WORKING PAPER

ENHANCING PEOPLE-CENTRED EARLY WARNING SYSTEMS (PCEWS) IN TRADITIONAL COASTAL COMMUNITIES OF BRAZIL: *AN INTERSECTIONAL APPROACH TO INCLUSIVE RISK COMMUNICATION*

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Global Disaster Preparedness Center

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ABSTRACT

Traditional and Local Communities (TLC) living in coastal southeastern Brazil are increasingly impacted by extreme climate and weather events. However, these communities are seldom involved in early Disaster Risk Management. Incorporating their knowledge is crucial to reduce conflicts and achieve sustainable solutions. Here we investigated the existing barriers to the dissemination and communication of early warning messages at the local level according to traditional communities. To this end, we adopted a transdisciplinary and mixed-methods approach, combining demographic data and georeferenced disaster information with focus groups, workshops and interview data. Our research focused on two TLCs in the Southeast coastal zone of Brazil, *Ubatumirim* & *Campinho,* which are frequently impacted by hydrometeorological hazards. We identified distinct patterns in the types and frequencies of disasters reported, unravelling the unequal distribution of disaster impacts in each municipality. From these workshops, we identified three key barriers to the dissemination and communication of warnings. First, information about potentially hazardous events is often delayed, with updates reaching the public after the event. Second, the communication networks depend on technologies that often fail during emergencies, making them unreliable. Third, there is no clear distinction between official warnings and misinformation, causing confusion and mistrust. To advance the effectiveness of warnings, future interventions should focus on (1) building redundancy in communication channels for priority groups, (2) designing, testing and evaluating evacuation protocols by involving these groups and (3) formulating customised response plans and emergency kits tailored to these communities.

Keywords: Early Warning Systems, Intersectionality, Risk Communication, Disaster Preparedness, Disaster Impacts.

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Participatory risk mapping in Quilombo do Campinho da Independência, Paraty (Rio de Janeiro), Brazil. March 2024

INTRODUCTION

Traditional and Local Communities (TLCs) living in coastal southeastern Brazil are increasingly impacted by extreme climate and weather events (Pereira et al. 2023). Despite this, affected communities are rarely involved in earlier stages of Disaster Risk Management (DRM). Yet, incorporating their knowledge is crucial to reducing conflicts, achieving sustainable solutions, and, therefore effective DRM (Lang et al., 2012). To address this gap, transdisciplinary approaches have been increasingly advocated to address climate-related hazards (Iwama et al., 2016; Londe et al., 2018; de Brito et al., 2018; Alcântara et al., 2023). Consequently, there is a growing emphasis on participatory or people-centred early warning systems (PCEWS), aiming to improve decisions taken by emergency institutions and exposed communities (Marchezini et al., 2017, 2018).

While these efforts are promising, much more is needed to ensure that everyone will have access to early warning systems (EWS) by 2027, as aimed by the EW4ALL initiative (WMO; UNDRR, 2022). Simply achieving "guaranteed coverage" of warning systems globally does not ensure their effectiveness. Tupper and Fearnley (2023) suggest using intersectional approaches tailored to the needs of marginalised groups. They emphasise that rather than merely counting whether EWS exist or not, these systems should be evaluated in terms of how well they protect lives and livelihoods.

In the case of the Brazilian national EWS, a key challenge to its effectiveness lies in improving the dissemination and communication of warning messages among last mile communities

(Marchezini et al., 2017). In fact, there is limited evidence as to the extent of the current official communication works at the local level and what could be improved to allow social groups from diverse socio-cultural contexts to take ownership of the system.

To address this gap, we investigated the barriers TLCs in coastal Brazil face in accessing and understanding early warning messages. More specifically, we explored how *Quilombola*[1] and *Caiçara* communities perceive the EW messages and the barriers they face. As the majority of marginalised communities in Brazil, they are not being invited to participate in the EWS implementation, evaluation and improvement. By "marginalised," we refer to collective identities outside mainstream society with limited social/economic or educational capital (Seglah & Blanchard, 2022). In Brazil, TLCs face exclusion from the land tenure system and encounter significant challenges in the demarcation of their territories, while also experiencing a devaluation of their worldviews and cultural representations within society (de Carvalho & da Silva, 2015). This reflects how risk is shaped by an unsustainable and exclusionary development model that leaves diverse social groups behind (Marchezini & Wisner, 2017). With this, we aimed to create a community-based risk communication prototype that could be transferred to other resilience-building activities targeting marginalised TLCs.

Our study focused on the Southeast coastal zone of Brazil known as the "Costa Verde Region", formed by the mountains called 'Bocaina' (in Rio de Janeiro) and 'Serra do Mar' (in São Paulo). Quilombo do Campinho da Independência is located in the municipality of Paraty (RJ), and the Caiçara community of Ubatumirim, is located in the municipality of Ubatuba (SP) (see figure 1). This region was chosen due to its history of extreme floods, landslides, coastal erosion, and strong winds (Iwama et al., 2014).

Besides these disasters, the region faces various challenges, including territorial conflicts, real estate speculation, deforestation, oil exploitation, and industrial fishing, which negatively impact TLCs (OTSS, 2022). In these traditional territories, livelihoods are primarily based on family labour and subsistence activities, highly dependent on forest and oceanic resources, such as community-based tourism, handicrafts, cocoa and several subproducts of cassava powder and fishing (Maretti and Simões, 2020).

In this context, TLCs are referred to here as 'last mile' communities, indicating their exclusion from the development of early warning systems and, consequently, risk communication strategies. While previous research in this study area explored and advanced capacity building on risk knowledge and hazard observation and monitoring (Albagli & Iwama, 2022; Pereira et al., 2023), little is known about suitable risk communication models tailored to the unique capabilities and needs of TLCs.

This paper focuses on understanding the barriers to the dissemination and communication of early warning messages in traditional coastal territories. It captures community experiences of recent extreme events and accessibility to EWS, aiming to develop a risk communication

1 - Quilombos are communities of descendants of enslaved people who escaped from captivity and formed their own communities. The quilombola territories are now protected by the Brazilian Constitution and National Policy for the Sustainable Development of Traditional Peoples and Communities (Brazil—Federal Constitution of Brazil, 1988; Brazil—National Policy for Sustainable Development of Traditional Peoples and Communities, 2007).The Caiçara identity is rooted in the cultural and social practices of communities situated along the Brazilian coastline, particularly in the States of São Paulo, Rio de Janeiro, and Paraná. Artisanal fishing is a marked subsistence practice of this group, which descends from Portuguese and indigenous communities (see Begossi, 1996).

prototype. It consists of a straightforward step-by-step model that evolves through mapping priority groups, identifying communication needs, designating messengers, and conducting scenario-based simulations. We expect that this prototype could support other community-led initiatives and enhance the current national EWS into more accessible, understandable and actionable warnings.

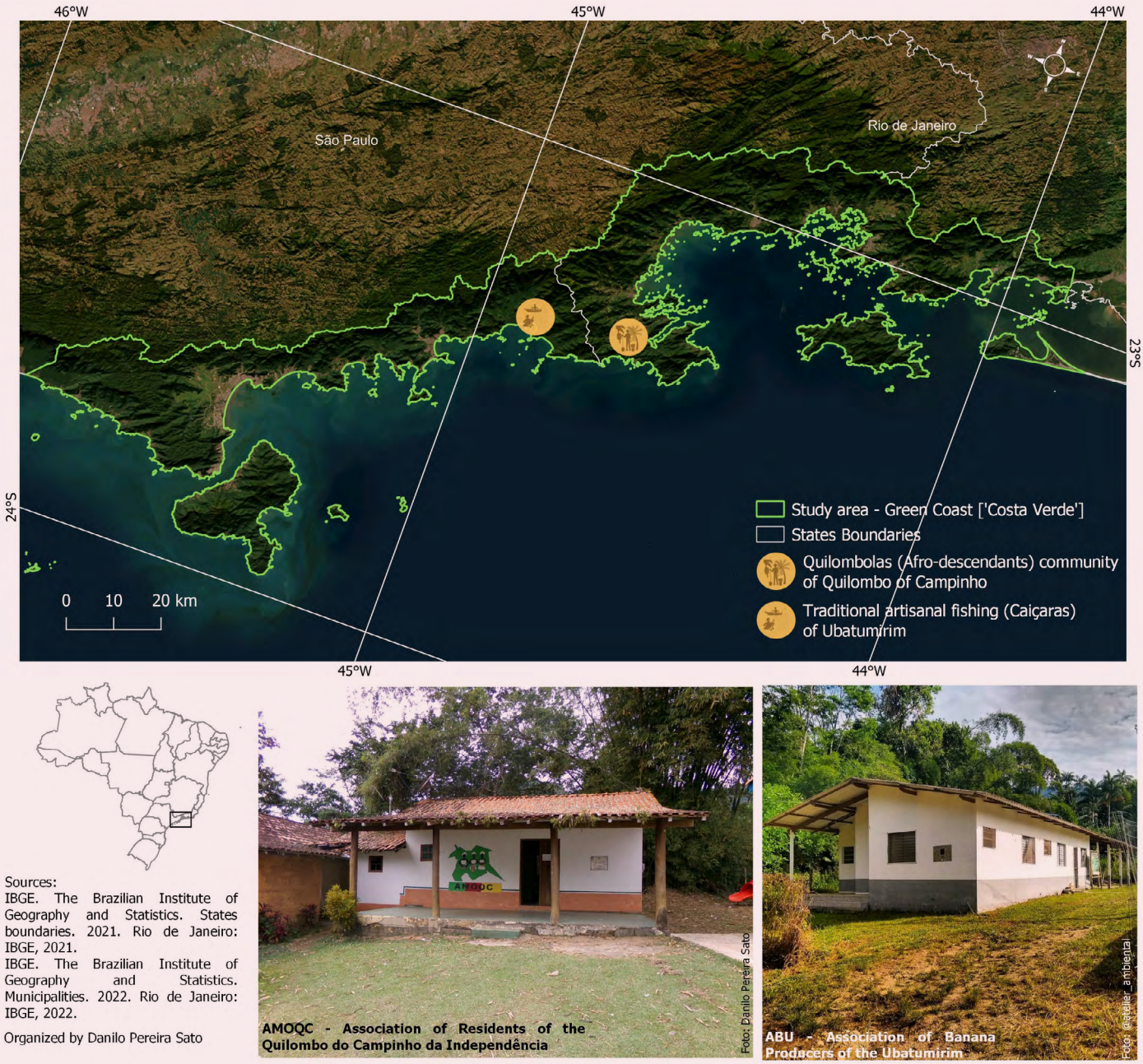


Figure 1: Map of the study area in the Green Coast (Costa Verde) region, located between the states of São Paulo (SP) and Rio de Janeiro (RJ). The map highlights the territories of Quilombo do Campinho (Paraty, RJ) and the Caiçara fishing community of Ubatumirim (Ubatuba, SP). Below, photographs show the headquarters of the Association of Residents of Quilombo do Campinho (AMOQC) and the Association of Banana Producers of Ubatumirim (ABU).

Source: Photographs by Atelier Ambiental and Danilo Pereira Sato. Digital cartography by Danilo Pereira Sato.

Workshop on piloting Unmanned Aerial Vehicles (UAVs) for Community Mapping
Quilombo do Campinho da Independência, Paraty (Rio de Janeiro), Brazil
October 2022 - Previous citizen science activity of the CoAdapta Litoral Project

REVIEW

PEOPLE-CENTRED EARLY WARNING SYSTEMS IN PERSPECTIVE

Early Warning Systems (EWS) can be defined as "an integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities systems and processes that enables individuals, communities, governments, businesses and others to take timely action to reduce disaster risks in advance of hazardous events" (UNISDR, 2017).

The EWS concept can be summarised along four simplified dimensions: risk knowledge, hazard monitoring, risk communication and response capacity. Risk knowledge refers to collecting data and assessing the dynamics and variability of hazards and vulnerabilities, identifying the main characteristics of single or multiple processes that can help relevant stakeholders to better understand the risk landscape. This is crucial for the development of EWS, the implementation of preventive measures and the direction of effective responses (IFRC, 2009). Hazard monitoring consists of observing and tracking hazard parameters through coordinated early warning services at global, national, and community levels. Combining scientific and local knowledge is necessary to downscale the monitoring settings to the local level, make predictions more empirically grounded and provide timely and actionable warnings (United Nations, 2006). Communication and dissemination are essential to mobilising cooperation among authorities, local communities, and the general public. It involves using various communication channels, formats, and contents (Victor, 2015). Finally, the response capability relies on implementing

multi-level response plans that must be regularly tested and updated based on previous experiences, transformations in the risk landscape and resource availability.

Marchezini (2020) emphasises that effective EWS must be people-centred, focusing on the needs, behaviours, and capacities of the communities they intend to protect —an intuitive yet often overlooked aspect. A major challenge to achieving participatory or people-centred EWS is recognizing risk as a socially constructed process. According to Maskrey (1993), risks and disasters are intrinsically linked to broader social structures, vulnerabilities, and inequalities. Historically, EWS focused mainly on hazard monitoring, as early paradigms in Disaster Science often acknowledged disasters as direct outcomes of natural events and prioritised engineering solutions to control nature (Hewitt, 1983). However, this approach has faced significant criticism, particularly for neglecting social vulnerability and sidelining the people who should be at the centre of DRM (Erisman et al. 2015; Marchezini, 2020; Fusinato et al., 2024).

Even though the bottom-up and participatory approaches in disaster risk research are well established, it is crucial to conduct further studies that go beyond the co-creation strategies used so far (Turnhout et al., 2020). By gathering intersectional data, a clear path can be established to tackle the structural inequalities that underpin vulnerability to disasters.

THE USE OF INTERSECTIONAL APPROACHES TO UNRAVEL STRUCTURAL INEQUALITIES

One third of the global population still lacks access to EWS, according to the World Meteorological Organization (2022). Globally, the consequences of inefficient or absent EWS have concerning implications, particularly for the Global South (IFRC, 2012). In order to address this disparity, it is necessary to critically reevaluate the underlying frameworks that shape disaster preparedness and response.

Intersectional thinking challenges the dominance of traditional epistemologies in disaster studies, advocating for policies and practices that are fair, restorative, and forward-thinking (Jean et al., 2023). This shift aligns with a new paradigm that seeks to unravel disaster root causes rather than merely controlling hazards.

From a groundbreaking perspective, the works of Moraga and Anzaldúa (1981) raised the question of unique social struggles experienced by black women, particularly in the United States, though their ideas resonated globally. Their work highlights the comprehensive nature of overlapping oppressions in women's lives and paved the way for the concept of intersectionality, which is underpinned by three key ideas:

1. **individuals are shaped by their simultaneous belonging to multiple interconnected social categories or identitarian markers;**
2. **the interaction between these social positions occurs within a context of asymmetric power relations driving oppression and privilege;**
3. **structural inequalities result from combining social categories, power relations, and specific individual contexts (Crenshaw, 1989; Hankivsky, 2014; Collins, 2015).**

Several fields of knowledge apply the intersectionality concept as a tool for identifying, understanding, and addressing structural inequalities while considering the nuanced experiences of individuals (Bauer et al., 2021). Using this concept in the context of vulnerability assessment is particularly helpful as it draws attention to multiple dimensions that directly dialogue with the physical, economic, social and environmental layers that compose vulnerability (Cardona et al., 2023). This growing recognition is also reflected in global guidelines adopting inclusive lenses to engage diverse social groups in disaster research.

The 'Gender Action Plan to Support Implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030' (Sendai GAP) is a document written to support researchers, academics, policy-makers and practitioners to address gender inequalities related to investments in DRR efforts, early warning systems, disaster recovery, reduction of gender-related disaster risks and improvement of resilience by 2030. Aligned with the four priorities of the Sendai Framework, it consists of a comprehensive structure made of nine key objectives and 33 actions to promote gender equality and empowerment of all women and girls in disaster risk reduction. Among these, Key Objective 1 emphasises the importance of increasing the availability of sex, age, income and disability disaggregated data and qualitative information on gender and disaster risk, to ensure that nuanced experiences of social groups with intersecting identities, such as older women with disabilities, are accurately represented in risk assessments. Key Objective 8, for instance, emphasises the need for gender-responsive disaster recovery plans, which recognise and address the increased burden of unpaid care and domestic work that falls on women and girls in the aftermath of disasters, as highlighted in Action 27 of this objective. By doing so, we can identify and address implicit gender norms that lead to disproportionate or unfair additional responsibilities during disasters.

Recently, a 'Global Survey Report on Disabilities and Disasters' was launched, revealing that 56% of the interviewed people either are unaware of or do not have access to disaster risk information in accessible formats in their communities. The survey reported that 84% of persons with disabilities do not have a personal preparedness plan for disasters (UNISDR, 2023). The document also reminds us that 80% of people with disabilities are in the Global South. Similarly, Yore et al. (2023) explicitly mentions intersectionality as a tool for designing inclusive and accessible EWS. It acknowledges the need for a comprehensive understanding of intersectionality, which is a fundamental aspect of all development initiatives involving communities and individuals. The authors mention that it is not about analysing every aspect of an individual's identity to create highly personalised solutions. Instead, it encourages the development of inclusive and adaptable systems capable of accommodating the diverse and intersecting identities within a population that is often silenced or overseen.

THE CHALLENGES OF RISK COMMUNICATION AMONG LAST MILE COMMUNITIES IN BRAZIL

In Brazil, the consolidation of a national structure to foster participatory and effective EWS faces several institutional, political, and cultural challenges. Civil defence organisations at the municipal, state, and national levels play a crucial role in disaster risk communication, as they serve as the main public entities involved in DRR efforts (Victor, 2015). According to the Brazilian National Civil Protection and Defence Policy - the civil defence is responsible

for mobilising and preparing communities in activities comprising the four axes of EWS and disseminating warnings through direct, face-to-face interactions with community leaders. However, the lack of investment and resources, miscoordination between institutions, and distancing between policy and practice result in significant gaps between local communities' actions (or lack thereof) during emergencies.

Despite being better resourced than other parts of Brazil, the Southeast faces a shortage of professionals and presents inadequate training for civil defence agents. A report shows that 46% of civil defence teams in the region consist of just two members (Brasil, 2021). There is a need to enhance these under-resourced civil defence bodies and provide continuous training, particularly in resource utilisation and prevention efforts with directly affected communities.

Due to the lack of capacities, most Brazilian states prioritise post-disaster actions, consequently emphasising disaster response in risk communication while neglecting other DRM phases. Londe et al. (2023) pointed out key actions that could enhance the landscape of risk communication in the country, such as: a) creating a space for visibility of civil defence actions at multiple governance levels to increase the public's understanding of how the civil defence system works; b) implementing a unified platform for knowledge sharing, including training and best practices; and c) promoting the importance of communication for enhancing the system's overall resilience through training and capacity building. From establishing working groups to the final evaluation and future planning, these recommendations are designed to ensure that the civil defence system is robust, well-understood, and capable of adapting to future challenges.

To advance disaster risk communication, structural changes must ensure the transition from a poor risk communication model to the creation of risk communication communities, where dialogue takes place in multiple directions (Stewart, 2024). These directions refer to the well-established top-down and bottom-up communication models, along with feedback loops integrated into an iterative process. This approach allows established protocols to be continuously adjusted over time, ensuring that local knowledge and community experiences are incorporated into decision-making (Gailard & Mercer, 2012; Erisman et al., 2015). It is expected to result in a coherent practice continuum where last mile communities are finally empowered to implement local solutions for delivering long-term and strategic disaster risk reduction goals.

Social Cartography Workshop, Quilombo do Campinho da Independência,
Paraty (Rio de Janeiro), Brazil.
May 2024

Early warming systems components in workshop,
Quilombo do Campinho da Independência,
Paraty (Rio de Janeiro), Brazil.
May 2024.

METHODOLOGY

In order to investigate the main barriers to the dissemination and communication of early warning messages within the communities, this study employed a mixed-methods approach, integrating both qualitative and quantitative methods. Figure 2 illustrates the methodology framework, which is structured into three main phases: (1) establishment of working groups, (2) developing a comprehensive geodatabase, and (3) conducting fieldwork campaigns.

First, three working groups were established to manage data, conduct fieldwork, and coordinate the activities. Community leaders were responsible for the articulation with traditional local communities and were part of the fieldwork team. The other two working groups (project coordination and data management), composed mainly of researchers from diverse institutions, also participated in community engagement through virtual meetings, fostering collaboration and facilitating the exchange of knowledge. Monthly online meetings were held between January and August 2024 to plan activities and integrate feedback (Figure 3). Each working group had the autonomy to convene and determine the operationalisation of activities relevant to its own tasks, resulting in several parallel meetings throughout the period.

Second, a comprehensive geodatabase was created to organise demographic information and reports on losses and damages (L&D) across selected communities in the coastal regions of

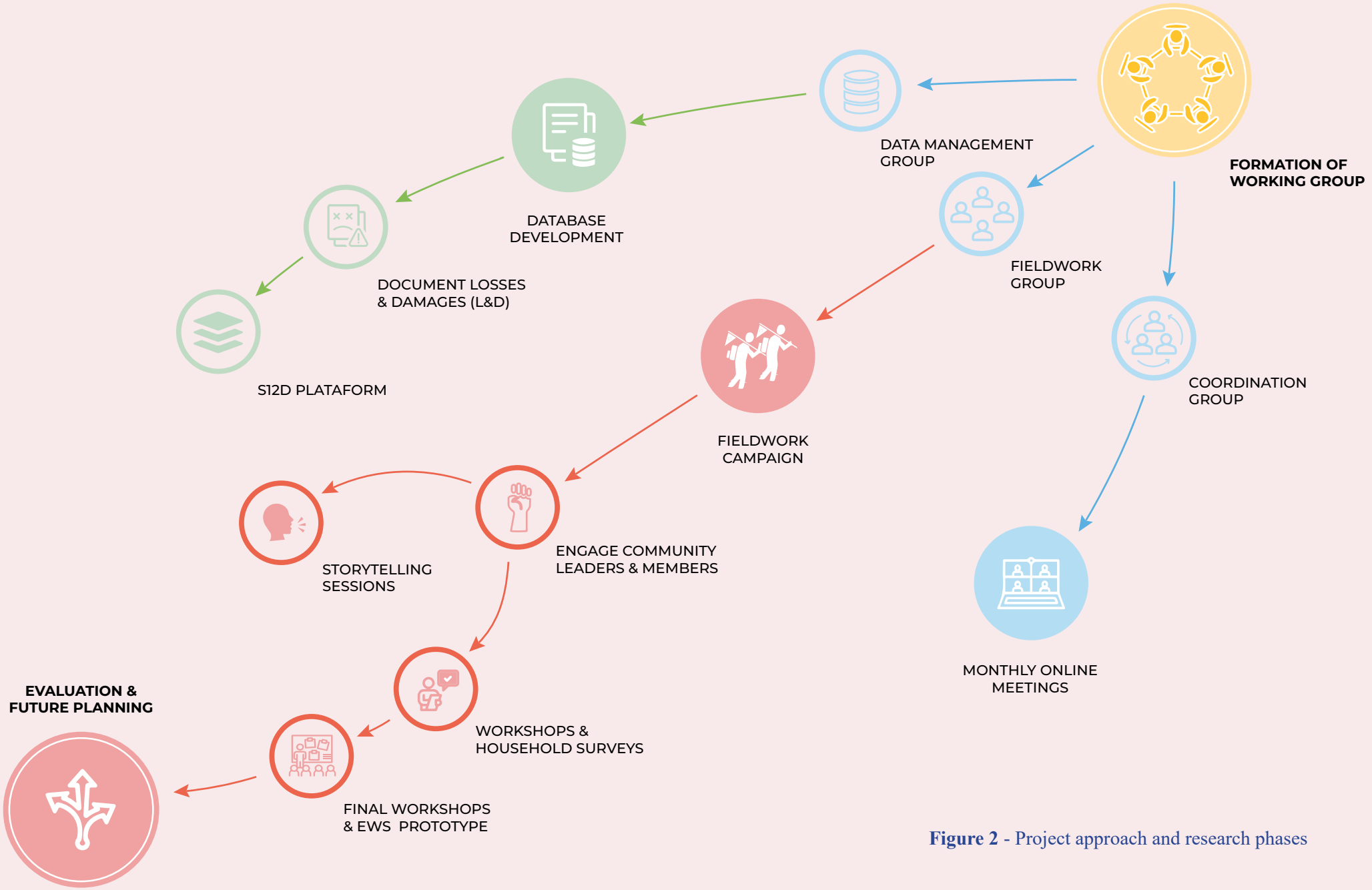


Figure 2 - Project approach and research phases

Rio de Janeiro and São Paulo. This step was conducted aiming to understand the TLCs needs and the disasters they face. Information on losses and damages was extracted from official reports and warnings issued by local governments across eight municipalities. The Integrated System of Disaster Information (sS2idD) platform[2] was used to aggregate and organise L&D data reported by local governments from 2006 to 2023. The S2iD is a product of the National Secretariat for Civil Defense and Protection - SEDEC in Portuguese.

Third, the fieldwork campaign was conducted. This phase spanned six months with the objective of engaging with community leaders and members. This phase aimed at gathering both qualitative and quantitative data through the implementation of storytelling sessions, workshops, and household surveys to capture the community's perceptions and experiences regarding recent extreme events and accessibility to EWS. The workshops were held at the municipal school in Quilombo do Campinho, each lasting two to three hours with 10 to 20 people, including students, teachers, leaders and community members. The focus group discussions were adapted to storytelling sessions, as oral traditions are of paramount importance in these communities. To select storytelling participants, a snowball sampling technique was employed and four traditional leaders of each territory were involved in one on one storytelling activities with a research team member. To understand if some groups are more likely to receive warning messages than others, we triangulated the demographic data with storytelling testimonies and workshop results.

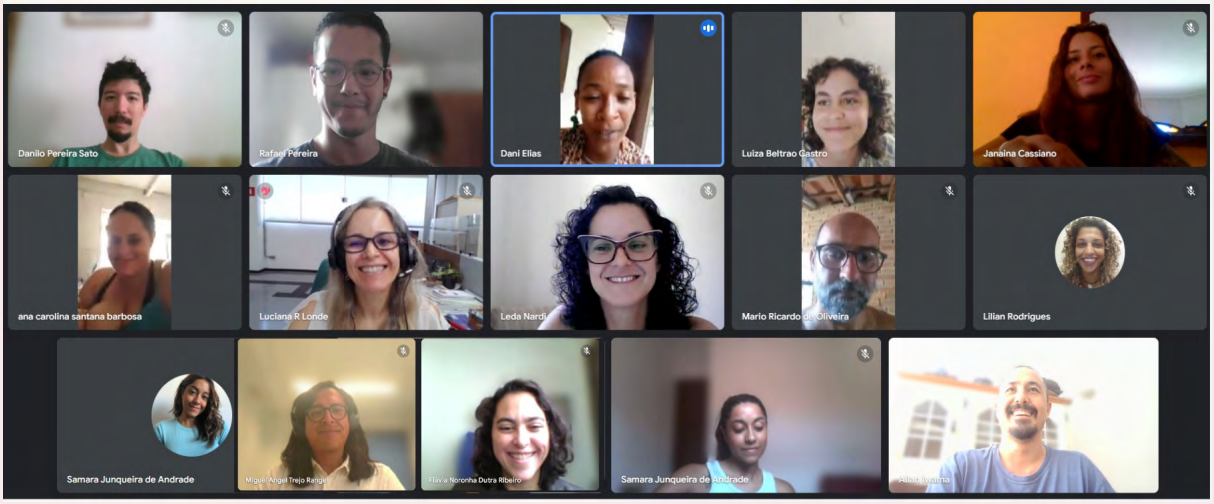


Figure 3 - Virtual meeting held in January 2024
Source: author's archive.

2 - S2iD is a platform developed by Brazil's National Secretariat for Civil Defense and Protection (SEDEC) with the objective of collecting, organising and disseminating data on disaster occurrences nationwide. It serves as a centralised database for local governments to report loss and damage (L&D) information, thereby facilitating disaster risk management, planning, and response. The platform is available online at <https://s2id.mi.gov.br/paginas/index.xhtml>

Storytelling in Quilombo do Campinho da Indepedência,
Paraty (Rio de Janeiro), Brazil.
July 2024.

KEY RESULTS

DEMOGRAPHIC PROFILES

Between 2010 and 2022, the Ubatumirim Territory experienced a significant population increase. In 2010, the population was 623, rising by around 108% to 1,300 residents in 2022 (IBGE, 2022). While the figures show an increase in both the size of the constructed area and the number of permanent residents, it is worth noting that there is also a considerable amount of uninhabited buildings, reflecting the expansion of second homes in the past decade. Specific data on the *quilombola* territory is unavailable for 2010, as the Brazilian government began surveying *quilombola* territories separately only in 2022, when the population of the area consisted of 610 residents.

The majority of population in *Quilombo do Campinho* are female (57.1%), while males represent 42.9%. By contrast, Ubatumirim has a higher proportion of male, representing 56.5% of the sample, compared to 39.1% female. It is worth noting that in Ubatumirim 4.4% identify as non-binary, a category not present in Campinho.

Variables	Campinho (n=28)	Ubatumirim (n=23)	Total (n=51)
Gender			
Female	57,10%	39,10%	49%
Male	42,90%	56,50%	49%
Non-binary	-	4,40%	2%
Race			
Black	71,40%	13,00%	45,10%
Brown	25,00%	13,00%	19,60%
Indigenous	-	4,30%	2,00%
White	3,60%	69,60%	33,30%
Disability			
	Campinho (n=6)	**Ubatumirim (n=6)**	**Total (n=12)**
Blindness or visual impairment	3,60%	8,70%	5,90%
Physical and mobility impairments	14,30%	17,40%	15,70%
Other	3,60%	-	2,00%

Table 1 - Summary statistics on demographic profile of the interviewees per territory

Source: Authors, 2024.

The racial composition differs significantly between the two territories (Table 1). In Q*uilombo do Campinho*, 71.4% of respondents are Black, 25% identify as Brown[3], and 3.6% as White, with no Indigenous respondents. In contrast, *Ubatumirim* has 69.6% White respondents, 13% Black, 13% Brown, and 4.3% Indigenous. When the total sample is considered, the breakdown of respondents consists of: 45.1% Black, 33.3% White, 19.6% Brown, and 2% Indigenous.

In adherence to ethical procedures, no individuals with disabilities or those under the age of 18 were interviewed. In each interview, the head of the household was requested to participate

3 - The term *"brown"* (a possible translation of "pardo" in Portuguese) is used to describe individuals of mixed ethnic and racial backgrounds. Formally introduced in the 1872 Brazilian census, it reflects the country's racial diversity, where a large portion of the population has multi-ethnic heritage. The classification is flexible and can vary regionally—someone identified as *pardo* in the south might be seen as white in the northeast (IBGE, 2013). Additionally, it's important to note that racial identification in research is often self-reported by the individuals interviewed.

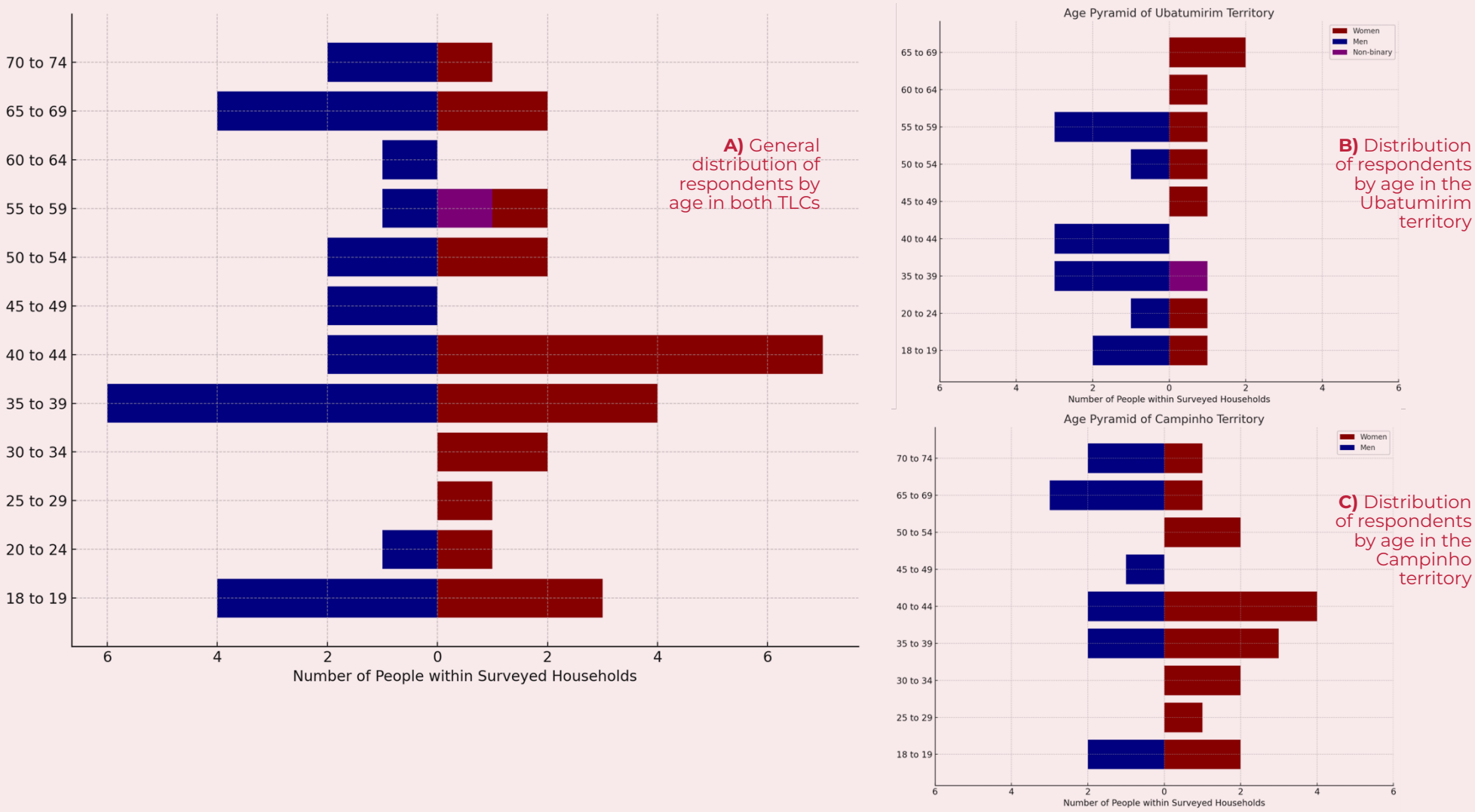


Figure 4 - Distribution of people within surveyed households by age range and gender (male/female/non-binary)

in the interview, responding on behalf of the entire family. In both territories, respondents reported living with at least one person with disabilities. In *Quilombo do Campinho*, 3.6% of people within surveyed households had a visual impairment or blindness, and the same percentage report living with a person with other disabilities. A larger proportion of respondents (14.3%) indicated that someone in the household has physical and/or mobility impairments. The prevalence of disabilities in Ubatumirim differs slightly from that observed in *Quilombo do Campinho*. Specifically, 8.7% of people within surveyed households in Ubatumirim have blindness or visual impairment, while 17.4% report physical and mobility impairments. Overall, across both territories, 5.9% of the total sample have blindness or visual impairment, 15.7% have physical and mobility impairments, and 2% reported living with a person with other disabilities.

The demographic profiles of *Quilombo do Campinho* and *Ubatumirim* exhibit discrepancies in gender distribution, racial composition, and the prevalence of disabilities among the population. In *Quilombo do Campinho*, there is a higher proportion of female and Black respondents, while in *Ubatumirim*, there is a higher proportion of male, White, and Indigenous respondents. The data on disabilities also reveals differences between the two territories, with physical and mobility impairments being the most commonly reported disabilities overall.

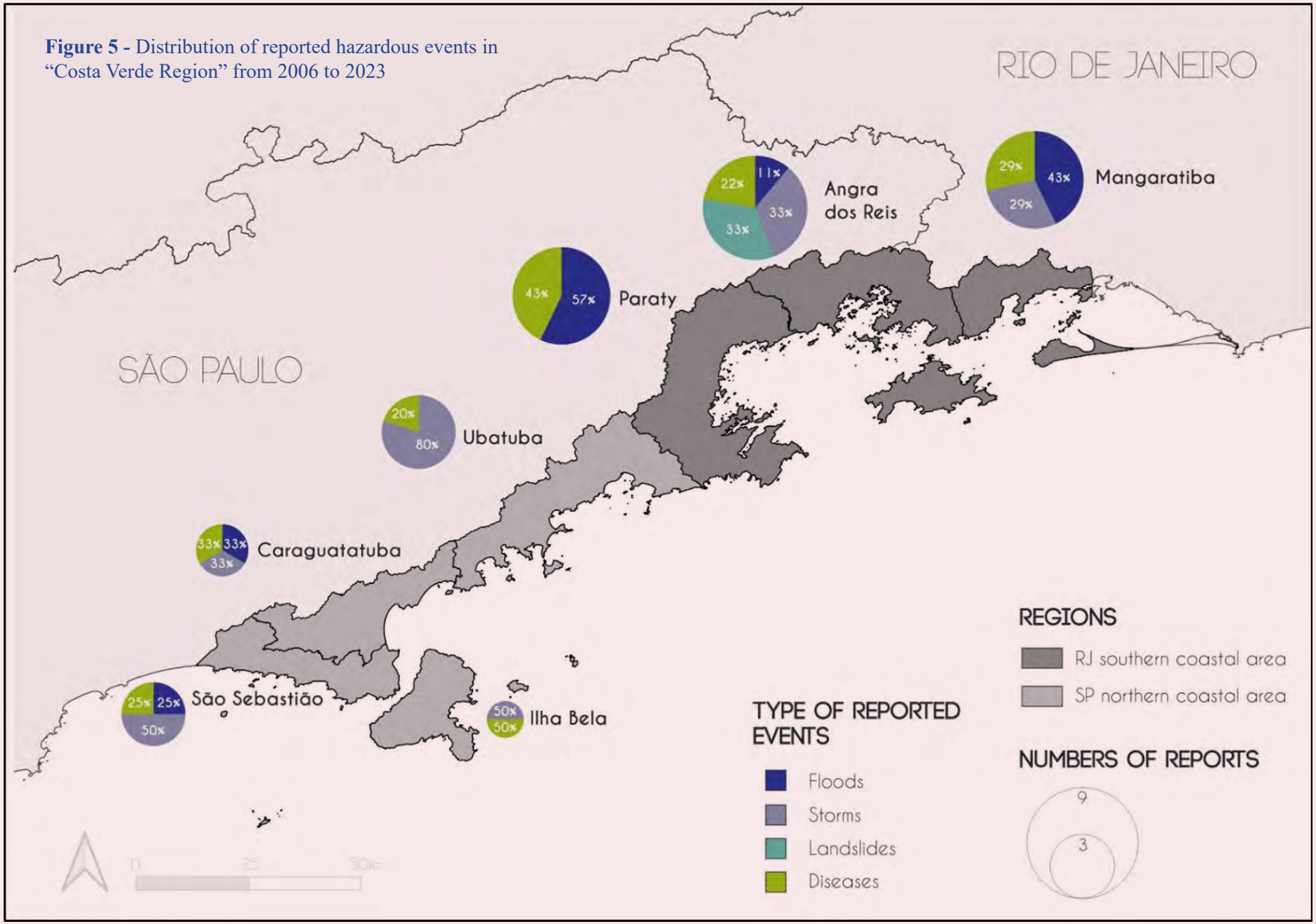
The age distribution in *Quilombo do Campinho* shows that the largest age group is 40 to 44 years old, representing 21.4% of respondents (Figure 4). The 35 to 39 and 65 to 69 age each account for 14.3% of the sample and 17.9% of respondents are aged 18 to 19, indicating a younger demographic presence. The older age group of 70 to 74 is also relatively well-represented, with 10.7% of respondents. In contrast, there is a gap in representation among the 20 to 24, 55 to 59, or 60 to 64 age groups.

In *Ubatumirim*, the age group with the highest representation is 35 to 39 years, comprising 21.7% of respondents. The 55 to 59 age group accounts for 17.4% of respondents, indicating a slightly older demographic compared to *Quilombo do Campinho*. The 18 to 19 and 40 to 44 age groups each account for 13.0% of the sample, demonstrating a balanced representation across different age ranges. In contrast to *Quilombo do Campinho*, *Ubatumirim* has respondents in the 20 to 24 and 60 to 64 age groups, representing 8.7% and 4.3% of the total sample, respectively. However, there are no respondents in the 25 to 29, 30 to 34, or 70 to 74 age groups, indicating a lack of representation in these age groups.

The age groups most represented across both territories are 35 to 39 years and 40 to 44 years, with each comprising 17.6% of the total respondents. It is also observed that the younger 18 to 19 age group is well represented, comprising 15.7% of the overall sample. However, certain age groups, such as 25 to 29 and 60 to 64, are underrepresented, with each group comprising only 2.0% of the total respondents. The older age group of 70 to 74 comprises 5.9% of the sample, with all respondents from this group living in *Quilombo do Campinho*.

The demographic profiles of *Quilombo do Campinho* and *Ubatumirim* are markedly different in terms of age distribution. *Quilombo do Campinho* has a stronger representation of middle-aged individuals, particularly in the 40 to 44 age group, while *Ubatumirim* shows a more balanced distribution across a broader range of age groups, with significant representation in the 35 to 39 and 55 to 59 categories.

Figure 5 - Distribution of reported hazardous events in "Costa Verde Region" from 2006 to 2023



Source: Organised by the author's based on data from the Integrated System of Disaster Information (S2iD) and Brazilian Institute of Geography and Statistics (IBGE).

DISASTERS IN THE COSTA VERDE REGION AS REPORTED BY OFFICIAL DATABASES

The spatial analysis reveals distinct patterns in the types and frequencies of these reports by municipality (Figure 5), unravelling the heterogeneity in the distribution of disaster impacts—especially the impacts of floods, storms, and pandemics—with landslides playing a major role in certain areas.

The analysis of the reports by state, from 2006 to 2023, shows that in São Paulo, storms, floods and pandemics were predominant. At the municipality level, in Ubatuba, storms were the most frequently registered hazard, accounting for 80% of all reported events and pandemics accounted for the remaining 20%. The hazards in Caraguatatuba were evenly distributed, with floods, storms and pandemics each contributing 33% of the total number of reports. In São Sebastião, the reported events were equally divided between pandemics and floods (25% each) and storms (50%). In Ilhabela, storms and pandemics each accounted for 50% of the reported events.

In the state of Rio de Janeiro, floods were the most frequent type of disaster, followed by storms, pandemics and landslides. In the municipality of Mangaratiba, floods are the most frequently reported disaster, accounting for 42% of all events. The remaining events were evenly split between storms and pandemics, each accounting for 28% of the reports. Angra dos Reis municipality had the most comprehensive distribution: landslides accounted for 33%, storms 33%, pandemics 22% and floods 11%. In Paraty municipality, floods were the dominant disaster, accounting for 57% of all reported events, while pandemics accounted for the remaining 43%.

A comprehensive historical analysis of the emergency situation and public calamity decrees revealed a significant number of disasters related to climate and weather extreme events (Table 2). For instance, a weather extreme event occurred on 9 January 2009 in Paraty, characterised by intense precipitation, with 300mm of rainfall leading to severe flash floods and landslides. The floods and landslides affected approximately 50,000 people, with 1,150 displaced individuals and economic losses amounting to 20 million BRL.

The meteorological event between 22 and 23 February 2018 in Ubatuba was characterised by heavy rainfall, which caused extensive damage across multiple neighbourhoods. The disaster resulted in the death of one person, injuries to two others, and the displacement of several families. In addition to the human losses, the event caused significant material damage to homes and infrastructure and even disrupted the drinking water supply.

As a result of the global coronavirus pandemic (SARS-CoV-2) in 2020, Brazilian authorities recognised the public calamity and included both Ubatuba and Paraty municipalities - as well as the majority of the cities in the country. In response to the situation, all non-essential activities were suspended, effectively placing both municipalities under lockdown to contain the spread of the virus.

From 1 to 3 January 2021, Ubatuba was affected by another intense precipitation event, which resulted in extensive damage across the city. The heavy precipitation resulted in the isolation of residential areas, flash flooding and landslides, and the displacement of 112 individuals. Furthermore, the event required the removal of several families from their homes.

Between 31 March and 3 April 2022 in Ubatuba, another extreme weather event was characterised by significant rainfall that resulted in landslides, the blockage of transportation routes, extensive

Date	Municipality	Hazard	Considerations	Reported Disaster Impacts
February 18-19, 2023	Ubatuba	Intense precipitation	Decree 67.502/2023: Declaration of a state of public calamity for 180 days in the affected municipalities.	Public calamity was declared for multiple municipalities including Ubatuba, due to flooding and severe rainfall impacts.
March 31 - April 3, 2022	Ubatuba	Intense precipitation	Decree 7859/2022: Declaration of Emergency Situation due to heavy rainfall resulting in significant material and environmental damage.	Landslides; obstruction of highways; severe damage to roads; assistance provided to affected families.
January 1-3, 2021	Ubatuba	Intense precipitation	Decree 7519/2021: Declaration of Emergency Situation due to heavy rains causing widespread damage across multiple neighbourhoods.	112 people displaced; neighbourhood isolation; flooding; flash floods; landslides; removal of families.
March 16, 2020	Paraty	COVID-19	Decree 46.984/2020 and 47.428: Recognized public calamity due to the COVID-19 pandemic affecting the entire state.	Suspension of all non-essential activities (lockdown).
March 16, 2020	Ubatuba	COVID-19	Decree 64.879/2020: Recognized public calamity due to the COVID-19 pandemic affecting the entire state.	Suspension of all non-essential activities (lockdown).
February 22-23, 2018	Ubatuba	Intense precipitation	Decree 6829/2018: Declaration of Emergency Situation due to heavy rainfall causing significant damage across multiple neighbourhoods.	Death of a resident; two injured residents; displacement of families; material damage to homes and infrastructure; interruption of drinking water supply; non-specified amount of economic losses.
January 9, 2009	Paraty	Intense precipitation	Decree 41.675/2009: Declaration of Emergency Situation due to 300mm of rainfall causing flash floods.	Floods and Landslides; 50.000 people affected; 1.150 people displaced; 20 million BRL in economic losses.

Table 2 - Main hazardous events reported by the government at the Ubatuba and Paraty municipalities from 2006 to 2023.
Source: organised by the author's based on data retrieved from the Integrated System of Disaster Information.

damage to infrastructure, and the need for assistance for local communities. The last event reported consisted of an intense precipitation event that affected the population of Ubatuba on 18-19 February 2023 and resulted in floods, obstruction of main roads and significant impacts across multiple neighbourhoods.

DISASTERS REPORTED BY PERCEPTION DATA

The perceptions of the most frequent disasters and their impacts according to the community memory are listed in Table 3. Both communities reported several impacts, mostly associated with hydrometeorological hazards. Among the events mentioned, three stood out: the heavy rains in 2022, the pandemic in 2020 and the droughts in 2015. These are the strongest memories documented. In Ubatumirim, during the flooding in April 2022, children could not access the school for a month, a resident lost his entire house, and numerous families lost all their furniture. During one of the workshops, a distinguished community member said that heavy precipitation events happen every seven years. However, the magnitude of the recent event, in which the river rose by over five metres, was unprecedented. The community members explained that this flooding was particularly alarming due to the extensive damage caused to individuals living near the river and that the interval between one heavy rain and another has been reduced.

In addition to hydrological events, it was reported in both communities that people have been experiencing increased heat levels in recent years. The leaders also reported that deforestation increased and the materials used to construct modern houses are contributing to the heat related discomfort.

The 2014-2015 drought is also broadly remembered by the community members of Campinho. The water levels of the Carapitanga River were significantly lower at that time, leading to conflicts for water resource use. Meetings were convened to address the issue and set up timetables for closing and reopening water supplies. The crops of two community members were severely affected by the water scarcity combined with the drought. The negative consequences of the lack of water were many and varied, such as the increase in illnesses. An extended period without water provision resulted in the exploitation of new sources of supply, namely Cachoeira Carneiros and Cachoeira de Cima. The problem of water scarcity also generated positive effects in the community, as a collective action to identify conflicts and seek joint solutions (Albagli and Iwama, 2022). Based on the collaborative map in the Carapitanga river with the Water Workshop (Oficinas das Águas, in Portuguese), several threats have been mapped for the watershed, an initiative of the Observatory of Sustainable and Healthy Territories (OTSS in Portuguese) and the Traditional Communities Forum of Angra dos Reis, Paraty and Ubatuba.

Year	Perceived impacts
2024	Flooding - “streets turned into rivers”. Bridge destroyed and neighbourhoods isolated
2023	Heat waves - “even the nights offered no relief”.
2022	Flooding - dermatological conditions, viral infections, carbuncles, absenteeism, emotional distress, discouragement, traumatic experiences, occupational challenges, loss of livelihood.
2022	Landslides - a section of the Rio-Santos road has collapsed.
2021	Storm - Electricity poles and lines fell, killing one person.
2020 / 2021	Pandemics - lockdown and the subsequent period of introspection have resulted in a renewed obligation for many individuals to end their careers; many worked in formal and informal sectors during the lockdown.
2014/2015	Water Scarcity - It has been reported by a “sensation of death” associated with long periods without drinking water.
2009	Landslide - road was blocked and numerous houses situated in close proximity to the river were affected.

Table 3 - Perceived impacts attributed to climate-related disasters by residents of traditional coastal territories

BARRIERS FOR THE DISSEMINATION AND COMMUNICATION OF EARLY WARNINGS

Following an analysis of the issues raised by the interviewed group, we identified three main barriers to the dissemination and communication of warnings.

I) Information about potentially hazardous events is often delayed, with updates reaching the public only after the event occurred.

II) The communication networks in the territory depend on technologies that often fail during emergencies, making them unreliable.

III) There is a lack of clear differentiation between official warnings and misinformation, causing confusion and mistrust in early warning messages.

The storytelling interviews carried out at the *Ubatumirim* territory revealed a lack of risk communication inside the community. One of the interviewees pointed to a systemic issue, where information only circulates after a tragedy has already happened. He observes:

> “I think there isn’t [risk communication]. Information only arrives after the event has already happened and many people have died. Now, someone is saying: ‘Look, there’s heavy rain coming, today there’s heavy rain in such and such region,’ ‘subject to flooding’ [...] It’s only when it happens, this is cultural. They wait for it to happen to then do something, and most of the time they don’t even do that.”

His frustration grows as he reflects on the absence of preventive measures, highlighting that the authorities fail to alert the community about the hazard

"There isn't. There's no communication medium from the city hall or Civil Defense that studies the soil, that really alerts the community: 'Look, this can happen in this region, it's going to rain heavily, be alert;' 'a debris flow is coming down the mountain, it's going to carry everything here.' Anyway, none of that exists!"

As this member reflects on the challenges of spreading warnings, he shares deep concern about the helplessness felt during such moments. He emphasises the overwhelming sense of isolation, saying, "You can't warn other people, you can't! You can't go around warning other people." This highlights the understanding that when individuals already know about the potential risks, during a hazardous event it is dangerous to put oneself at risk trying to communicate with others.

"No one is prepared for this. No one is prepared. And no one cares, I mean, related to public agencies, public sectors, they don't prepare, they don't campaign, you don't see absolutely anything."

This statement highlights the absence of proactive measures and public awareness campaigns by the authorities. Another local leader expands on the fear and anxiety that grips the community during disasters. He shares his concern for the most vulnerable populations, pointing out,

"And then, when you hear 'ah, there's going to be a disaster,' we worry more about people who are more vulnerable, right, especially regarding floods and also in the hinterland, the issue of isolation."

He highlights the technical challenges exacerbating the community's vulnerability. He explains the difficulties in contacting essential services, especially when electric power and communication networks fail:

"For example: the electric power fell down. How do you call the company when there's no signal, just cell phones [there is only the device with no signal}? Today, I have a SIM card that gets a signal from the tower in the community, but it started only about two months ago. I only got the signal from Prumirim here because it was 3G and all. There was no signal. I had to ask someone to call the company: 'oh, the power's out at my house, can you call them?' Or use Wi-Fi, because you can't use it via 3G, right. Wi-Fi... when the Wi-Fi is out, everything is out, life is out, oxygen is out"

This testimony highlights the critical dependence on technology and its consequences when it fails. Another voice from the community shares the concerns about the reliability of the warnings, particularly those from the Civil Defense. She expresses her doubts, stating,

"Sometimes an alert from Civil Defense arrives, right, and I sometimes have doubts if it's really true. Because sometimes people start circulating things on the internet and you stay in a state of alert, right, because whether you like it or not, you get scared when it says 'Civil Defense Alert,' you know?

But sometimes it doesn't have a symbol, doesn't have a logo, doesn't have... anyone can pick up a cell phone nowadays and make, like, a card and send it on the internet to scare people, you know? I find this very worrying."

She continues by discussing the complications that arise when communication networks are down, which can leave the community completely isolated:

"Look... thinking about it, how do we do it, because there are times when, when it starts to rain, you lose power, you lose the internet, you lose cell service and you don't have WhatsApp, which is the channel to send out information, so it gets complicated, very complicated."

Finally, another community member adds to the narrative by describing a specific incident when her community was cut off from the outside world. She illustrates the severity of the situation by saying,

"And so, when these heavy rains come, we lose power, we lose the internet, then we're left without communication with anyone, right. The last time was like that, we were without power for several days, we couldn't cross [the river]... on the day of the bridge incident, we were without electric power, without internet, people couldn't cross over."

It has been identified that there are expressive accessibility issues about the dissemination of warnings during emergencies, particularly in situations where technology is relied upon. In such instances, technology often proves to be unreliable. When communication networks fail, entire sections of the population are deprived of essential information, which subsequently limits their ability to respond effectively. The lack of timely information and confusion between official warnings and misinformation indicate that the system is not inclusive. This can cause a particularly adverse effect on individuals who have limited access to technology, such as the elderly and people with disabilities.

Finally, the ability to take action is limited. The combination of delayed information, unreliable technology and a lack of trust in warnings makes it increasingly difficult to create effective, actionable warnings. When warnings are not issued promptly or cannot be distinguished from misinformation, individuals may be hesitant about when and how to act, which could result in delayed or inefficient responses by the communities.

INSIGHTS ON PRIORITY GROUPS FOR ENHANCING ACCESSIBILITY, INCLUSIVITY AND ACTIONABILITY OF EWS

The triangulated data gathered from IBGE (2022) and head of household interviews provides valuable insights into the experiences of key social groups within the TLCs, for instance, school-age children and youth, individuals with disabilities, older adults, and geographically isolated households. Additionally, it sheds light on the important roles that women fulfil in their communities, in terms of productive labour, reproductive labour and leadership.

School-age young people from 18 to 19 represent 19.7% of household members in both

territories. Analysing the presence of young people and children in this group using data from the 2022 quilombola census (IBGE, 2022), it is possible to see that this is the largest group in the quilombo territory. Almost 4 out of 10 residents are in this age group with the under-19 age group representing around 37.5 % of the territory's total population (Figure 4). Enhancing accessibility for the different age groups within this age range requires distinct strategies. Younger children may need help understanding the severity of warnings and acting appropriately without supervision. In response, it is necessary to use simple and visual language, through pictures or interactive activities that can be developed in the community school. Ensuring that parents are also well informed is crucial, as they are the ones who will ultimately guide children's actions in emergencies. On the other hand, older young individuals displayed a high level of capability in disseminating information within the territory. During the workshops, the community members expressed interest in engaging the young students in reactivating a project developed a few years ago to connect the community's households through a community-based radio located close to the school. Testing the dissemination of information within the community would be beneficial, and the partnership with the school made it possible to realise that these groups have a lot of potential to contribute practically to enhance local EWS.

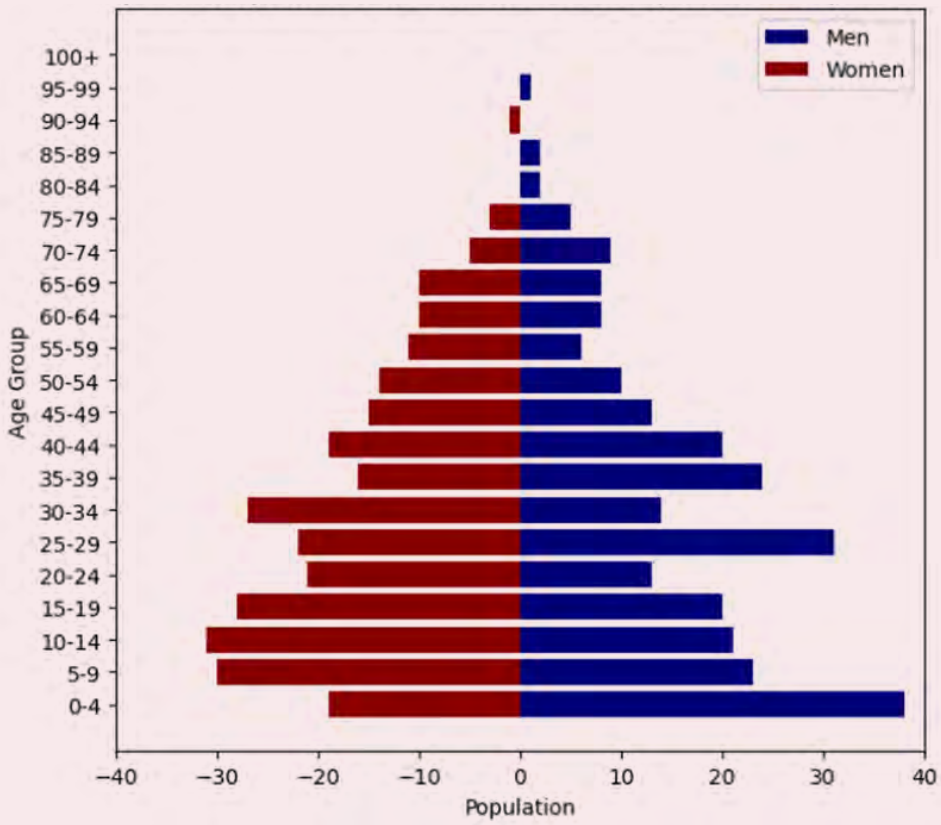


Figure 6 - Population Pyramid of the Quilombo do Campinho Territory at 2022

Source: IBGE, 2022.

In the context of emergency preparedness, it was repeatedly highlighted that people with disabilities would likely face significant challenges in protecting themselves during an emergency situation. The workshop participants identified households in which family members with physical disabilities or reduced mobility face considerable obstacles in dealing with disasters.

The current infrastructure does not facilitate the free movement of these individuals across the territory. In the event of damage to these access routes, as has occurred previously with roads and bridges, the risk of isolation will be increased. Despite the existence of inclusive social media tools that typically reach the general population of the two territories, it is unclear whether this group, along with people with disabilities, can be effectively included through the use of these tools. It is possible that additional support may be required to ensure adequate response to alerts. It is therefore essential to engage these groups and family members in future capacity-building activities.

The results indicate that the intersection of age and geographic isolation presents significant challenges in designing effective communication strategies that encompass the entire community. The demographic analysis highlights a notable presence of older adults in both regions.

In Campinho, this population is relatively evenly distributed, whereas in Ubatumirim, they are more geographically isolated from essential services such as healthcare, security, and education, which could serve as shelters in emergencies. This isolation complicates evacuation from disaster-prone areas and poses challenges to using inclusive technologies, as mobile phone coverage is lacking in many locations. These issues significantly reduce the actionability of warnings for older people. Messages must be coupled with localised response mechanisms, pre-arranged transportation to shelters, and communication methods that do not rely on mobile phone coverage.

In both communities, the local leaders responsible for articulating with experts and other stakeholders are women. These women take the lead in community engagement on various policy agendas, playing community roles as well as productive and reproductive roles. This includes caring for the elderly, people with disabilities and children. It is still uncertain to what extent these responsibilities are shared with male family members, but it is noticeable that women currently carry out these leadership and caring roles. By conducting a gender analysis combining the educational levels of the respondents, it was possible to observe that for both men and women, a significant proportion of people completed upper secondary education. However, there is a gap at the tertiary education level.

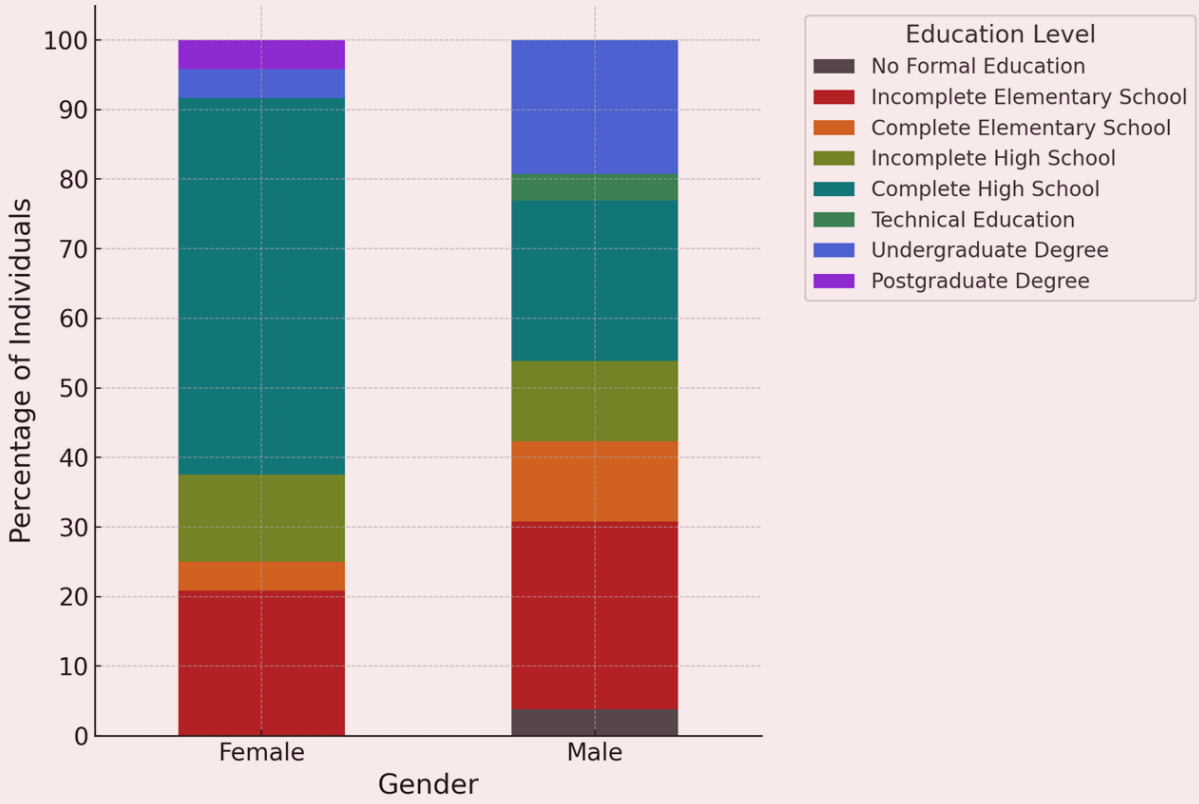


Figure 7 - Distribution of education levels by gender

Source: IBGE, 2022.

The data showed that men are more likely than women to be enrolled in technical education and undergraduate studies. The proportion of people with a postgraduate degree is relatively low among all respondents, with a slightly higher proportion for men. A large group of people have not completed primary education or have no formal education at all. This suggests that part of the population, particularly women, face barriers to further education. The chart highlights educational disparities, particularly at the lower levels of education, where a larger proportion of women have incomplete education. This suggests that women may face greater challenges in accessing or completing their education, particularly at the basic level. The overall trend shows that while both genders have individuals at all levels of education, men are more represented in higher education, while women are more represented in the lower or incomplete education categories.

Storytelling session with Ana Rosa, president of the ABU
(Association of Banana Cultivators of Ubatumirim)
Ubatuba (São Paulo), Brazil
June 2024

Technical fieldwork at the caiçara (artisanal fishing) community herbarium.
Ubatumirim, Ubatuba (São Paulo), Brazil
May 2024.

DISCUSSION

Our findings demonstrate that the communities involved in the study have limited access to warnings and have been affected by severe and recurrent climate-related disasters. The intersectional view of the communities revealed that addressing structural inequalities is crucial to ensure effective EWS. In this section, we discuss the proposed four-step prototype, which was developed to foster inclusive risk communication strategies based on the intersectional view of the communities and the disaster impacts identified.

First, for an inclusive and community-based EWS, we recommend **mapping priority groups**. Our findings illustrate that the identification of identitarian markers enhances the comprehension of accessibility. Previous studies by Morganstein (2024) and Jean et al. (2023) demonstrate that failure to address the inequalities related to identities increases the range of impacts people could suffer from future hazards. By integrating intersectionality with demographic profiling, we were able to discern the nuanced experiences of individuals within communities that could have been overlooked by the existing national EWS. By mapping the territories and their sociodemographic characteristics, we observed that individuals could lack warnings due to the spatial distribution of resources in the territories. This problem is exacerbated by pre-existing social inequalities, such as school-age children and youth, individuals with disabilities, older

adults, and geographically isolated households. This is in line with the growing body of evidence indicating that marginalised groups are particularly vulnerable during and after disasters (Pongponrat & Ishii, 2018; Jean et al., 2023; Mendis et al., 2023; Seglah & Blanchard, 2024). In this sense, this first step consists of carrying out meetings and gatherings to encourage plural participation of all community members and active listening that allows for horizontal dialogue to adjust demands and expectations. Data from demographic profiles and risk mapping could be integrated to define who participates and, based on diverse cultural perspectives, identify and locate households that would struggle the most to protect themselves. As an iterative process, stakeholders involved in the mapping can update their database to chase the transformations on the risk landscape and the demographic changes in the community profile as well.

Second, after studying identitarian markers through demographics, it is critical to understand the values, trust, and beliefs, as well as media consumption patterns that influence which sources are regarded as trustworthy. This phase focuses on **identifying the communication needs of vulnerable groups**. In the case studies given, it intends to connect school-age children and teens, people with disabilities, older citizens, and geographically isolated households—groups that may face higher barriers to receiving early warning messages—along with all other community members. For this method to be effective, warnings must be presented in various accessible media, including auditory, visual, and written (Yore et al. 2023). In addition, the IFRC (2012) recommends investigating redundancy "as the more it is heard, the more likely a credible message will be believed and acted upon". However, one of the most significant barriers identified was the spread of misinformation, which causes confusion and mistrust in early warning messages. Fakhruddinrisk et al. (2020) demonstrated that the problem of misinformation and disinformation is part of a larger picture involving internet governance, education systems, and political decisions that could eliminate sharing such content rather than perpetuating it. In the short term, fact-checking efforts could be a viable alternative to addressing it locally. More than understanding the sources perceived as most trustworthy by community members, it is critical to properly include local organisations in the warning chain to ensure credibility and incentivise individuals to actively disseminate misinformation. However, effective risk communication necessitates the development of trust, which takes time. According to Fakhruddinrisk et al. (2020) and Stewart (2024), holding open and public dialogues involving scientists, government, local authorities, and communities to discuss responsibilities, uncertainty, trade-offs, and difficult decisions strengthens these bonds over time.

Third, **designate messengers** to communicate with territory residents and authorities during emergencies. One of our study's findings is that information about potentially hazardous events is frequently delayed, with updates reaching the public after the event has occurred. To overcome this barrier, public policies should encourage strengthening local committees in which TLCs can influence decision-making regarding official risk communication strategies (Londe et al., 2023). Capacity building and transdisciplinary approaches could improve coordination between local communities and experts (Albagli & Iwama 2022; Pereira et al. 2023), but community proximity to experts and authorities does not guarantee inclusive warning dissemination. Our findings are also consistent with the literature on participatory approaches, which states that communities are diverse and that people may have unequal capacity to express their concerns because different social actors have varying access to participatory processes (Few et al. 2007; Turnhout et al. 2020). This phase entails identifying stakeholders among local authorities, while the community must appoint speakers for internal and external communication. Furthermore, it is necessary to define individuals who will notify civil defence in an emergency and identify

backups for these roles, as well as to clearly assign roles and responsibilities while considering the institutional and community dimensions of the communication process (Victor, 2021). Residents who live within the territory, nearby, or have easy access should be responsible for contacting and assisting isolated households, as well as transporting them to temporary shelters. On a larger scale, however, sharing control over the information flow and ensuring that communities have representatives included in the national structure of EWS could greatly improve the coverage and guarantee delivering information and returning feedback to improve the system. Locally, the actions will be more likely to succeed if the representatives are aware of the diversity of needs, worldviews, and ways of knowing among communities (Best et al., 2022). If communities regularly participate in capacity building activities and messengers can reach the various groups within the territories, they will function more effectively (Wells et al., 2021).

Finally, the fourth step is to **perform simulations based on risk scenarios**. During this phase, local authorities are invited to conduct simulations on various risk scenarios. Our findings demonstrate that multiple hazards are relevant when developing future scenarios. The analysis of disasters reported in the Serra da Bocaina Coastal Region from 2006 to 2023 revealed that floods were the most common disaster in both municipalities where the TLCS are located. In Paraty, floods accounted for 57% of all reported incidents, while in Ubatuba they made up 80%. The most memorable events for the communities in question occurred between 2009 and 2024. The dataset covers a broader range of climate-related hazards, such as flooding, heat waves, landslides, storms, water scarcity, and significant pandemic impacts. Participants can practice the entire response cycle from warning to evacuation by selecting relevant scenarios, planning them in detail, and assigning roles. Following the simulation, feedback should be gathered to determine the effectiveness of the response. The community then uses this feedback to refine and improve their disaster plan, ensuring they are prepared for emergencies. These simulations are critical for saving lives and increasing overall preparedness.

In our approach, improving the current national EWS relies on identifying social inequalities as a barrier to accessible, inclusive, and actionable warnings. Efforts for universal inclusion may seem unattainable if conflicts and diverse intersectional realities are not acknowledged. By proposing an iterative process around risk communication and actively uncovering the needs and capabilities of local communities, we aim to facilitate the collective responses to disasters from a community management perspective, understanding that it is a small step that must be continuously improved over time.

Graphical illustration of early warming system community-based made by student in Quilombo do Campinho da Independência, Paraty (Rio de Janeiro), Brazil. May 2024.

LIMITATIONS AND OPEN QUESTIONS

The current study is limited as it is still uncertain how warning messages will reach different groups in the target population of TLCs. The next phase of this study will test the effectiveness of different sources in each territory and among different social groups, as well as assess individual decisions made in response to emergencies. It is crucial to gain insight into the awareness levels and understanding of protective cultural-behaviours, warning instructions, and the trust placed in them within Traditional and Local Communities. Furthermore, it is essential to understand their preferences for future warnings. The analysis of these factors will assist in the assessment of the EWS performance and the integration of feedback into the prototype. Another area that requires further investigation is the discrepancy between perceived disaster impacts and official reports on losses and damages, despite a similarity across communities. The primary impacts of these events include severe health issues, such as skin rashes, viral infections, emotional distress, occupational disruptions, livelihood loss, infrastructure damage, and fatalities. Further research could suggest that combining historical official records with memory documentation may improve the accuracy of reported disaster impacts and serve as a starting point for an impact-based EWS. Both communities have been affected by several disaster impacts during the last 20 years, but they are clearly under-notified in official reports. While coping with severe climate

events is part of their history, documenting these memories has only recently begun. In Brazil, the executive power can decide to decree a state of emergency or a state of public calamity. These decrees allow for the extraordinary allocation of resources to respond to disasters and major crises, and their terminology is based on the Brazilian Classification and Codification of Disasters (COBRADE, in Portuguese), which standardised the disaster typologies in the country. However, despite its widespread use as an official reference, the COBRADE system has encountered criticism and difficulties in standardising terminology and accurately structuring reports. Variations in how data is presented and classified at different government levels or agencies can lead to inaccuracies, highlighting the importance of standardisation. Significant variations exist in the level of detail concerning losses and damages across reports. Effective long-term risk management includes mapping affected areas, evaluating losses and damages, and importantly, identifying affected individuals while justifying immediate response actions. Accurately assessing impacts is necessary for disaster recovery actions, adaptation planning, and the development of impact-based EWS. Simultaneously, pinpointing the most impacted social groups can help evaluate their past responses to hazards and enhance their resilience to prevent similar outcomes.

Inaugural meeting to discuss the project's implementation, which began during the SARS-CoV-2 pandemic. This working paper presents the results of a GDPC-funded project that represents an expansion of this earlier initiative.
Quilombo do Campinho da Independência, Paraty (Rio de Janeiro), Brazil
August 2021.

KEY RECOMMENDATIONS

To improve long-term risk management, implementing a transdisciplinary strategy of impact assessment is crucial. To guarantee that an integral compensation of losses and damages for people directly and indirectly impacted by disasters will be provided, accurate impact information is needed for developing efficient DRM strategies and establishing impact-based EWS (de Brito et al., 2024). To this end, official reports and local knowledge can be combined to improve the accuracy of disaster impact reports. This should consider data from official databases and local-scale observations made together with directly affected communities. Impact reports should identify those affected, classify losses and damages, and structure reports accurately, to make them widely available.

To overcome the main barriers to the dissemination and communication of warnings identified, it is necessary to develop a robust strategy for distinguishing official warnings from misinformation. This can be achieved by implementing source-differentiated warnings and sending coordinated messages that will be multiplied by local community members. Warning messages must carry visible authority logos and local organisations should verify the source of warnings to confirm their credibility and actively

discredit misinformation. Testing effective communication sources in each territory and among different social groups is also essential. This requires assessing the individual decisions made to respond during emergencies.

It is also important to recognise the significant presence and impact of women, who not only form the majority of community leaders but are also at the forefront of community engagement and caregiving. From a gender perspective, it is clear that during emergencies, it is necessary to mobilise families with children, people with disabilities and elderly family members first. This strategy often results in more care work for women. Hence, a deeper understanding of women's various roles – productive labour, reproductive labour, and leadership – is vital to ensure that the responsibilities placed upon them do not become disproportionate or unfair.

To advance the actionability of warnings, future interventions should explore the redundancy in communication targeted to the identified priority groups, design, test and evaluate evacuation protocols from houses to shelters, specifically involving these groups and additionally, formulate customised response plans and emergency kits.

Technical fieldwork in Civil Defense in municipality of Paraty, Rio de Janeiro, Brazil. June 2024.

CONCLUSION

This research contributed to narrowing the knowledge gap about People-Centred Early Warning Systems tackling the structural inequalities among last mile communities. The results are used as a baseline for translating disaster preparedness research into practice, with a specific focus on addressing the communication barriers in Traditional Local Communities (TLCs). The 4-step risk communication prototype developed through this research—mapping priority groups, identifying communication needs, designating messengers, and conducting scenario-based simulations—addresses the major challenges faced by these vulnerable populations while more structural changes don't come through. Such an approach reflects a growing consensus in disaster risk management that communities most at risk must be actively involved in developing strategies to protect themselves and ensuring that marginalised groups are not overlooked in disaster preparedness. The case studies allowed us to understand that enhancing PCEWS requires an integrated approach that combines official data with local knowledge, addresses misinformation, and empowers vulnerable groups, particularly women, who play a pivotal role in caregiving and community leadership at the TLCs involved in the study. By prioritising accurate impact assessments, distinguishing credible warnings, and designing inclusive, community-driven response strategies, we can better prepare communities and reduce vulnerability. Therefore, the next phase of this research is to apply and test the developed prototype, assessing how the local community will respond to the warnings and providing training for emergency drills based on risk scenarios and its transferability to other resilience-building activities targeting last mile communities.

Storytelling in 'Rancho Caiçara' [Artisanal fishing house], Perequê-Açu, Ubatuba (São Paulo), Brazil. April 2024.

ETHICAL APPROVAL

Ethical approval was obtained from the Social Research Ethics Committee of University College Cork (log 2023-156).

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Technical fieldwork at the Civil Defense of Ubatuba municipality (São Paulo), Brazil.
In the image: Civil Protection and Defense of Ubatuba, member from the Network for Education in Disaster Risk Reduction (Rede ERRD-LN, in Portuguese) and supervision team from the University of São Paulo and the National Centre for Monitoring and Early Warning of Natural Disasters (CEMADEN).


MARIA FARINHA
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Storytelling with ‘Juninho’ [Jorge Inocêncio Alves Junior],
caiçara [artisanal fishing] of Ubatumirim,
Ubatuba (São Paulo), Brazil.
June 2024.

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Compromissos Futuros

Diálogo
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Companheirismo
Respeitar um ao outro
Valores
Democracia
Ajudar um ao outro
Trabalhar em conjunto
Equidade – Inclusão

Encontro 2: Entre 22 e 26 de abril (3ª feira)

Encontro 3: 24 ou 25 de junho

Word cloud of future commitments for implementing community-based EWS, Quilombo do Campinho da Independência, Paraty (Rio de Janeiro), Brazil May, 2024.