

Strengthening Disaster Adaptability Through Social Infrastructure:

A Study in Punta Hermosa

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I. Abstract

In the past few decades, the growing frequency and severity of natural disasters have been aggravated by the effects of climate change. The district of Punta Hermosa represents a vulnerable community in this context, particularly due to its susceptibility to landslides, emphasizing the necessity of developing strategies aimed at strengthening community resilience. This study explores how social infrastructure, such as public gathering spaces, contributes to the adaptive capacity of residents after natural disasters. Through a sequential design, a 64-participant survey was conducted to assess community disaster experiences and preferences on public socialization spaces. Data was gathered from five local neighborhoods affected by landslides and was distributed via social media such as WhatsApp and Facebook. The main results indicated strong support networks within the community, where all respondents reported being actively involved in actions and initiatives to aid members of their community after the landslides. The survey results were framed within a broader context through a literature review, examining theories and evidence about the role of social infrastructure in creating support networks and enhancing community resilience. The review also emphasized disaster management steps to contextualize the community's actions. The study revealed that the actions carried out by the community align with the response phase of general emergency management plans (National Governors Association, 1979) and that community networks can facilitate an immediate and more efficient response to landslides by allowing a rapid evaluation of the situation and the effective distribution of resources. These findings determined the impact of social networks and social infrastructure on enhancing resilience, guiding recommendations for designing social infrastructure with a focus on facilitating interactions and fostering social networks in Punta Hermosa.

II. Keywords

Landslides; social infrastructure; social networks; social capital; climate change adaptation; emergency management; disaster management; disaster response; disaster recovery; climate change adaptation; collective efficacy.

III. Introduction

The built environment plays an important role in strengthening communities and improving their capacity to adapt to environmental challenges (Eicher & Kawachi, 2011). Existing research suggests that building social infrastructure, commonly referred to as public spaces, where neighbors can create trust and support networks with each other, can increase community resilience and adaptive capacity to climate disasters (Adger, 2003). These places encourage social connections and enhance the ability to carry out organized effective actions in the future (Klinenberg, 2018). Nonetheless, the access people have to quality public spaces is often unequal, leading many individuals to reside in neighborhoods that lack stimulating environments for social interaction. Ultimately, this situation lowers their possibility to create bonds with their communities, thereby reducing their potential for achieving collective efficacy and fostering a cooperative response to adapt to climate change hazards (Furlan, 2015). Collective efficacy is defined as the shared belief of a group in its capability to organize and carry out actions to achieve a goal (Bandura, 1997). This concept is significant as the confidence of a group in their collective capabilities enhances the likelihood of successful execution (ibid.).

There are certain neighborhood factors that influence people achieving higher levels of collective efficacy (Cohen, Inagami & Finch, 2008). Social infrastructure is defined as the physical spaces that serve as the structural framework for social engagement (Hartt, DeVerteuil & Potts, 2023). These are places where social relationships develop; when they are highly accessible, they foster contact, interpersonal

support, and collaboration between neighbors (Klinenberg, 2018). However, when these places become inaccessible, social activities are inhibited and individuals are left to look after themselves (ibid.). Social infrastructure is essential because in-person interactions are the pillars of community life, as frequent interaction, especially when participating in enjoyable activities, makes relationships naturally grow (Klinenberg, 2018). Not only does the built environment encourage the development of supportive community bonds, but it is also proven that quality public spaces, such as parks and other recreational services have a positive influence in vulnerable groups and disadvantaged populations as they encourage inclusion (Lo et al., 2015).

In the literature on how built environments improve collective efficacy, more attention has been focused on the effects of designing public spaces to improve human health and connections rather than the precise role of social infrastructure in enhancing these networks to allow a better adaptation to climate change hazards. Even though those might be strongly connected, a knowledge gap was found concerning the specific impact and benefits of social infrastructure in strengthening community resilience and improving the ability of the community to adapt to climate change through organized actions. The literature suggested a positive relationship between public spaces and community resilience (Eicher & Kawachi, 2011) and more research should be done to explore more aspects of the potential of social infrastructure to increase adaptive capacity to climate disasters, achieve collective efficacy and determine which public spaces are more effective to encourage social interactions.

Landslide disasters often impact the communities of Punta Hermosa, Lima, Peru (*Figure 1*). Landslides in the country are typically caused by the El Niño phenomenon, as each year it occurs, it alters the climatic conditions with intense rainy seasons and

heavy rainfall, promoting landslides with mudflows and debris (García, L., Guzmán, O., & Hurtado, S., 2020).

This research paper examined how social infrastructure, such as public gathering spaces, contributed to increasing the adaptive capacity of residents to landslides. Employing a sequential design, a survey was conducted to assess community perceptions, landslide experiences and preferences regarding social infrastructure. The findings, contextualized through a literature review on disaster management and additional data collection, determined the impact and potential of social infrastructure in enhancing adaptive capacity to climate disasters and promoting organized responses. These findings also guided recommendations for its implementation and government measures, aimed at bolstering community resilience and adaptation in the face of climate-related disasters.



Figure 1. Photograph of residents cleaning up after the March 2023 Punta Hermosa landslides. Retrieved from Alonzo, 2023.

a. Literature review

The literature review pursued two main goals. Initially, it aimed to examine existing evidence concerning the importance of social infrastructure at encouraging social support networks and increasing the capacity of communities to adapt to natural disasters. Subsequently, the review sought to delve into emergency management steps and practices, to provide a broader contextual framework.

Social infrastructure and social relationships actively condition community resilience and disaster recovery (Aldrich & Kyota, 2017). The first step in understanding the importance of social infrastructure to build resilient communities is to uncover how community support networks assist with disaster adaptation measures. A study conducted by Semenza et al. (1996) about 300 people who were part of the 700 heat-related deaths of the Chicago heat wave of 1995, stated how social interaction and connections decreased the risk of mortality, since some people were able to persuade others to leave home and visit cooling shelters or had support groups that released the stress of the situation or care for their well-being (ibid.). People who died during the heatwave also had higher ratios of risks of death because most of them did not leave home and have poor social contact, did not have friends in Chicago nor participated in collective activities like attending church or were part of support groups (Semenza et al., 1996). Adger (2003) examined this study and agreed that networks between individuals and groups, also known as social capital, are important elements for increasing the adaptive capacity of a community to climate disasters. The author concluded that the ability to cope will depend on their potential to act collectively in the face of hazards (ibid). Similarly, Aldrich, Oum & Sawada (2015) analyzed the situation of a Japanese community facing an earthquake and tsunami in Tohoku in 2011. The authors found that locals also managed to survive by the actions of others: for elderly and people with lower mobility the only hope to

survive in that situation was the assistance of neighbors, family, or caregivers, and it was because of these connections that they were able to be saved (Aldrich et al., 2015). The study also found how social networks gave locals financial and emotional support to adapt from the disaster and concluded that bouncing back from tragedy is not achievable only through wealth and external aid, but through social connections that allow the community to act collectively (ibid.).

Collective efficacy is highly connected to the adaptive capacity to climate disasters as the ability to adapt to societies is mostly dependent on their potential to act collectively in the face of climate change (Adger, 2003). The importance of social infrastructure in this research came strongly linked to the fact that these spaces encourage social networks between neighbors, which ultimately increases their chances to act collectively and adapt to natural disasters. In 1997 psychologist Albert Bandura defined collective efficacy as the shared belief of a group in its capability to organize and carry out actions to achieve a goal (Bandura, 1997). This concept is relevant because the more confident a group feels about their shared abilities, the execution is more likely to succeed (ibid.). Relating this term to the built environment, Cohen et al. (2008) analyzed data from Los Angeles County to determine which features of the environment were associated with achieving higher levels of collective efficacy: a greater number of parks and other recreational services were positively associated with the development of social trust and collective efficacy, as they evoke a positive image that facilitates cooperation and interaction (ibid.).

A significant amount of social infrastructure is one neighborhood factor that can influence people in achieving higher levels of collective efficacy (Cohen et al., 2008). Social infrastructure are public places where social relationships develop. Klinenberg (2018) defined this concept as physical spaces where people can assemble, such as playgrounds, parks, athletic fields, swimming pools, courtyards, community gardens,

green spaces and even sidewalks. Social infrastructure is essential because in-person interactions are the pillars of community life, as frequent interaction, especially when participating in enjoyable activities, makes relationships naturally grow (Klinenberg, 2018). When these spaces are highly accessible, they encourage contact, interpersonal support and collaboration between neighbors; however, when inaccessible, social activities are inhibited, and individuals are left to look after themselves (ibid). Not only does the built environment encourage the development of supportive community bonds, but Lo et al. (2015), while analyzing vulnerability and infrastructure in the Canadian York Region, proved that quality public spaces have a positive influence in vulnerable groups and disadvantaged populations as they encourage inclusion. These groups often have higher vulnerability because of their diverging abilities to handle the impact of social risks and physical hazards, to which they are more exposed (ibid.).

In response to recurrent emergencies caused by disasters, the need to have guidelines to effectively address such events became essential over time. Therefore, as a result of research in the field of disasters, the U.S. National Governors Association identified four key phases of Comprehensive Emergency Management (CEM): mitigation, preparedness, response, and recovery (National Governors Association, 1979). Additionally, the consensus in the literature suggests that these phases occur in a circular process, as each phase follows a continuous process and can occur simultaneously (Fagel, 2011) (*Figure 2*). The main actors identified in a CEM include the citizens, government entities, and private sector entities such as NGOs, industries, and businesses (ibid).



Figure 2. Graph of the phases of a Comprehensive Emergency Management plan.

Adapted from " Comprehensive emergency management: a Governor's guide" National Governors Association, 1979

The analyzed literature generally agrees on the definitions and procedures for each phase. The prevailing concept found for mitigation entails taking actions to reduce or eliminate long-term risks to the environment, people, and property, with the objective to subsequently minimize costs in response and recovery (Center for Leadership in Public Health Practice, 2013, Coppola, 2015; Fagel, 2011). However, recent studies have shed light on the fact that reducing the risks of a disaster can also represent a significant investment in planning strategies and professional knowledge, which is why it is important to highlight that achieving disaster mitigation is not always feasible in developing countries (Coppola, 2015).

Since achieving complete mitigation of a disaster is nearly impossible, taking preparedness measures is key to being ready and equipped to face these events (Coppola, 2015). The preparedness phase involves all the actors mentioned earlier. It includes taking measures to designate responsibilities, train assistance staff, identify resource sources to meet needs during emergencies, and allocate response facilities. These views align with

the insights provided by the foundational work established by the National Governors Association (1979), and the scholarly contributions of Fagel (2011) and Coppola (2015).

Response is a short-term stage that follows when the disaster is imminent or immediately after it has occurred. Existing literature concurs that it involves a rapid situation assessment to prioritize response activities, undertaking actions to provide assistance to victims and save lives, measures to reduce damage and repair critical structures, and ensuring the continuity of essential services (Center for Leadership in Public Health Practice, 2013; Coppola, 2015; Fagel, 2011).

The recovery phase can take place while response efforts are still underway. This is a personalized stage, and the measures and their duration will depend individually on each community and the type of disaster. The main concept of this phase lies in restoring the community's systems and activities to normalcy over a long-term period, which requires considerable sources of supply (National Governors Association, 1979; Coppola, 2015). Research on this phase has consistently indicated it may involve taking steps to rebuild infrastructure, informing the population about progress, implementing mitigation strategies, managing donations, addressing the needs of victims, revitalizing the economy, etc. (Center for Leadership in Public Health Practice, 2013; Fagel, 2011).

Ideally, every community should possess a Comprehensive Emergency Management (CEM) plan to enhance its ability to face disasters. However, for Punta Hermosa, being a district with a modest population and financial constraints, the significant investments necessary for such measures may represent a challenge.

b. Statement of Sustainability + Problem Statement

The research aimed to contribute to the understanding of the role of community social networks in enhancing the resilience and adaptive capacity of communities facing natural disasters. Through this, the goal was to propose solutions to safety concerns in vulnerable

communities, with the aim of promoting the well-being and sustainable development of these communities in the face of climate change.

IV. Methodology

a. Research Question

This study seeks to examine how public spaces where people gather for social interaction, commonly referred to as social infrastructure, contribute to enhancing the adaptive capacity of Punta Hermosa's residents in the face of natural disasters. The objective is to explore the potential of social infrastructure for disaster risk reduction and decreased vulnerability in this coastal district of Lima, Peru. Given this framework, the research question for this study is:

- What is the role of social community interactions and social infrastructure in developing adaptability to a natural disaster?

b. Methods

The research adopted a sequential design approach that commenced with data collection via a survey instrument (see Appendix A). The survey was exclusively targeted towards residents of Punta Hermosa who were impacted by landslides. The purpose was to analyze their perception of disaster response, neighborhood networks, and preferences for socialization spaces. The survey was distributed via Facebook and WhatsApp, chosen because they are the most widely used social media and messaging apps in Peru. Facebook and WhatsApp host neighborhood groups where Punta Hermosa community members tend to share thoughts on the district, sell products, or engage in casual conversations. This distribution method was selected because these channels are frequented by the audience, increasing the likelihood of participation and enabling the collection of more precise data.

The survey was structured into four sections, each serving a specific purpose. The first section, "Demographic Information," aimed to gather personal details from the participants to develop a profile of the respondents. The second section, "Socialization and Public Spaces," sought to explore participants' interactions within existing community areas, examining the frequency, motivation, and locations of these interactions. The third section, "Collective Efficacy and Community Action," aimed to investigate the community's collective actions in response to landslides and their efforts before, during, and after such events, with the goal of understanding their experiences in facing disasters. The fourth section, "Establishing a Connection between Social Networks and Community Infrastructure," focused on understanding the impact of social relationships on the community's overall resilience and identifying their preferences regarding public spaces for socialization.

Additionally, the survey results were contextualized within a broader framework through an extensive literature review and secondary data collection. These examined existing theories and evidence regarding the role of social infrastructure in forming social support networks and enhancing community resilience to natural disasters. They were also focused on disaster management steps to situate the community's actions. The findings discovered the impact of social networks and the role of social infrastructure in enhancing resilience in the community. Subsequently, these insights guided recommendations for the design of social infrastructure, with a specific focus on facilitating social interactions and fostering the establishment of social networks for the residents.

c. Study Site

The Punta Hermosa district is a part of the Lima province, one of the 43 districts in the Lima department of Peru (Portal iPeru, 2023). It borders the Lurin district to the north,

the Huarochiri province to the east, the Punta Negra district to the south, and the Pacific Ocean to the west (ibid.). The district holds a significant appeal for the residents of Lima due to its historical standing as one of the pioneering seaside destinations in the southern region of Lima, alongside with Punta Negra and San Bartolo. Its area comprises eight beaches: El Silencio, Caballeros, Señoritas, La Isla, Central, Blanca, Kontiki, and Norte (ibid.). Punta Hermosa is mostly recognized for its role as a coastal beach resort, its favorable climate, and its various tourist landmarks.

The study area is in the district of Punta Hermosa, Lima, Peru, specifically in five neighborhoods located in Norte beach that are often affected by landslides (**Figure 3**) due to their proximity to the Malanche Ravine. These neighborhoods are Bolognesi, Eten, Grau, Elías Aguirre and Pimentel. Landslide disasters frequently impact the communities of the district (Fig. 1), which are typically attributed to the El Niño phenomenon, an annual occurrence that modifies climatic conditions and leads to substantial rainy seasons and intense rainfall (García, L., Guzmán, O., & Hurtado, S., 2020). Consequently, these altered weather patterns contribute to the occurrence of landslides, characterized by mudflows and debris (ibid.).

According to INEI (2017), the population of Punta Hermosa is made up of 15,874 inhabitants, of which 51.40% are men (8,159) and 48.60% (7,715) are women. Regarding age groups, people from 0 to 29 years represent 49.43% of the population, almost half of the inhabitants, while adults from 30 to 64 years represent 45.56% and people over 65 years represent merely 5.10% of the population (INEI, 2017).

The social infrastructure in the district mainly includes squares, community parks, a recreational center, the beach boardwalk, sports grounds, and markets. Besides the beach and the beach boardwalk, the district's sports complex and its recreational areas constitute

a significant portion of the most frequented public spaces by the residents (Expedia Group, 2023).

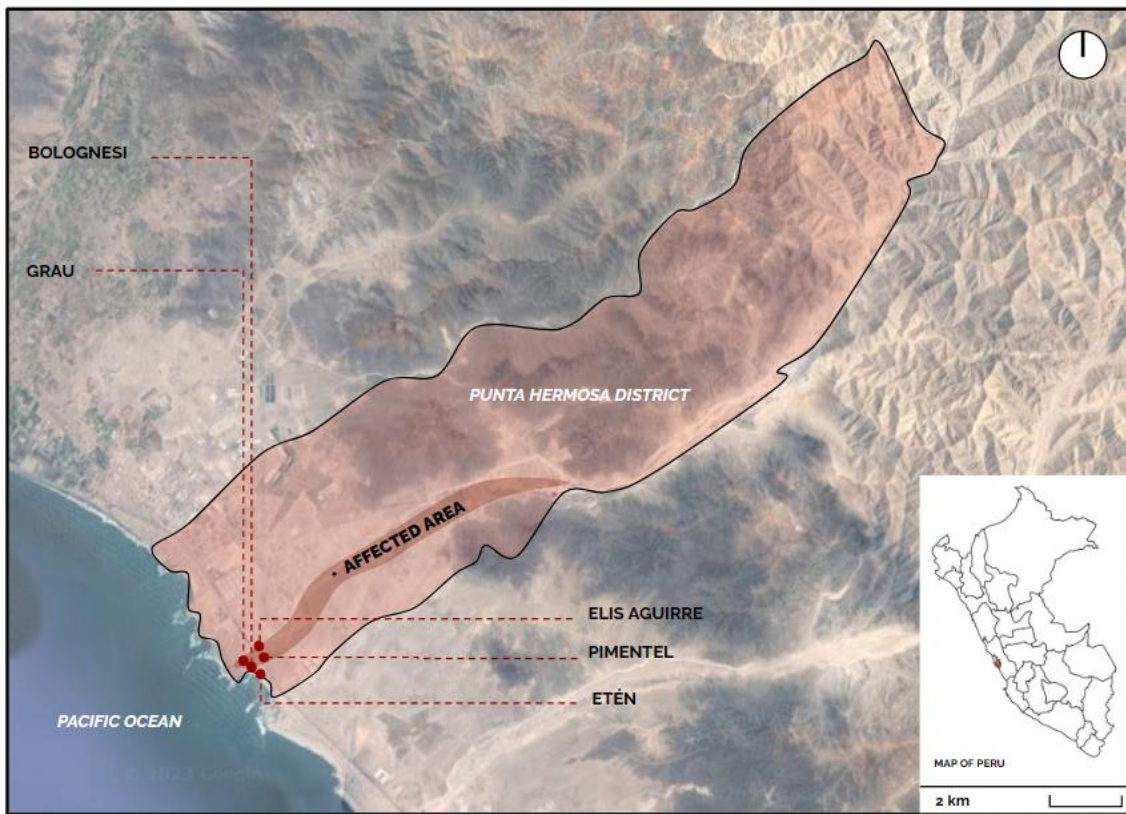


Figure 3. Map of the district of Punta Hermosa, Lima, Peru, highlighting the area often affected by landslides and the neighborhoods that were studied.

A survey was developed to collect specific information from 64 residents. Furthermore, secondary quantitative data from reputable sources such as the Peruvian National Institute of Statistics and Informatics (INEI) and online resources were collected to supplement the research findings with data related to population demographics, age distribution, gender composition, and other relevant factors.

The survey, completed by 64 individuals, provided a clear and comprehensive demographic representation of residents in Punta Hermosa affected by landslides. Among these respondents, 40 individuals (63%) fell within the age range of 30-49 years, 22 individuals (34%) were in the 18-29 years age group, and 2 individuals (3%) were between 50-65 years old (**Figure 4**).

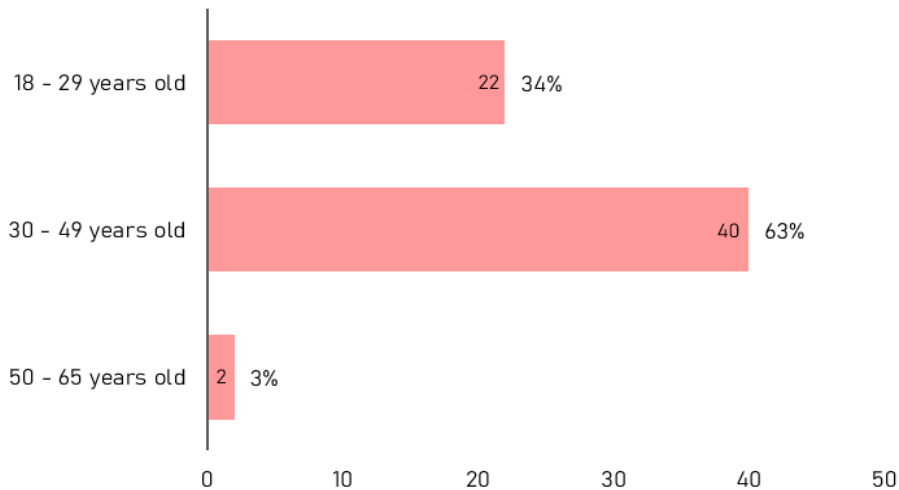


Figure 4. Age group distribution of residents who completed the survey.

The gender distribution among the 64 respondents showed that 30 (61%) were male, and 25 (39%) were female. In terms of their educational attainment, all respondents possessed post-secondary education, with 26 (41%) holding a Technical Degree, 37 (58%) having earned a bachelor’s degree, and 1 (2%) having completed a Postgraduate or Graduate Program. Concerning household size, the majority reside in homes with one additional individual, consisting of 33 respondents, representing 54% of the surveyed population. Additionally, 42% (27 individuals) live in households with 3-5 people, while 6% (4 individuals) reside alone. Most respondents, accounting for 81%, do not own their homes and have rental contracts, while the remaining 19% are homeowners.

V. Results

In the second section of the survey that focused on socialization and public spaces, 100% of the participants reported actively socializing with their neighbors on a daily or weekly basis. When asked why, the answers were as seen in **(Figure 5)**. When asked about where they usually met or gathered with them, public spaces were the most mentioned, with the boardwalk as the most, followed by the streets, the beach, local events at squares, markets and lastly, local restaurants and their own houses **(Figure X)**.

Q8. Why do you choose to socialize with your neighbors?
"Because I feel safer interacting with them; they are familiar faces I always see."
"Because I come across them regularly."
"Because I frequently run into them, so it's inevitable not to socialize with them. Punta Hermosa is a small district."
"Because we organize ourselves to address district problems and share information".
"To strengthen bonds of solidarity and promote a good life through cooperation".
"With the purpose of establishing friendships with our surroundings".

Figure 5. Reasons why residents socialize with their neighbors.

Regarding the perception of the availability and accessibility of public spaces in Punta Hermosa, the results reveal a somewhat mixed sentiment among the participants. The majority, comprising 55% (35 people), expressed dissatisfaction with the current state of public spaces, highlighting concerns about insufficient maintenance. In contrast, 31% (20 individuals) indicated satisfaction with the availability of public spaces, appreciating the recreational opportunities they provide but also indicating the lack of maintenance by the municipality, which is why they did not feel entirely satisfied. A smaller percentage, 13% (8 respondents), remained neutral in their assessment, while only 2% (1 person) reported being very satisfied.

When asked if public spaces in the district, such as parks, squares, sports courts, and playgrounds, facilitate community bonds, all 64 participants (100%) expressed their agreement. They mentioned that these spaces serve as hubs for various events and interactions, enabling neighbors to connect, children to make friends, and the community to engage in religious and sporting activities. Additionally, participants were given the opportunity to select multiple options when asked about public spaces in Punta Hermosa that have encouraged them to meet people. The most chosen spaces for meeting others included sports courts (75% or 47 votes) and the beach boardwalk (98% or 62 votes) as the most important one. Additionally, parks and plazas were selected by 73% (46 votes)

of the participants, indicating a strong role in community interaction. Markets also played a part, with 33% (21 votes) selecting them. Finally, playgrounds had a smaller role, chosen by 8% (5 votes).

Regarding the survey section on "Collective Efficacy and Community Action before, during, and after the disaster," all 64 participants reported that their neighborhoods were impacted by landslides. They specified that they reside in the Bolognesi, Eten, Pimentel, Elias Aguirre, and Grau neighborhoods.

In response to a question about taking disaster preparedness measures, 10% of the participants indicated that they do take such precautions. Participants mentioned engaging in online activities, like being part of active WhatsApp groups and participating in discussions on social media platforms, like Facebook groups. They described their communities as supportive, emphasizing the exchange of preventive information and opinions within neighborhood groups. The remaining 90% of the participants reported not actively engaging in disaster preparedness measures.

Residents were also asked if they trusted their neighbors for disaster preparedness, with 79% expressing confidence in their neighbors' readiness for landslides and other natural disasters. They cited their community's proven track record of solidarity during past disasters, emphasizing various forms of mutual support such as exchanging information, sharing resources, coordinating child and elderly care, and offering assistance in times of crisis. The remaining 21% did not entirely trust their neighbors for preventive measures but acknowledged their support and cooperation in addressing issues after a disaster had occurred.

In response to the question about exchanging information with neighbors regarding landslides, the results showed that the majority, comprising 79% (50 participants), reported that they do engage in information exchange with their neighbors. On the other

hand, 21% (14 participants) indicated that they do not exchange information with their neighbors on this topic.

In response to whether they contacted anyone for help during the disaster, 83% of the participants (52 individuals) confirmed that they reached out to various sources for assistance. The reasons for contacting others ranged from seeking support from friends and neighbors living nearby, ensuring collective preparedness, and organizing community efforts in response to the disaster. Some respondents also connected with family members to reassure them of their safety. Notably, a few mentioned refraining from contacting municipal authorities while relying on the solidarity and assistance of their neighbors.

Turning to the question of whether they or their community members provided assistance during or after the disaster, all 100% of the participants (63 individuals) reported active involvement in various initiatives to aid one another. These actions involved the extensive cleaning of affected homes and the boardwalk area, and the exchange of personal protective equipment, tools, provisions, and shared machinery resources. The community demonstrated exceptional solidarity by offering shelter, donating tools, organizing childcare, and actively participating in the extensive cleanup efforts in the neighborhood. The following text is a testimony provided by one of the respondents:

"Our house didn't flood, but we spent several days helping clean some homes and the boardwalk, along with many neighbors who shared the desire to contribute with their spirit of solidarity. We received personal protective equipment, tools, food, drinks, etc. Machinery was hired among neighbors. My husband brought his pressure washer from his workshop, and we helped clean the boardwalk with the hose, extensions, and connection points provided by other neighbors as we

progressed along the boardwalk, from house to house. Many neighbors offered their homes to shelter others, some hotels did too, and businesses provided drinks and food. Tools and other donations came from neighbors as well. I also heard that in one house, some families organized to take care of children, with nannies and moms, so that the moms of these children could go out to help with the cleaning. I was pleasantly surprised by the level of solidarity I witnessed."

When rating the sense of community and cooperation among residents in Punta Hermosa concerning climate-related challenges, a significant 89% of participants (56 individuals) expressed a strong level of community bonding and collaborative disposition. An additional 11% (7 participants) considered the community's cooperation level to be moderate, which was still a positive sign of community involvement and working together.

Participants were also asked to briefly describe their experiences during and after landslides in Punta Hermosa. The responses revealed stories of neighbors coming together to ensure safety and support. In one case, residents coordinated a rapid evacuation as they heard police officers warning of an impending landslide, highlighting their community's collective and proactive spirit. Many recalled how their neighbors assisted with moving vehicles, seeking shelter, and helping one another after the disaster. Collaborative cleanup efforts and the exchange of resources and tools featured prominently in the narratives, showcasing the crucial role of local solidarity and the lack of help from the local government. The text below offers a testimony from one of the participants:

"My parents have an apartment in a safe area and a house they rent out for the summer in a landslide-prone zone. I was at the apartment when a video arrived in the WhatsApp group of the community. I told my dad, and we rushed towards the

house, which is very close to the watercourse. When we arrived, the landslide had already overflowed, and we had no way to reach our house where the tenants were. We lost everything; it flooded up to hip height, and the tenants were evacuated by civil defense. The next day, another landslide occurred. The following 2-3 weeks were filled with pure work from friends and volunteers for my house and all the neighbors who lost everything. We had to hire machinery like water pumps because the municipality was not managing enough. Was there help from the municipality? Yes. Was it sufficient? Not at all. The Punta Hermosa community did ten times more by seeking sponsorships on social media, volunteers, and visibility."

The survey results indicated a unanimous consensus, with 100% of respondents affirming a strong positive connection between their social relationships within the neighborhood and their ability to adapt to natural disasters. Participants emphasized the mutual support and cooperation present among neighbors, expressing a sense of unity and willingness to help one another during challenging times. This collaborative spirit and the strong bonds with longtime neighbors were particularly highlighted as sources of emotional support and practical assistance in disaster recovery.

When asked about the types of features they would desire in public spaces to promote the creation of social networks (**Figure 6**), the participants presented a range of preferences. The majority, 94% (59 individuals), expressed a strong desire for places dedicated to sports and physical activities. Venues for social events were also highly favored, with 79% (50 participants) indicating their importance in fostering social connections and interactive events. Green areas, valued by 57% (36 participants), were also valued to promote community interaction and recreational activities. In contrast, a smaller percentage, 14% (9 participants), expressed interest in squares for socializing.

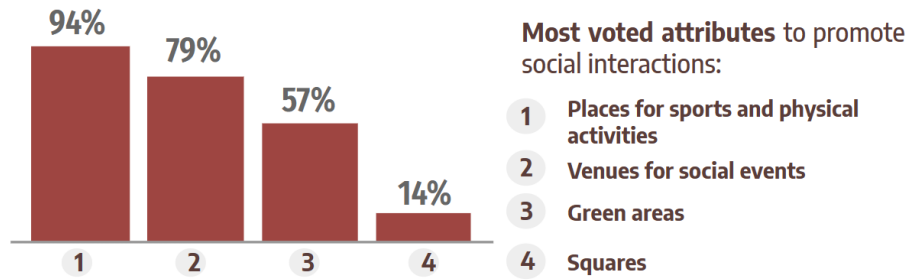


Figure 6. Types of infrastructure residents prefer in public spaces to promote the creation of social networks.

Additionally, the literature review highlighted the significance of community networks in enhancing the adaptive capacity of communities to climate disasters, illustrated through case studies such as the 1995 Chicago heat wave and the 2011 Tohoku earthquake and tsunami. Previous research established that community support played a crucial role in survival and adaptive capacity (Aldrich et al., 2015), as individuals relied on assistance from neighbors, family, or caregivers. Moreover, it was found that individuals who had greater social contact through participation in collective activities had higher chances of survival (Semenza et al., 1996).

VI. Discussion

The survey revealed that the community carried out the response phase in accordance with the CEM Plan discussed in the literature review. By engaging in activities such as assisting neighbors, providing aid, conducting rescues, and cleaning up immediately after the disaster, the importance of connections in the Punta Hermosa community was clearly demonstrated. This highlighted the need to provide spaces to strengthen these bonds.

One of the most surprising findings was the unanimous affirmation among the surveyed participants that they socialized consistently with their neighbors. This phenomenon could be attributed to the district's small-scale and neighborhood-oriented nature. This makes it highly probable for residents to encounter their neighbors regularly,

which aligns with their reports of daily or weekly interactions. This also explains why the beach boardwalk and the street are the primary locations for socializing with neighbors. The beach boardwalk serves as a public space for leisure and beach access, while the street functions as a social thoroughfare. However, there are also cultural reasons why the population might tend to socialize with their neighbors. In Peru, as well as in other Latin American countries, building the sense of familiarity is crucial for most communities, making it easier for people to naturally seek to connect with their neighbors. This is not a reality for other countries such as the US, where people don't seem to find the need to create relationships with their neighbors.

Most residents expressing dissatisfaction with the availability, maintenance, and accessibility of these spaces suggest that while the community has fostered close bonds, the motivation behind these connections seems primarily due to the previously mentioned cultural motivations and the shared use of the same streets and beach boardwalk to get to places rather than intentional socializing. Had the community had a well-functioning and desired infrastructure, the bonds between people could be even stronger. This also highlights the lack of adequate public spaces for enhancing socialization in the district.

The preferences for places to play sports, green areas, and social events that foster neighborly connections make sense for various reasons. First, because sports are recognized for encouraging physical activity and competition. This sentiment is particularly strong in Peru where people have a strong passion for sports teams such as soccer, volleyball, and basketball. Second, considering that Lima is primarily a desert, green spaces and vegetation are especially appreciated by the general population for their ability to alleviate stress and enhance emotional well-being. These areas also appeal to a diverse range of age groups. Third, venues for social events serve as communal gathering

points through entertainment, which can also benefit various age groups, depending on the type of event.

Furthermore, it's remarkable that the majority of the community did not take preventive measures for landslides, even though the area has a history of being at risk, especially during El Niño events. Unfortunately, preventive measures take time, resources and are expensive, which without initiative from the local government of Punta Hermosa leaves people with no support and no option but to respond and adapt to the conditions once the disaster has already happened. However, even though people are not taking preventative measures, they still have a very strong exchange of information with each other through social media. They rely on social media groups to access knowledge about the neighborhood which somewhat compensates for the lack of preventative measures. Since people are more aware of the situation in the neighborhood, they tend to feel more confident about taking response measures.

Additionally, most interviewees indicated reaching out to their neighbors during the disaster to request evacuations, aid, and organize collectively afterward. This evidence, coupled with all respondents affirming their involvement in helping other community members recover from the disaster, reaffirmed the community's adaptive capacity in the face of disasters through interpersonal bonds. These findings align with other cases analyzed in the literature, as demonstrated by studies such as those conducted by Semenza et al. (1996) on the Chicago heat wave of 1995 and Aldrich et al. (2015) on the Tohoku earthquake and tsunami of 2011. Consequently, it is not surprising that the community perceived a beneficial relationship between their adaptive capacity to natural disasters and their connections with their neighbors. As mentioned in the literature, pre-existing bonds enhance the willingness to collaborate and achieve collective efficacy during hard times (Aldrich et al., 2015).

The research findings state that social networks are beneficial and serve a big purpose. The actions carried out by the community align with the response phase in accordance with the CEM Plan by the National Governors Association (1979) (**Figure 7**). As preparedness measures are not present and are not a viable option for residents of Punta Hermosa due to the lack of support from the local government, strengthening their ability to respond and adapt to natural disasters becomes imperative. Community networks can facilitate a quicker and more efficient response to landslides by enabling a rapid evaluation of the situation and the effective allocation of resources according to who needs them. By contrast, any government would still have to run an extensive assessment of the damage to send resources accordingly, which could consume valuable time. In this context, the potential role of social infrastructure for disaster-prone communities also became evident, as it provides a space for socialization and the creation of community bonds.



Figure 7. Diagram correlating the phases of a Comprehensive Emergency Management plan with the research findings. Adapted from " Comprehensive emergency management: a Governor's guide" National Governors Association, 1979.

VII. Conclusions

Community networks are important for disaster-prone communities for various reasons. One of these reasons is that they play a crucial role in effective emergency management, as pre-existing bonds enhance the likelihood of mutual support when a disaster strikes. Therefore, this study was conducted to assess the role of these interactions and the potential of social infrastructure in developing adaptability to natural disasters, specifically in the landslide-prone community of Punta Hermosa. For this purpose, three main research methods were used: a Survey, a Literature Review, and Secondary Data Collection. The survey gathered data from 64 residents from five local neighborhoods affected by landslides and was distributed via social media groups. It was designed to assess community experiences and preferences. The main results indicated strong support networks within the community. All respondents reported being actively involved in actions and initiatives to provide assistance to members of their community after the landslides, such as providing refuge, aid, food, and cleaning up. Additionally, most respondents reported not taking any preventive measures. The Literature Review and Secondary Data analysis helped place the findings in the context of existing research. This led to the conclusion that the actions carried out by the community align with the response phase in accordance with the CEM Plan by the National Governors Association (1979). Furthermore, the study revealed that community networks can facilitate an immediate and more efficient response to landslides by allowing a rapid evaluation of the situation and the effective distribution of resources. Ultimately, this demonstrated the potential of social infrastructure to strengthen communities with a high vulnerability to natural disasters, considering how beneficial it could be as it encourages stronger social networks.

a. Recommendations

The municipality and government should encourage social interactions between neighbors through the implementation of public spaces for socialization, considering how beneficial social infrastructure is for disaster-prone communities. The community demonstrated a strong sense of community and eagerness to spend quality time with neighbors. This should be considered by the government as an opportunity to improve community resilience to landslides.

The municipality and government should consider the preferences of the community and implement them. The Punta Hermosa residents expressed the following preferences for public spaces that promote neighborly connections: sports facilities for physical activity and competition, green areas known for stress reduction and well-being, and social event venues that provide communal gathering points for various age groups.

b. Limitations

The study faced some limitations, primarily related to the geographical location of the research. Conducting an in-person survey could have offered more insights and potentially resulted in a richer collection of experiential narratives from the residents. Furthermore, the number of respondents was constrained to those with access to social media groups in the district, making the sample unintentionally restricted.

c. Future work

To continue addressing this issue, the findings of the study could be examined to create policies aimed at strengthening the resilience of vulnerable communities through social networks. These policies could be integrated into local disaster management plans. Moreover, long-term studies should be conducted in other vulnerable communities to fully understand the development of support networks before, during, and after natural disasters. This could help gain a deeper understanding of the nature of neighborhood

relationships and how they evolve over time. Similarly, research could be conducted in communities with different levels of social infrastructure to assess the influence of these built environments on the creation of social networks.

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Appendix A

Survey

The purpose of this survey is to examine to what extent are built environments contributing to build community climate resilience, measured by features in the public spaces where people gather to socialize of Punta Hermosa, Lima, Peru that affect the ability of their community to achieve collective efficacy to help mitigate landslides.

The purpose of this survey is to find data on the experience of Punta Hermosa residents with landslides disasters.

Instructions:

Please take a moment to respond to the following questions as accurately as possible.

Your feedback will help us gain a better understanding of the community's views on climate resilience, the built environment, and community support during and after disasters.

Demographic Information:

1. Do you currently reside in Punta Hermosa, Lima, Peru? For how long?

- Yes _____

- No

2. How old are you?

- 0-17

- 18-29

- 30-49

- 50-64

- 65 and over

3. What is your gender?

- Female
- Male
- Other (please specify)
- I'd rather not say.

4. What is your level of education?

- Primaria completa
- Secundaria completa
- Grado técnico
- Grado Universitario
- Posgrado

5. How many people live with you?

- I live alone.
- 1-2 people
- 3-5 people
- 6 and over

6. Do you own or rent your current residence? (Please specify) _____

Socialization and Public Spaces:

7. Do you socialize with people in your neighborhood? If the answer is yes, how often do you interact with them? Explain.

- Yes _____
- No

8. Why do you choose to socialize with your neighbors? _____

9. Where do you interact with them? _____

10. How do you feel about the availability and accessibility of public spaces in Punta Hermosa? (parks, playgrounds, sports grounds, squares)

- Very satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very dissatisfied

11. Do you think that the public spaces where people gather to socialize in Punta Hermosa, such as parks, playgrounds, squares, sport grounds, encourage bonds between the community? Please explain.

- Yes _____
- No _____

12. Which public places of Punta Hermosa have encouraged you to meet people? (You can pick more than one option)

- Parks
- Markets
- Sport grounds
- Playgrounds
- Beach boardwalk

Collective Efficacy and Community Action before, during, and after the disaster:

13. Has your neighborhood ever been affected by landslides? (Please add the name of your neighborhood)

- Yes _____
- No

14. Do you take any disaster preparedness measures? For instance, do you attend community meetings for prevention, exchange information with neighbors, participate in drills, etc.? If the answer is yes, please briefly specify which ones.

- Yes _____

- No

15. Do you rely on the people in your neighborhood when it comes to preparing for landslides and other natural disasters? For instance, do you hold preventive community meetings, exchange information, share resources, coordinate child and elderly care, etc.? Please specify which activities you engage in.

- Yes _____

- No

16. Do you exchange information with your neighbors about landslides?

- Yes

- No

17. When the disaster happened, did you contact anyone for help? (for example, a government service, a family member, a neighbor) Why did you contact them? Please explain.

- Yes _____

- No

18. Did you or your community members help others during or after the disaster? If yes, please share any actions or initiatives that you or your community undertook to assist others during or after the disaster.

- Yes _____

- No

19. How would you rate the sense of community and cooperation among residents in Punta Hermosa when it comes to addressing climate-related challenges?

- Strong
- Moderate
- Weak
- I don't know.

20. If you have experienced a climate-related disaster in Punta Hermosa, could you briefly describe your experience during and after the disaster?

Establishing a connection between social connections and social infrastructure:

21. Do you see a benefit between the social relationships that you have with the people in your neighborhood and your ability to cope with natural disasters? Explain.

- Yes _____
- No _____

22. What types of features would you want in your public places to enhance the creation of social networks? You can choose more than one.

- Places to play sports.
- Green areas
- Venues for social events
- Plazas