), Food and Agriculture Organization (FAO), Oxfam, World Vision, Kulima, Comité Económico para o Desenvolvimento Social (CEDES)], amongst others, have provided (in 2019), 205,901 tonnes of different seeds (maize, rice, beans, soya, vegetables, sorghum, millet) and 541,828 tonnes of these seeds (in 2020); they have also provided 4,470 tonnes of fertilisers (2019) and 9,195 tonnes of fertilisers (in 2020), dozens of pesticides and thousands of hoes and other implements including for fisheries ([Governo do Distrito de Buzi, 2021](#)).

Aid has multiple benefits but also side effects especially concerning the functioning of food environments. First, and importantly, aid saves lives and may also empower local markets and reduce the burden of migration or of further eroding household assets (WFP, 2022). It may also provide opportunities for employment and access to new assets that might be used to positively change the lives of the millions of people accessing it. Aid also dictates the performance of food chains and environments. First, as food travels from the swamps (term used to denote where food is abundant) to the deserts (term used to refer areas where healthy foods are insufficiently available and accessible such as Buzi) (National Collaborating Centre for Environmental Health, 2017), people have less control over quantity, quality, safety, preference on what they eat. Decisions on these issues are made far from their environments but ultimately define their health. Second, are not only the food miles (the distance food travels from its original production site to its place of consumption) (Coley et al., 2009) that matters but also who gets that food.

Humanitarian aid is provided using its own rules and preferences; there are guidelines and criteria for inclusion and exclusion and some of these make people dependent on humanitarian aid. Mandamule (2023) found out that to get aid in Buzi, one needed to be physically weak but also present all the time at the place where they have been registered (Figure 6 below). This *involuntary immobility* and *involuntary unfitness* may limit someone's ability to develop extended and long-range networks that are needed for long-term resilience and food consumption.

A	B	C	D	E	F	G	H	I	J
Select Province Name	B1.1 Select District Name	B1.2. Select Posto Name	B1.3. Select Locality Name	B1.4. Enter the site Name	C1.2 Select one	C1.3 Enumerators to chek house state	D1. Are you head of family /Head of household ?	D2. Gender of head of HH	D3. Age of head of HH
1	Sofala	Buzi	Bandua	Inhanjou	1. Own	2. In this house it seems like no one lives;	Head of the Family	Male	70
2	Sofala	Buzi	Bandua	Inhanjou	1. Own	1. In this house it seems like someone lives;	Head of the Family	Male	65
3	Sofala	Buzi	Bandua	Inhanjou	1. Own	1. In this house it seems like someone lives;	Head of the Family	Female	36
4	Sofala	Buzi	Bandua	Inhanjou	1. Own	1. In this house it seems like someone lives;	Head of the Family	Female	40
5	Sofala	Buzi	Bandua	Inhanjou	1. Own	1. In this house it seems like someone lives;	Head of the Family	Male	35
6	Sofala	Buzi	Bandua	Inhanjou	1. Own	1. In this house it seems like someone lives;	Head of the Family	Male	54
7	Sofala	Buzi	Bandua	Inhanjou	1. Own	1. In this house it seems like someone lives;	Head of the Family	Male	80
8	Sofala	Buzi	Bandua	Inhanjou	1. Own	1. In this house it seems like someone lives;	Head of the Family	Female	42
9	Sofala	Buzi	Bandua	Inhanjou	1. Own	2. In this house it seems like no one lives;	Head of the Family	Female	48
10	Sofala	Buzi	Bandua	Inhanjou	1. Own	1. In this house it seems like someone lives;	Head of the Family	Female	79
11	Sofala	Buzi	Bandua	Inhanjou	1. Own	1. In this house it seems like someone lives;	Head of the Family	Female	26
12	Sofala	Buzi	Bandua	Inhanjou	1. Own	1. In this house it seems like someone lives;	Head of the Family	Male	60
13	Sofala	Buzi	Bandua	Inhanjou	1. Own	1. In this house it seems like someone lives;	Head of the Family	Male	40
14	Sofala	Buzi	Bandua	Inhanjou	1. Own	1. In this house it seems like someone lives;	Head of the Family	Male	40
15	Sofala	Buzi	Bandua	Inhanjou	1. Own	1. In this house it seems like someone lives;	Head of the Family	Male	40

Figure 6. Physical presence as one of the criteria used by aid providers to get aid in Buzi **Source:** Mandamule (2023)

Third, aid has impacts on long-term production and consumption patterns. Seeds, fertilisers and other production related supports are reshaping new production systems, new flavours and eating habits, and the functioning of the markets. We found people who produced too little because:

- (1) The seeds they received came too late for the production season or were of poor quality and/or less drought or flood tolerant compared to their traditional ones;
- (2) The new technologies demanded technical support which they did not have, so they ended up using seeds, pesticides, fertilisers they received from aid organisations without knowledge on how to best use these products.

In these cases, aid is influencing, to some extent, what to produce, when to produce and with what technologies. All these ultimately shape what is available in the markets.

Finally, aid has impacts on local power relations and long-term access to resources. Literate people, fluent in English and well connected politically were more likely to access multiple resources in Buzi [5]. An elite group that capitalised on most humanitarian opportunities was also investing in geographic and service areas likely to be in demand due to gas exploration by

Buzi Hydrocarbons [6]. In a nutshell, humanitarian food environment has been very critical in ensuring the minimum food intake of the most destitute, but its long-term impact deserves further critical analyses.

3.5 The built food environment (formal and informal markets): affording the cheap and unhealthy

Markets appeared as a key food environment in Buzi. As pointed out previously, the majority depended on the market to meet their food demands. The research identified 16 marketplaces, along the district, and dozens of informal sales stands in the communities. These marketplaces sell five main types of products: (1) Non-food items such as clothes, household items, and mobile phones (2) Services such as hairdressers, photocopies, and shoe repair (3) Fresh vegetables (4) Animal products and (5) Staple foods. Most of these marketplaces engage mostly on petty trading and use petty cash as the most relevant cash flow mechanism. This “coin economy” is seasonal, being quite dynamic during the harvest period (May–July) and less during the lean season (December–February). Inbound products are mostly non-food items and are more available during the abundance harvest period when the outbound products, mainly food products, are also more available. During the lean period, an inbound of food item is noticed and outbound is limited. Trade (inbound and outbound) is mostly done with Beira and Chimoio cities located around 2–3 h’ drive (about 200 km).

Overall, we found limited sales of meat, fruits and vegetables but expanding selling of junk food and drinks such as sweets, snacks, cookies, soft drinks, mixing juices, alcohol. Expiry dates for packed products are controlled regularly in all major markets by health services that also instruct vendors not to sell from the ground, to protect their products from dust and other environmental factors. These instructions are usually to no avail; vendors prefer to sell from the ground and in the sun, when that improves their visibility and chances of finding clients.

Infrastructures with easy-to-clean concrete slabs, roofs and drainage are often deserted or only partly used, as vendors claim that they do not have any clients there and revert to streets. Visual inspection of fresh vegetables was satisfactory. The freshness and quality of food products is usually controlled by vendors and clients. Meat and fresh fish are usually sold from shops with refrigerators – meat is often not traded on markets at all but purchased directly from the places where it is slaughtered, after having received clearance from the district veterinary. In some markets, fresh meat was seen for sale from uncooled, unprotected sales places. Fish is often sold dry – dry and salted, it conserves well and is an easy commodity to sell and to conserve at home. The influx of NGOs and aid workers was pointed, in group discussions, as good for local sells.

Food products usually suffer from being stacked in mixed loads and without proper protection (e.g. crates) when transported to the market. Means of transport are one of the bottlenecks to carry products from the *machambas* (farms) to the market. Hardly any market at all had storage facilities or cold rooms. Vendors organise storage facilities themselves or take the products home.

Sanitation is a problem in many markets and fairs: water and latrines are often not available. Only a few markets have functioning toilets; when there are toilets, they are usually hardly used as they must be paid for. Running water at the marketplace is an exception, usually it needs to be fetched from nearby pumps against a fee. Hand washing facilities were installed in many markets during Covid-19, but most had disappeared or were off-service when we passed by August 2023.

Drainage issues in many markets, with stagnant water mixed with litter, create unhealthy environments for food handling and sales. Waste collection, typically organised through “cleaning days,” “paid cleaners,” or “individual responsibilities,” is often inadequate, leading to clogged drains and scattered trash. Waste disposal is ineffective, with open-air trash sites where waste is either burned or buried. The prevalence of rodents and insects results from inadequate storage facilities and inconsistent waste management. As a result, people tend to choose convenient, cheap, and often unhealthy food options.

Studies, particularly in Africa, show similar trends. [Recchi \(2021\)](#) notes that petty trading in the Global South is often conducted by poor, less-educated individuals, mostly women, while in the Global North, it is typically by migrants in precarious conditions. [Kumar and Sharma \(2019\)](#) highlight the challenges faced by informal vendors in India, including harassment, storage issues, lack of sanitation and utilities, and financial pressures. In Africa, [Mitullah's \(2004\)](#) review of informal trade found that street vendors, often women from disadvantaged backgrounds, work under poor conditions with limited resources. What Buzi presented is a built food environment comprising poor conditions and expanded access to cheap but largely unhealthy food.

3.6 Intra and inter-annual dynamics of food environments-making use of different food environment

There is no reliance on just a single food environment in Buzi. Although households may rely heavily on one food environment, especially agriculture and own production, they usually move around the different food environments during a year and between years. There is also a difference between the better-off and the most destitute. A good agricultural harvest may reduce the demand for other food environments while the reverse may push people to engage in other food environments sooner. [Figure 7](#) summarises the intra-annual dynamics of the food environments in Buzi. We looked at the access to different food environments during a year. Our analysis suggested that during the harvest period households rely heavily on the cultivated food environment; this represents the period when their food security is at the highest level which is around May–July. During this period the District Economic Activities Services (SDAE) are a key player helping on market integration and post-harvest control. Then, when food stocks from their own production start to dry out, people will use income generated through different sources and turn to the formal markets (the better-off) or to informal markets (the most destitute). This would happen around October–December when the food insecurity starts to click on. During this period the key players are no longer the SDAE but mostly local and regional traders with some engagement from SDAE and NGOs. When the situation worsens, the better-off would shift from the formal markets, costlier and relatively higher quality, to more informal (less costly and relatively lower quality) while the most destitute would move from the informal markets to the wild environment and or humanitarian environment. This represents a period where food security is at its lowest level and happens around January–February. At this point, humanitarian NGOs and District Planning and Infrastructure Services (SDPI) become critical players. Food security improves if early

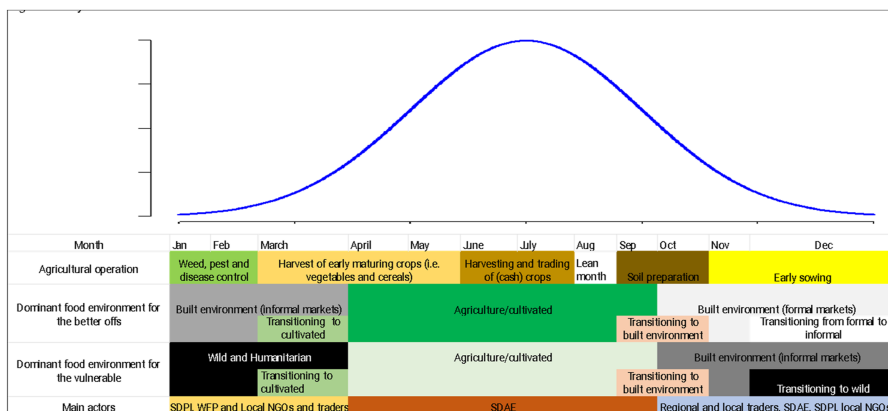


Figure 7. Intra-annual dynamics of food environments. **Source:** Authors' own work

harvests follow rainfall. Otherwise, they will remain dependent on the aid and environment for as long as it is needed.

Depending on each year's rainfall, extreme climate events and other stressors, the time spent on each of these five food environments may change and exceed a year or more leading to inter-annual dynamics. Usually, NGOs provide food support for three months but in the case of Buzi this had to be expanded to over six months during the Idai response in 2019, Covid-19 and cyclones Chalane, Eloise and Guambe over the following years [7]. In other contexts, such as in the Sahel, dependency on humanitarian aid has expanded over years due mainly to harsh climate conditions (Parodi *et al.*, 2024). In Buzi, therefore, people permeate between different food environments depending, primarily, on how own food production performs and what social, economic and financial resources one possesses.

4. Conclusions

This paper looked at the food environments under the contexts of disasters and used the case of Buzi district in Mozambique to expand the understanding of food environments. In doing so, this work shows that complex disasters and an unfit environment, marked by limited and decaying ecosystem services are, forcefully, pushing people to be integrated into the cheap and unhealthy food markets. Furthermore, the paper demonstrated that in the Buzi district, agriculture is important, but not necessarily the food environment people rely on for their year-round food intakes; most food needs are met through cheap markets. Additionally, it shows that agriculture is not only being pressured and influenced by the climate crisis but also by the influx of aid and humanitarian actors who provide seeds, pesticides, fertilisers, production tools, extension services and link their "beneficiaries" to markets for their outbound products. Access to the network of aid requires, in most cases, that people develop what we have called *involuntary unfit* and *involuntary immobile* by which people must showcase their inability to access other food environments and must be present all the time at the eyes of the aid givers. In such contexts, aid is not only saving lives but also determining, in the short and long term, who produces what, when, how, under what conditions and for whom.

Our study also looked at the dynamics of demands on the different food environments for different months and across years. In doing so, it shows that people in Buzi do not rely on a single food environment; they crosscut the different food environments and use different expertise, including local knowledge, social networks and other assets to get the most of each food environment in time and space. The findings have far reaching implications, especially on the types of interventions that would allow people primarily to expand their access to health food from their own production (reduce food miles of health foods) and expand their access to health foods from the built environments. Amongst others, this would require a local (or national) network of input producers and suppliers, and a robust food surveillance system on (1) inbounds (prices, quality and quantities), (2) surrounding ecosystems, and (3) dynamics of input and food supplies along the year(s).

Overall, the findings of each piece of this study demonstrate that in disaster-prone settings like Buzi, food security is shaped by a complex interplay between disrupted natural ecosystems, humanitarian interventions, and evolving market dynamics, demanding multi-sectoral, time-sensitive, and locally grounded responses. The study is a contribution to the ongoing debates on how to best ensure FSN to the most vulnerable people but still misses several issues that require further analysis. We touched upon the different data sources from the geographical to quantitative and qualitative and, in most of the case, with limited critical and in-depth discussion. We recommend further studies that focus, in depth, to each individual food environment. Future research should also explore aspects such as food affordability, convenience, desirability, safety, marketing, and regulations, which require further attention.

Notes

1. Excerpts from key informants 3, 6, 10 and 13.
2. <http://www.research-advisors.com>. Assessed June 6, 2022.
3. Excerpts from key informants 7, 11, 16 and focus group discussion with men, and focus group discussion with women.
4. Excerpts from key informant 3.
5. Excerpts from key informants 6, 9, 12, 15 and 17.
6. Excerpts from key informants 1, 6, 10, 11, 16 and 17.
7. Excerpts from key informants 10, 13 and 16.

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