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Flood Risk Management in a Rural Town in Samborondón, Ecuador: Strategies to Mitigate its Impacts, 2025

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Abstract
The research is aligned with Sustainable Development Goal 13, which seeks to advocate for action against climate change and improve environmental management to address natural hazards such as flooding caused by intense rainfall. The study aimed to diagnose the vulnerability and impacts of flooding in a rural community, in order to propose practical risk management strategies. A quantitative approach was used, with a non-experimental and cross-sectional design, using a validated questionnaire for a sample of 117 residents. The results show high physical, institutional, economic, and social vulnerability, with significant damage to facilities or equipment, agricultural losses, health problems, and limited response capacity. The community experienced significant social impacts, including temporary migration and emotional distress, with slow recovery due to limited post-disaster preparedness and support. It is concluded that environmental management must be strengthened through investments in infrastructure and community training to reduce latent weaknesses in the face of flood disasters. This review highlights the urgency of comprehensive risk management that includes prevention, mitigation, preparedness, response, and recovery to effectively address this natural threat.
Keywords: *Disaster, environmental management, natural hazard, rainfall.*

INTRODUCTION

Floods are one of the most destructive natural hazards, exacerbated by climate change. International reports warned of its increasing frequency and impact, affecting millions and causing significant losses. This phenomenon caused forced displacement, destruction of infrastructure, loss of crops and damage to ecosystems, especially in vulnerable regions. In Ecuador and South America, these conditions were worsened by structural deficiencies and poor community preparedness. The Samborondón canton in Ecuador exemplifies this problem due to its geography and exposure to events such as El Niño. It is urgent to implement prevention and adaptation strategies to strengthen the resilience of the most vulnerable territories.

This research is relevant for its focus on flood risk management in vulnerable rural areas, aligning with the 2030 Global Goals, especially goal 13 on actions against climate change, linked to indicator 13.1.1, which assesses nations with climate risk management plans integrated into their policies. It strengthened local resilience and generated useful knowledge for public policies aligned with global commitments on climate adaptation, contributing to safer and more sustainable communities in the face of extreme hydrometeorological events (UN, 2022).

The World Meteorological Organization, in a 50-year study (1970-2019), reported that 50% of 11,072 disasters and 45% of 2.06 million deaths were due to weather events. This caused economic losses of $3.6 trillion, with a daily average of 115 deaths and $202 million in losses. The trend continues, with daily climate changes increasing the likelihood of extreme events, such as floods (WMO, 2021). The World Wildlife Fund warns that unforeseen floods are one of the four main risks of climate change in Europe, linked to the increase in temperature that will affect habitat and biodiversity. Estimates indicate that, without controlling for the increase in temperature, there will be torrential rains and more frequent floods (WWF, 2024).

The UN Office for Disaster Risk Reduction reported that every year, around two million people in Africa suffer floods, and more than half become displaced, especially in Ethiopia, Kenya, Somalia, Uganda and Djibouti. The situation will soon worsen due to floods affecting agriculture and livestock key to food sovereignty. In the last five decades, North and Central America, including the Caribbean, has received 18% of global climate disasters, with 4% of victims and economic losses of 1.7 trillion dollars, with floods being one of the main causes. Climate change, a major driver of global risks, causes disasters that affect billions; If its effects increase, the trend will not stop anytime soon.

The Economic and Social Commission for Asia and the Pacific reported that in 2022, Asia and Oceania recorded more than 140 disasters, causing 7,500 deaths and economic damage of more than 57 billion dollars, affecting 64 million people, with floods responsible for 64% of deaths, especially in Afghanistan,

Bangladesh, India, Nepal and Pakistan. The threat of greater economic losses in agriculture and livestock requires mitigation and adaptation strategies to ensure food sovereignty, especially in the poorest settlements (ESCAP, 2023).

The OECD highlighted that, in the last fifty years, South America contributed to 3% of global deaths caused by floods and concentrated more than 17% of extreme weather events, resulting in economic losses of more than 100 billion dollars, with expectations of worsening in the future. Actions to combat flooding in poor and vulnerable communities should be prioritized.

The World Bank warned that, due to global warming, intense rains will increase in frequency and magnitude, which could cause a 200% increase in the population affected by floods in Argentina, Brazil and Colombia; 300% in Ecuador and 400% in Peru, with a temperature increase of 1.5 degrees Celsius. Floods have doubled the reduction in income among vulnerable populations, pushing six million people into extreme poverty by 2030 (WBG, 2021).

The Inter-American Development Bank reported that climate change is impacting health in Latin America and the Caribbean with heat waves, droughts and floods, resulting in child malnutrition, allergies, respiratory and cardiovascular problems, and infectious diseases. It is estimated that between 2030 and 2050 there will be an additional 250,000 deaths annually from global warming. Effects on mental health include: PTSD, anxiety, stress, schizophrenia, uncertainty, discouragement, insomnia, sleep disturbances, suicide attempts, and eco-anxiety (IDB, 2023). The Institute of Environment and Human Security highlighted that, since 1970, floods in Ecuador have been the main threat and cause of deaths in hydrometeorological risks, and the third cause of deaths nationwide. In Ecuador, flooding is mainly due to seasonal rainfall and the lack of adequate drainage systems (UNU-ASH, 2021).

The Citizen Prefecture of Guayas points out that the province suffers floods annually due to intense rains, with rivers overflowing in rural areas. Action plans should be implemented to prevent and mitigate the impacts of hydrometeorological events, such as agricultural losses, damage to infrastructure, and migration (GADPG, 2024). The Samborondón canton, in Guayas, is very vulnerable to flooding due to its location on the plain of the Guayas River and near the Daule and Babahoyo rivers. Flooding is frequent, especially during El Niño. It is essential to improve the adaptation of the territory and the population to prevent social, economic and ecological losses. Rural areas, which make up three-quarters of the canton, face concerns about a lack of earthquake-resistant housing and a lack of flood preparedness. If left unaddressed, these weaknesses exacerbate the effects of climate change (CIIFEN, 2022).

The rural area of Samborondón showed high vulnerability to flooding in winter. This condition was exacerbated by uncontrolled urban growth, loss of native forests, and inefficient planning. The floods caused crop and livestock losses, damage to rural homes, displacement and the spread of disease. Risk management remained reactive, focusing on humanitarian aid and improvised evacuations. The lack of a comprehensive model for the prevention and response phases limited community resilience and maintained vulnerability, leading this thesis to pose the following question: Which flood risk management model should be structured to reduce social, economic and environmental impacts?

The research quickly addressed the recurrent floods in the rural area of Samborondón, seriously affecting its population socially, economically and environmentally. It was based on the social foundation of risk and comprehensive management to explain the structural vulnerability of the territory. The comprehensive model optimized local scheduling and decision-making in the face of extreme weather events. The social and economic dimension urged the protection of rural livelihoods and the reduction of losses in production, infrastructure and health. The study was aligned with legal regulations on risk management, climate change and sustainability. This effort improved the knowledge applied in vulnerable rural contexts, offering solutions to strengthen community resilience.

The general objective of this study was: to structure a comprehensive flood risk management model; and the following specific objectives were addressed: a) to diagnose the level of vulnerability of the local population; b) identify the impacts caused by floods in the study area, c) design strategies in the model to mitigate the social, economic and environmental effects generated by flood events in the community studied, and d) validate the proposed model.

Globally, several authors have studied flood risk management, the vulnerability of the population and its social, economic and ecological impacts.

Godefoy et al. In 2023, it was highlighted that vulnerability refers to the exposure of families, localities or countries to harmful events and their inability to protect themselves. A study in 15 Cuban municipalities, with 1994 respondents, identified physical, material and social factors as strengths or

weaknesses in response to floods, concluding that it is crucial to improve human capacities to support the population. The need to assess the vulnerability of the locality and, based on these findings, develop strategies to improve the capacities of its inhabitants in the face of disasters was identified.

Guragain and Doneys (2022) conducted a quantitative study in Nepal on vulnerability in 216 households affected by floods, finding greater risk in social and physical components, especially in female-headed households. They concluded that improving access to services and building capacities in displaced families is crucial to reduce the impact of future floods. Adequate training of the flood-affected population reduced their vulnerability through information, such as early warning systems.

Zhou et al. In a study on floods in China (2025), the risk and exposure of the inhabitants of the Yangtze River were assessed. The research used regression analysis and found that economic strength, measured by income and social security, is related to a better ability to cope with floods, increasing resilience in urban areas and decreasing in rural areas. The findings indicate that risk management should protect rural incomes and livelihoods from flooding.

Kong (2024) conducted a study in China on rural floods, assessing the effectiveness of disaster responses and the differences between urban and rural areas. He concluded that the increase in flooding in rural areas is due to various factors and that these localities are more vulnerable than cities in governance and disaster management. An effective risk management model is required that reinforces preparedness for disaster prevention plans, advocacy for rural infrastructure, support for water conservation projects, emergency response teams, and education on prevention and rescue in rural communities.

Zhang (2022) conducted a study in China on disasters, including floods, which sought to evaluate the efficiency of prevention and outcomes. Using analysis of time-series data of floods in 20 cities from 2014 to 2017, it found that between 68% and 91% of crops were affected, with an average annual rate of 81.06%. He concluded that it is crucial to develop tactics to optimize investment in prevention. The results suggest that efficient flood risk management requires new investments in infrastructure, especially in rural areas.

Almamosi et al. In 2024, the 2020 Dagiri flood was investigated in Nigeria, assessing its socio-economic impacts through maps, surveys and interviews. The results showed income losses, educational delays, agricultural damage, health problems, damage to infrastructure and poor risk management, concluding that families in flood zones must be relocated. Strategies to mitigate flood risk must strengthen the resilience of affected communities.

Meléndez and Gutiérrez (2024) conducted a study in Harlan County, Kentucky, to measure community functionality and resilience to flooding. Using a quantitative model based on seven dimensions (population, environment, government services, infrastructure, lifestyle, economic development, and sociocultural capital), they found that the indicators improve disaster response and that this approach helps in decision-making to strengthen resilience in rural communities. The flood risk management model will incorporate the key dimensions to achieve better results.

Ibarra Armenta and Salazar Yánez (2024) studied economic losses in families in Sinaloa due to floods. Using a quantitative approach, they surveyed 160 affected people, revealing an average of $3,800 in losses per home. They concluded that a vulnerability reduction model is more effective than state offsets. Rural people need preventive risk management models to minimize the impacts of floods and protect lives and infrastructure.

Santana et al. In 2024, research was conducted in Cuba to develop a training strategy to improve knowledge about disaster risk reduction in a rural community in Santa Clara. A random sample of 85 inhabitants was used, revealing a low perception of risks and preparedness for disasters. It was concluded that a community education strategy could address these shortcomings. Capacity building in rural localities will be required to improve their resilience in the aftermath of disasters, such as floods.

Avendaño et al. investigated the impact of floods in Peru and Chile. In 2024, the impacts of flooding in the Atacama Desert were assessed, analyzing the vulnerability of its inhabitants. Overflows were found in the last hundred years that damaged rural infrastructure. It was concluded that there are human settlements in risky areas without an adequate risk management plan. It is crucial to learn from the past and implement actions to reduce the impacts of flooding, establishing minimum risk management standards to ensure safety in these localities.

Sauer et al. In 2024, a quantitative study was conducted that analyzed 913 satellite imagery and disaster data from two decades to assess progress in reducing flood insecurity. It was found that vulnerability is lower in areas with good infrastructure and higher in rural areas with low economic development, which

suffer deaths and forced migrations. They concluded that progress in managing this threat is limited. Risks will be managed with minimum safety guidelines to protect buildings in rural settlements.
Abdul et al. In 2025, a study was conducted in Malaysia to identify user-centered cultural aspects, key to managing flash floods. Using a quantitative approach with convenience sampling, 351 floodplain residents expressed interest in an app that simulates an early warning system, thereby improving flood preparedness, response, and recovery. These initiatives will be key to implementing early warning systems in rural areas, thanks to the wide internet coverage and the use of mobile applications for real-time communications.
Zhu et al. In 2025, quantitative research was conducted in Lake Poyan, China, to assess the decline of ecosystem services in flood-prone areas. Using the sink source theory and an irrigation transfer model, it was found that the risk in previously high areas increased, resulting in a 24.66% decrease in the value of the lake basin's ecosystem services. The results indicate that flood risk management should be a continuous process for authorities and communities, thus improving prevention and mitigation.
Koralay and Kara (2024) conducted a study in Söğütlü, Turkey, to create a flood risk map. They used ArcGis's analytical hierarchy and weighted overlay, finding that areas near rivers are more prone to flooding. They conclude that these maps help formulate disaster prevention and response plans. This study highlights the importance of designing flood maps that consider factors such as soil type, precipitation, land use, and elevation.
Salih and Hassablla (2024) conducted a study in the Wadi Hail basin, Saudi Arabia, to identify areas vulnerable to flash floods and evaluate their generation using a physical hydrological model with HEC-HMS and data from IMERG V.06. The results help to understand the impact of extreme rainfall in flood-prone areas and are useful for authorities in flood management in the face of extreme events. The application of this experience in similar places should promote infrastructure and ensure environmental stability in areas prone to flooding.
Rahman et al. A 2024 study in Aceh Utara, Indonesia, evaluated a participatory model for flood management through stakeholder interviews. The findings highlighted the need for this approach, which includes raising awareness of flood risks, improving infrastructure according to community criteria, planning for more effective evacuations, and strengthening community capacity for response and mitigation.
Will et al. In 2024, a study was conducted in the marginal areas of Yaoundé, Cameroon, to assess vulnerability to flooding considering social, economic, and structural aspects. Data was collected from residents, municipalities, experts and NGOs, analysing 40 indicators of exposure and resilience. Despite the challenges of poor infrastructure, residents have developed strategies to cope with flooding. The research concluded that the institutions involved in the intervention were largely ineffective and faced problems of technical expertise, financing and coordination. The information revealed the need for strong institutions, with trained human resources and timely funding for emergencies.
In another study by Thijs et al. In 2024, research was conducted in the Netherlands to measure business losses from business interruptions due to flooding. It found that one day of outage costs 0.5% of annual revenue, concluding that prompt compensation reduces the duration of these outages and losses, requiring more insurance, government compensation and an agile post-disaster insurance mechanism. Rapid and coordinated intervention by the state will be crucial to repair flood damage and restore normalcy.
In Vietnam, Can et al. In 2024, a study was conducted in An Giang to assess the vulnerability of its inhabitants to floods, using a framework that integrates natural disasters, economic, social, and environmental factors through 42 criteria. The Hierarchical Analytical Process was applied to weigh criteria and prepare risk maps, finding that 6.5% of the communes presented a high risk of flooding, mainly affecting agricultural and high-poverty areas. In these cases, it is prudent to implement measures to mitigate future threats and reduce flood risk.
Minguez et al. In 2024, the Tuti Island Heritage for Climate Action project in Sudan was launched, which uses an early warning and community management system for floods. Its objective is to preserve traditional knowledge as a strategy for adaptation to climate change. During the 2020 floods, which affected 875,000 people in Sudan and caused losses of $4.4 billion, the island of Tuti reported no casualties or significant damage, highlighting the importance of traditional knowledge in flood disaster mitigation. Indigenous ancestral knowledge about the use of drums and whistles can be useful in rural communities with scarce resources.

The Worshipper et al. A 2024 study in Gicumbi, Rwanda, analyzed the effects of flooding on rural households and their coping strategies using a mixed approach with 399 surveys. The results showed crop destruction, damage to homes, and food and water shortages, while coping strategies included saving, support from loved ones, selling goods, and migration. Governments and stakeholders should develop strategies and programmes that facilitate access to early warning systems and increase disaster risk awareness, thereby improving the resilience of communities.

Munpa et al. In 2024, flood resilience was assessed in Phra Nakhon Sri Ayutthaya, Thailand, through a survey of 552 villagers. One-third had not participated in flood preparedness. The results indicated that critical factors for improving resilience included financial aspects, community awareness, multi-sector collaboration, citizen participation and flood data management. In addition, the flexibility of infrastructure and reliable communication systems were key to dealing with flood disasters. Incorporating these elements into a flood risk management model could increase rural resilience.

Echendu (2024) studied in Port Harcourt, Nigeria, on the contribution of indigenous knowledge to modern flood risk management, involving risk management experts. He concluded that, although their applicability is limited, some practices, such as tree and mangrove planting, are still useful. It is logical to ask governments to halt the conversion of wetlands and promote their restoration, due to their importance in flood mitigation. Urban forests help manage storm runoff and improve environmental quality.

Rameli et al. In 2024, research was conducted in Malaysia on community resilience to floods, surveying 350 affected people. Flood-prone areas were found to have frequent overflows, causing unrest, although support from governments and NGOs helped mitigate this. It was concluded that community participation in flood management is key and strategies to address the psychological effects on the community should be improved. Authorities must recognize the importance of the emotional and mental effects on the population that has lost homes, belongings and loved ones.

Chen et al. In 2024, a study was conducted in Wuhan, China, to identify critical routes in flood scenarios, critical for transportation planning and flood risk reduction. An integrated framework was used that combined flood modelling with displacement simulation, revealing that the impact of flooding on roads depended on proximity to water bodies, low topography and high transport demand, which helped to prioritise interventions. In floods, it is crucial to improve the resilience of the connectivity system for evacuations, humanitarian aid and recovery.

Pazhuhan and Amirzadeh (2024) conducted research in Saadi, Iran, to improve flood resilience. They applied 400 surveys and interviews with six experts, revealing a high level of risk perception, although after the floods, 60% of the infrastructures were not improved, making it difficult to prepare for future disasters. The research provided valuable information for urban planners and policymakers to develop community flood resilience plans.

Akram and Mushtaq (2024) conducted a study in Pakistan to analyze the relationship between flooding due to environmental changes and mental well-being in vulnerable rural communities. They found that natural disasters increase psychological and physical stress, with results including suicide, distress and disorders such as post-traumatic stress disorder, depression, anxiety and sleep problems. It is crucial to understand the influence of weather and climate change on psychosomatic health, and to offer support to flood-affected communities.

According to De Casto et al. A 2024 study in Brazil analyzed the effectiveness of health systems in preventing and responding to flood emergencies in Rio Grande do Sul. Field hospitals were established that provided medical care, managed chronic illnesses and offered mental health support. The results indicated that strengthening these systems helps build resilience to minor disasters. It was concluded that these programs must be continuous, proactive, multidisciplinary and adequately funded to maintain essential public health functions. Strengthening health systems ahead of floods is key to addressing the physical and emotional conditions of the population.

Prada and Arrieta (2024) evaluated flood risk management in Piura, Peru, after El Niño in 2017, through a qualitative study that collected information on those affected and economic damages. They found that the lack of organization in risk management left more than 90,000 victims and 21,000 homes destroyed, with agricultural losses of more than 221 million soles. They concluded that to strengthen community resilience it is essential to invest in infrastructure, ecosystem services and institutional capacities. To reduce vulnerability, it is key to plan and manage risks with the participation of affected communities.

Zambrano and Macías (2021) studied social capacity in the face of flood risk in Chone, Ecuador, using a qualitative and quantitative approach with 60 heads of household. It was determined that including these

capacities in municipal planning promotes community collaboration in the preparation and assessment of initiatives for adaptation to climate change, concluding that a strengthened social capacity improves the connection of knowledge with the decisions of the authorities. Risk management will be strengthened with the inclusion of community knowledge and experience.

Mejía et al. In 2023, a quantitative exploration was conducted in Montalvo, Ecuador, to assess the impact of the municipal Risk Management Plan. A questionnaire was applied to the inhabitants, revealing that effective risk management requires good planning, communication, education and coordination. It was concluded that resilience to floods is strengthened with continuous training for the population. The instrument used in this study on flood risk management is a good starting point for the questionnaire that will be applied to the rural community of Samborondón.

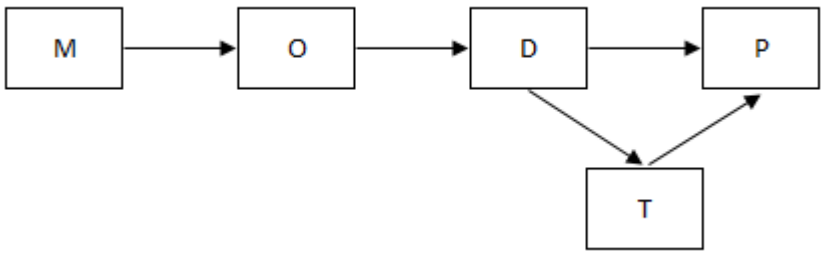
Theory of the Social Construction of Risk, Wisner et al. The UK's 2003 theory suggests that disasters are social phenomena that occur when a vulnerable population faces a threat, although they need a physical or natural mechanism to happen. Risk management should focus on increasing the resilience of communities to human-caused disasters, on the other hand, the UN Theory of Sustainable Development seeks to balance economic progress, equity and environmental conservation, ensuring that current generations meet their needs without harming future ones (UN, 1987). It is crucial that policymakers plan actions to reduce the social, economic, and ecological impacts of disasters, especially those related to floods in Ecuador.

METHODOLOGY

This project seeks to propose strategies to mitigate the impacts of floods, given that the current risk management model is inadequate, and is based on applied research. This decision was based on the National Council of Science, Technology and Technological Innovation of Peru, which indicated that this research offers new knowledge about visible realities with a practical objective. It seeks to establish, with validated scientific information, the means to satisfy a specific demand and solve a problem in the environment (CONCYTEC, 2018). This original study seeks to acquire new knowledge and achieve a practical objective, following Castro et al. (2023), which defines according to the Oslo Manual, the study adopted a quantitative approach, focused on the collection and interpretation of numerical data to answer the research question. This approach stands out for its objectivity and quantity, allowing the researcher to obtain adequate information for statistical analysis. Quantitative research focused on measurable data to ensure reproducible and generalizable findings, facilitating a deeper understanding of the phenomena. Quantitative research is fundamental in various disciplines, especially in the social sciences, becoming a key instrument for generating useful knowledge (Morán et al., 2025).

The quantitative exploration was performed without manipulating the independent variable. The impact of the independent variable on the dependent variable was analyzed through previous situations not caused by the researcher (Fossa, 2021), the research had a cross-sectional scope, observing the phenomenon in a single time point according to the researcher's strategy. The data was collected once and the deductions reflect the state at that time (Hernández – Sampieri & Mendoza, 2023).

Figure 1
Research Design Schematic



Note. Prepared by Dino Marcello Brambilla Serra.

Where:
M: Sample.
O: Observation.
D: Diagnosis and assessment.
T: Revision and theoretical argumentation aimed at understanding the phenomenon.

Q: Proposal of strategies to solve the problem expressed in a plan.

The first variable of the study was risk management, defined by Villalba (2022) as a collective and political mechanism that must be sustainable and territorially expanded. The components of risk must be assessed considering current or potential threats, the vulnerability of the community and its exposure to hazards, together with its training and participation capacities, in its operational definition, is a set of activities and processes aimed at reducing risks and dealing with the effects of floods. The variable is broken down into prevention, reduction, preparedness, response, and recovery actions, considering institutional and community capacities, which made it possible to establish strategies adjusted to the rural context, aligned with Ecuadorian regulations on comprehensive risk management (LOGIRD, 2024).
The second variable investigated seeks to identify the impacts of floods; its definition is presented below, in its conceptual definition: Segundo Green et al. Impacts are the effects of a hazardous event or flood disaster. It includes economic, human and environmental consequences, such as deaths, injuries, diseases and alterations in physical, emotional and social health, in its operational definition they are direct and indirect damages to infrastructure, economy, social welfare and habitat. Its relevance depends on the vulnerability of the community and its assets. For this second variable, the dimensions were classified into social, economic and ecological impacts.
The rural town under study, affected by floods, has 265 inhabitants, including children, adults and the elderly. We included people aged 15 to 65 years according to Godefoy et al; excluding those who are outside that range. With the inclusion and exclusion judgments, the study population was 167 inhabitants. The sample size was estimated considering a finite population, known or less than 100,000 elements (Maureira & Flores, 2024). The following formula was used to estimate the sample size:

$$n = \frac{N}{1 + \left[\frac{e^2 * (N-1)}{z^2 * pq}\right]}$$

Taking:
$n =$ Tamaño de la muestra
$N =$ Tamaño de la población
$z =$ Valor de 1,96 de distribución normal para nivel confianza 95% $p =$ Probabilidad de éxito (generalmente se utiliza 0,5)
$q =$ Probabilidad de fracaso $(1 - p)$
$e =$ Margen de error deseado (0,05 para margen error 95%)

$$n = \frac{167}{1 + \left[\frac{(0{,}05)^2 * (265-1)}{(1{,}96)^2 * (0{,}5 * 0{,}5)}\right]}$$

$$n = 116{,}61 \approx 117$$

The sample unit was established in 117 inhabitants of the rural locality.

Pérez and García (2023) state that the survey is the most widely used quantitative technique to collect and process data quickly and efficiently. A survey was carried out to directly obtain relevant information from the affected population on the study variables. A Likert-type questionnaire was used to obtain standardized data, facilitating descriptive statistical analysis. SPSS version 27 was used to automate complex statistical calculations in data processing.
Roco et al. (2024) state that, to measure the reliability of the instrument, Cronbach's alpha should be used, which evaluates the relationship between the elements of the test. There is no ideal value for this statistic, but a range between 0.7 and 0.9 is accepted. A pilot test was carried out with a questionnaire to 23 inhabitants of a similar rural population in Samborondón, obtaining a statistic of 0.83. To validate the instrument, five doctors in Public Management were consulted, who passed the questionnaire to apply it in the rural community of Samborondón. The criteria of sufficiency, clarity, coherence and relevance were evaluated.
Aiken's coefficient V, after the qualification of the experts, was used to validate the relevance of an appraisal appeal. Technique for evaluating the acceptability of content by specialists. This estimator varies

between 0 and 1, where 1 indicates total agreement among experts (Flores & Terán, 2022). The proposed instrument obtained a rating of 1.

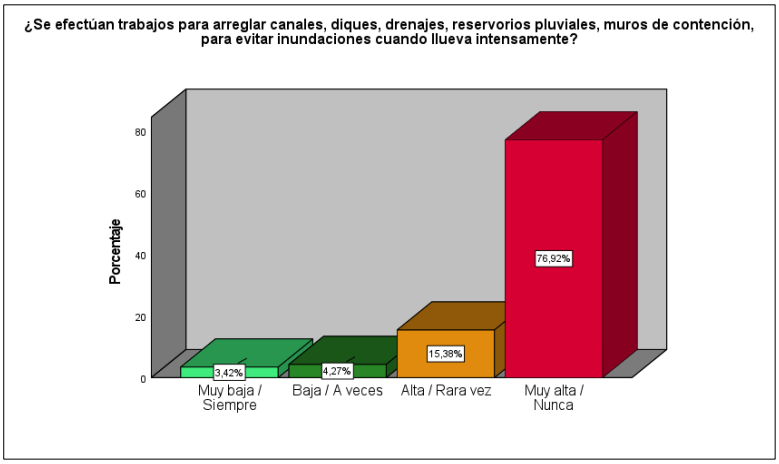
Ethical principles were respected in the research, citing and acknowledging other authors to avoid plagiarism and comply with University Council Resolution No. 0470-2022/UC updated the Code of Ethics in Research of the César Vallejo University. The informed consent of the participants was required, clarifying objectives, scope and confidentiality of the information. Anonymity, responsible use of data and respect for community culture were guaranteed. Voluntary participation was encouraged and results were shared with the community as part of the research engagement.

RESULTS

Specific Objective 1

Diagnose the level of vulnerability of the local population.

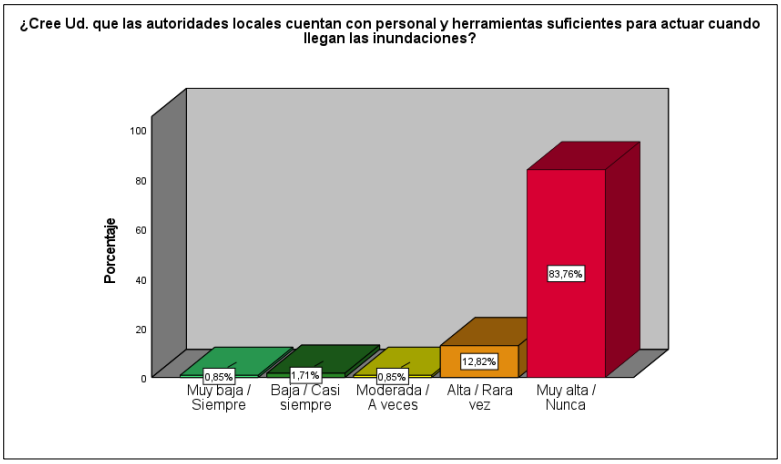
Figure 2 Level of physical vulnerability



Note. Prepared by Dino Marcello Brambilla Serra. Adapted from Guragain and Doneys (2022).

76.92% of the inhabitants surveyed indicated that no work was ever carried out in the locality by any level of government, which would make it possible to fix canals, dikes, drains, rainwater reservoirs or retaining walls, allowing the population to have a better response capacity to flood events; Along the same lines, 15.38% of those surveyed responded that this type of preventive work was rarely carried out, 4.27% stated that this type of action was sometimes implemented and a scant 3.42% stated that they were always carried out. In aggregate terms, the majority perception of the inhabitants of the community admits that there is a very high level of physical vulnerability in the territory and therefore in the community that inhabits it; since the relevant engineering works to mitigate the impacts generated by floods are not being developed.

Figure 3 Level of institutional vulnerability

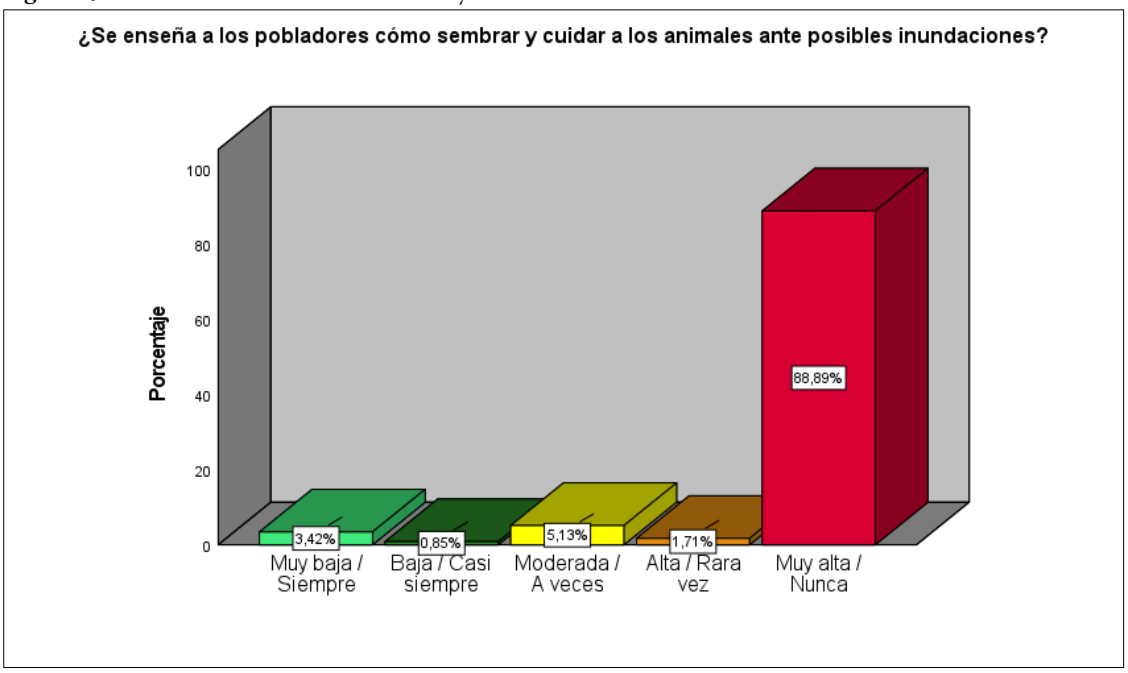


Note. Prepared by Dino Marcello Brambilla Serra. Adapted from Guragain and Doneys (2022).

83.76% of those surveyed considered that the institutions of Samborondón do not have adequate personnel or tools to manage flood emergencies. Only 12.82% said that they rarely handle necessary

resources, 0.85% mentioned that they are sometimes equipped, 1.71% that they almost always are, and another 0.85% said that they always arrive prepared. The shortage of personnel and materials in floods reveals a high institutional vulnerability.

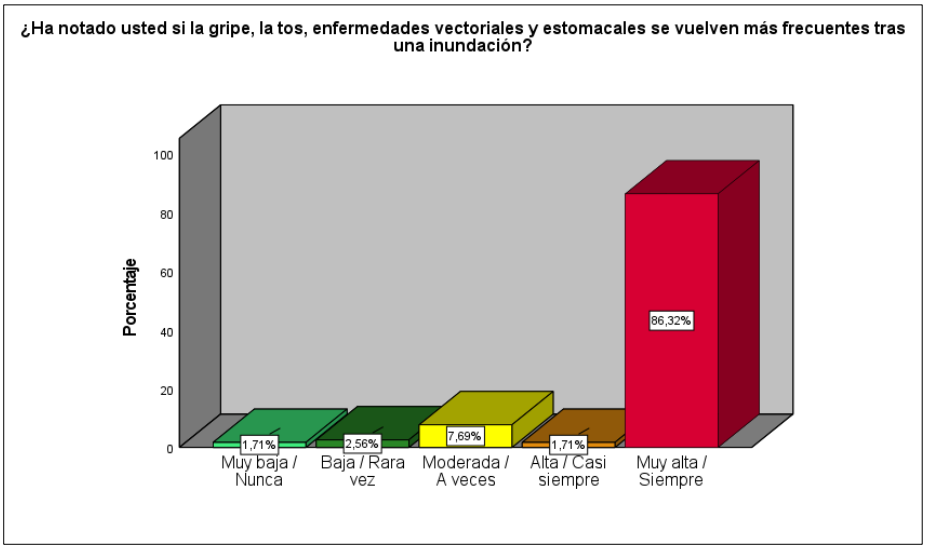
Figure 4 Level of economic vulnerability



Note. Prepared by Dino Marcello Brambilla Serra. Adapted from Guragain and Doneys (2022).

88.89% of respondents did not receive training on planting and animal care before floods. Only 1.71% reported rarely having participated in educational activities, 5.13% did so sometimes, and 0.85% almost always. Only 3.42% said they had constant access to information on crop and animal protection. The community shows high economic vulnerability, with agriculture and livestock as predominant activities.

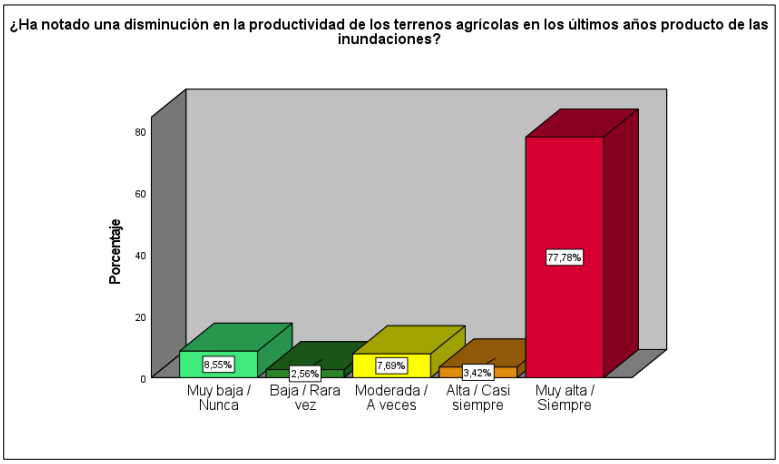
Figure 5 Level of social vulnerability



Note. Prepared by Dino Marcello Brambilla Serra. Adapted from Guragain and Doneys (2022).

89.32% of respondents stated that floods caused influenza and other ailments in the rural population, while 1.71% said that health problems almost always occurred. 7.69% indicated that this happens sometimes, 2.56% that it happens rarely, and another 1.71% stated that these diseases never occurred. The inhabitants of this area mention that their poor health during the winter and the El Niño phenomenon makes them more vulnerable, indicating a high level of social vulnerability.

Figure 6 Level of environmental or ecological vulnerability



Note. Prepared by Dino Marcello Brambilla Serra. Adapted from Guragain and Doneys (2022)

77.78% of respondents stated that floods always reduce agricultural productivity; 3.42% said almost always, 7.69% indicated that sometimes, 2.56% rarely and 8.55% never faced problems in their crops. The information collected showed that most of the respondents noticed a continuous impact on agricultural yield, evidencing high environmental vulnerability of soils to extreme weather events.

Specific Objective 2
Identify the impacts caused by flooding in the study area

Table 1 Social Impacts Dimension

	Never	Seldom	Sometimes	Almost always	Always
As a result of the floods, have families been forced to temporarily leave their homes?	36,8%	23,9%	11,1%	7,7%	20,5%
Have you noticed if flu, cough, vector and stomach diseases become more frequent after a flood?	1,7%	2,6%	7,7%	1,7%	86,3%
Is it common for the floods to generate psychological effects on the inhabitants, such as anxiety, fear or sadness?	1,6%	0,0%	2,6%	4,3%	91,5%

Note. Prepared by Dino Marcello Brambilla Serra

20.5% of the rural population studied always left their homes after floods, while 63.2% did so at least once. 86.3% of those surveyed indicated that after floods they always suffer from flu, cough, dengue fever and stomach problems. 91.5% suffered from depression due to hydrometeorological phenomena. This community had to be displaced and faced illnesses and mental health problems.

Table 2 Economic Impacts Dimension

	Never	Seldom	Sometimes	Almost always	Always
How often is your home or your community's infrastructure (roads, bridges, or schools) affected by flooding?	2,6%	0,0%	8,5%	10,3%	78,6%
Do families have less money coming in during the flood season?	0,0%	1,7%	0,0%	4,3%	94,0%
Do floods frequently affect crops and farm animals?	0,0%	0,0%	0,0%	6,0%	94,0%
Do families lend money to informal lenders to recover from the economic losses caused by the floods?	9,4%	5,1%	6,0%	12,8%	66,7%

Note. Prepared by Dino Marcello Brambilla Serra

78.6% of respondents stated that floods always affect local infrastructure, 94% noticed a decrease in income in winter, and the same percentage indicated that their crops and livestock always suffer from rains. In addition, 66.7% frequently resorted to informal loans to recover from economic losses, and 90.6% did so at least once. Serious damage to infrastructure, family and agricultural economic deterioration, and financial fragility were observed.

Table 3 Environmental Impacts Dimension

	Never	Seldom	Sometimes	Almost always	Always
Have the floods damaged water sources (wells, estuaries) used by the community?	40,2%	1,7%	3,4%	3,4%	51,3%
Have floods modified the course of rivers, canals or estuaries?	28,2%	3,4%	5,1%	8,5%	54,8%
Have you noticed a decrease in the productivity of agricultural land in recent years as a result of floods?	8,5%	2,6%	7,7%	3,4%	77,8%

Note. Prepared by Dino Marcello Brambilla Serra

51.3% of respondents indicated that floods have always damaged freshwater sources, and 59.8% said they have been affected at least once. In addition, 54.8% said that floods always altered rivers and canals, and 71.8% confirmed that this happened at some point, while only 28.2% said that it never impacted them. Finally, 77.8% reported a decrease in agricultural productivity due to rainfall, with 91.5% noting that this occurred at least once, and only 8.5% saying they never experienced it. Locals reported that the territory suffered environmental problems, such as the lack of clean water, alteration of water bodies and decreased harvests.

Specific Objective 3

Design strategies in the model to mitigate the social, economic, and environmental effects generated by flood events in the community studied.

Table 4 Prevention Dimension

	Always	Almost always	Sometimes	Seldom	Never
Do you think that local authorities provide timely information on possible flood threats?	0,9%	5,1%	1,7%	8,5%	83,8%
Have you been taken into account by local authorities when designing or updating flood risk management plans?	0,0%	0,0%	11,1%	7,7%	81,2%
Do the authorities help them reinforce their homes before the arrival of rains and floods?	0,8%	0,0%	1,7%	2,6%	94,9%
Are irrigation and natural canals cleaned prior to the rainy season?	6,0%	2,5%	31,6%	23,1%	36,8%
Do farmers in your community take steps to prevent flooding from damaging crops?	22,2%	0,0%	6,0%	6,8%	65,0%

Note. Prepared by Dino Marcello Brambilla Serra

83.8% of respondents said they were never informed about flooding; 81.2% were not considered in risk management plans, 94.9% did not receive help to reinforce homes before winter, 65% stated that farmers did not take precautions and 59.9% indicated that irrigation canals were rarely cleaned. Adequate actions were not taken to prevent flooding in this community.

Table 5 Mitigation Dimension

	Always	Almost always	Sometimes	Seldom	Never
Do the programs of the different public institutions prioritize the reduction of flood risks in your community?	0,0%	5,1%	2,6%	11,1%	81,2%
Is work being done to fix canals, dikes, drains, storm reservoirs, retaining walls, to prevent flooding when it rains heavily?	3,4%	0,0%	4,3%	15,4%	76,9%
Do local authorities take action to protect places that act as natural barriers against flooding? (canals, estuaries, wetlands, riparian forests, etc.)	4,2%	0,0%	9,4%	2,6%	83,8%
Are early warning systems in place to help reduce the impact of flooding?	0,8%	0,0%	2,6%	2,6%	94,0%

Note. Prepared by Dino Marcello Brambilla Serra

81.2% of those surveyed stated that the programs of the competent institutions never prioritized flood risk reduction; at the same time, 76.9% stated that engineering works were never carried out as a buffer

mechanism to mitigate their impacts; on the other hand, 83.8% stated that no local authority ever carried out actions to enhance natural barriers that minimize the force of overflows, and subsequently 94% warned that early warning systems were never implemented. It was possible to see that no operations were carried out in this community aimed at mitigating future flood impacts.

Table 6 Dimension Preparation and Capacity Building

	Always	Almost always	Sometimes	Seldom	Never
Do you think that the local authorities have enough personnel and tools to act when floods arrive?	0,8%	1,7%	0,9%	12,8%	83,8%
Do you have training events in your community, including evacuation drills, to know how to act in a flood?	0,0%	6,8%	17,1%	23,1%	53,0%
Are the villagers taught how to plant and care for the animals in the event of flooding?	3,4%	0,9%	5,1%	1,7%	88,9%
Do you think your community is better prepared to face a flood than it was 5 years ago?	5,1%	11,1%	12,8%	18,8%	52,2%

Note. Prepared by Dino Marcello Brambilla Serra

In this dimension, 83.8% of those questioned mentioned that the authorities never had sufficient personnel and tools to control flood events; In another aspect, 76.1% said that training days and drills were never or rarely carried out to be prepared for this threat, 88.9% answered that the inhabitants were never taught how to plant and how to take care of their animals in times of intense rain, and 71% stated that they never or rarely during the last five years. improved their preparedness for overflow disasters. In this context, it was assessed that this population was not trained or had capacity-building elements to be able to protect themselves in case of floods.

Table 7 Response Dimension

	Always	Almost always	Sometimes	Seldom	Never
Do institutions in your community act in coordination to help in a flood event?	3,4%	1,7%	7,7%	3,4%	83,8%
In a flood event, do you help those most in need first? (Children, older adults, pregnant women and people with disabilities)	10,3%	5,1%	2,6%	6,8%	75,2%
Have you used a safe place (school, church, community center) to shelter in case of a flood emergency?	0,0%	0,0%	0,9%	14,5%	84,6%
Are people affected by the floods receiving medical care in a timely manner?	5,1%	5,1%	20,5%	14,5%	54,8%

Note. Prepared by Dino Marcello Brambilla Serra

83.8% of the community had the perception that the competent institutions called upon to attend to the population in flood emergency events never act in a coordinated manner; Likewise, 75.2% said that never during disasters was aid to the most needy prioritized; only 15.4% of the inhabitants rarely or sometimes used a safe place as a shelter; Finally, in this same context, 54.8% of those surveyed revealed that they never received adequate medical care. The response received by the rural community after the disaster did not prove to be effective.

Table 8 Recovery Dimension

	Always	Almost always	Sometimes	Seldom	Never
Is priority given to the reconstruction of flood-damaged homes?	2,6%	0,0%	1,7%	3,4%	92,3%
After the floods, do the authorities carry out works to resist future similar events?	0,0%	0,0%	6,0%	8,5%	85,5%
Do the authorities support smallholder farmers to recover their crops after a flood?	1,7%	5,1%	6,0%	6,0%	81,2%
Are the supply of services such as drinking water, electricity or road building quickly reactivated?	1,7%	1,7%	2,6%	10,3%	83,8%

Note. Prepared by Dino Marcello Brambilla Serra

92.3% of the population did not see priority in the reconstruction of homes after floods; 85.5% said that local authorities never invest in infrastructure for future emergencies; 81.2% mentioned that farmers were not supported to recover their damaged crops; and 83.8% denounced the lack of reactivation of basic services such as drinking water and electricity. The data suggests that the community did not recover quickly after the rains.

DISCUSSION

This section compares the results of the exploration with theoretical and empirical references to identify coincidences, discrepancies and contributions to flood risk management in rural areas. The reflection is adapted to the objectives of the research and presents an analysis that integrates social, economic, environmental, institutional and governance approaches.

The diagnosis of vulnerability in Samborondón reveals high weakness in all categories: physical, institutional, economic, social and environmental. This outcome supports what Guragain and Doneys (2022) indicated, who, in a study in Nepal, found that social and physical factors are crucial in the vulnerability of flood areas, especially in rural households with a female majority. Accordingly, Godefoy et al. Institutional capacities and community dynamics directly affect risk exposure and mitigation.

The study confirms that the lack of investment in infrastructure, scarce personnel, lack of technical training and deficiencies in the health system increase the vulnerability of the population. This result supports the theory of the social construction of risk by Wisner et al. (2003) argues that disasters depend not only on natural phenomena, but also on socioeconomic conditions and exposure. In Samborondón, physical and institutional limitations lead to frequent flooding.

The results coincide with Kong (2024), who indicates that rural areas have less governance and risk management than urban areas. In Samborondón, the community lacks continuous technical assistance and does not participate in the development of prevention plans, which perpetuates its vulnerability. Zhang's (2022) conclusion on the need to increase investments in protective infrastructure is confirmed, as soil degradation and low agricultural productivity are due to the lack of preventive strategies.

The vulnerability diagnosis supports previous research and offers evidence for Ecuador, enriching the understanding of this problem in Latin America. Samborondón, despite its recurrent floods, lacks sustainable strategies and community programs, which fails to comply with international commitments to mitigate risks due to climate change.

The second specific objective reveals significant impacts of flooding in three key areas: social, economic and environmental. The population suffers recurrently from respiratory, vector, and gastrointestinal diseases, along with fear, anxiety, and depression after heavy rains. The Inter-American Development Bank (2023) warns of physical and mental problems, such as post-traumatic stress and anxiety, after hydrometeorological disasters in Latin America and the Caribbean.

The findings confirm Akram and Mushtaq (2024) about the deterioration of mental well-being in rural communities after floods, which include depression and suicidal thoughts. The evidence in Samborondón highlights the need to include mental health in risk management plans, an issue that is little addressed in Ecuador's public policies.

94% of respondents report reduced income and losses in crops and livestock during the rainy season. The findings coincide with Ibarra Armenta and Salazar Yánez (2024), who in their study in Mexico found that high family economic losses make planning to reduce vulnerabilities more effective than post-disaster compensation. Samborondón shows that the population resorts to informal loans, increasing their financial vulnerability and perpetuating debt. These results support what was mentioned by Uwayisenga et al. (2024) document that, in Rwanda, rural households sell assets or go into debt to face financial problems due to floods. In Samborondón, economic vulnerability affects rural communities with little savings and limited access to credit.

51.3% of the participants observe damage to freshwater sources and 77.8% report a decrease in agricultural productivity. It coincides with what was recorded by Zhu et al. (2025), on the decrease of ecosystem services in flood zones in China, with Avendaño et al. (2024) highlighting that, in the Atacama Desert, overflows impact crops, infrastructure, and habitats. In Samborondón, the environmental effects include the loss of soil fertility and water alteration, demonstrating that hydrometeorological events impact both the population and the ecological balance.

Community evidence supports the Theory of Sustainable Development, which holds that environmental degradation harms present and future needs. Repeated impacts on water resources and soils threaten food security and rural sustainability, underlining the importance of including the environmental dimension in risk management.

The third objective seeks to design strategies to mitigate the effects of floods, and the results suggest that a comprehensive approach to prevention, mitigation, preparedness, response and recovery is needed. This approach coincides with the vision of Villalba (2022), who argues that disaster risk management should be a collective and planned process, rather than isolated interventions.

The Samborondón community lacks training, early warnings and protection infrastructure, showing a focus on humanitarian assistance after disasters. This is consistent with what was observed by Badamosi et al. (2024) in Nigeria, where the community response was limited by the lack of a comprehensive plan, according to Santana et al. (2024) in Cuba, they highlight the importance of community educational strategies to reduce social vulnerability. In both cases, as in Samborondón, the lack of preparation aggravates the impacts and hinders recovery.

The proposal for a comprehensive management model in the area is based on coordinating social, economic and institutional aspects in a participatory manner. The evidence is in the work of Rahman et al. In 2024, in Indonesia, it is highlighted that participatory models increase the effectiveness of management by involving the community in evacuation plans and infrastructure. This approach fits Samborondón, as its inhabitants lack formal ways to participate in risk planning.

The technological component shows similarities with the experience of Abdul et al. By 2025 in Malaysia, mobile apps for rural environments optimized preparedness, response, and recovery. In rural Samborondón, despite the limited technological coverage, the increased availability of mobile phones offers an opportunity for accessible and inexpensive early warning systems. This brings innovation to the management model by integrating modern solutions in a vulnerable environment.

The results suggest that strategies should encompass both the material and the psychosocial. The high percentage of people affected by emotional damage after the floods, according to Rameli et al., is revealing. (2024), the urgency of including psychological and community care in disaster management. In Samborondón, symptoms of anxiety and depression persist without addressing in previous interventions.

In conclusion, the findings support that a comprehensive flood risk model should include community resilience to anticipate, cope with, and recover from disasters. Meléndez and Gutiérrez (2024) propose seven dimensions to assess rural resilience, including infrastructure and socio-cultural capital. The case of Samborondón shows the importance of including social capital and community organization, which have notable deficiencies.

The analysis of results reveals three key contributions. Vulnerability in Samborondón is related to common structural factors in rural areas, but with greater institutional neglect. The social, economic, and environmental impacts of flooding are complex and long-lasting, affecting the life and health of the community. Mitigation strategies must be comprehensive, encompassing prevention, education, community, and the environment, rather than just reacting to the crisis. The study offers specific evidence

that enriches the debate on flood risk management and underscores the need to strengthen community resilience in Samborondón with a participatory and sustainable methodology adapted to its territory.

CONCLUSIONS

This study demonstrates that a comprehensive flood risk management model is necessary for the rural community of Samborondón. The analysis of data and its comparison with theories confirmed that the lack of an articulated model limited the resilience of the population, perpetuating its structural vulnerability. The comprehensive model identified that risk management must systematically include prevention, mitigation, preparedness, response, and recovery, encompassing social, economic, environmental, and institutional dimensions.

The first specific objective revealed that the community presents a high level of vulnerability in all the dimensions analyzed: physical, institutional, economic, social and environmental. The results showed a lack of flood control infrastructure, limitations in risk management, absence of technical training, and poor health and sanitation services. These restrictions led to floods becoming frequent disasters, evidencing the structural weakness of the territory.

The second specific objective identified that the floods affected the community socially, economically and environmentally. Families moved from their homes and suffered an increase in respiratory, vector, gastrointestinal diseases and psychological problems. Households reported losses in crops and livestock, damage to homes, lower incomes, and debts to informal lenders. The floods damaged soil fertility, polluting waters and altering rivers, affecting food security and sustainability. These findings confirmed the complexity of the impacts and the need for a comprehensive approach to risk management.

The third specific objective established that the community requested preventive and corrective actions to mitigate social, economic and environmental effects in material and psychosocial dimensions. The results showed that the population lacked early warnings, management plans, continuous training and institutional support in prevention and recovery. It was proposed to include measures to strengthen community resilience, such as canal maintenance, agricultural training, post-disaster psychological care, accessible warning systems, and population participation in planning. The need to coordinate actions between local, national and international authorities to ensure the sustainability of the proposals was highlighted.

In summary, the research concluded that it is essential to implement a comprehensive flood risk management model to leave the backlash behind and adopt a preventive and sustainable approach. It was confirmed that the model must be adapted to the characteristics of rural Samborondón to reduce vulnerability and strengthen resilience to hydrometeorological events.

REFERENCES

1. Abdul, S., Yogarayan, S., Ali Bukar, U. y Sayeed, S. (2025). Managing Flash Flood Crises with Cultural Perspectives: Auser-Centric Feature Identification Study . Retrieved May 18, 2025, from https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0318996

2. Akram, S. & Mushtaq, S. (2024). Environmental change and floods: the long-ignored effects of displacement on mental health. Recuperado el 14 de septiembre de 2025, de https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2024.1434123/full

3. Avendaño, C., Pino, E., Espinoza, J., Cabrera, F., Ramos, L., Chávarri, E., Ingol, E., Vera, B., & Ascencios, D. (2024). The Impact of Floods in the Northern Zone of the Atacama Desert: A Systematic Historical Review of Events in the Period 1911 to 2022. Retrieved June 1, 2025, from https://www.scielo.cl/pdf/rda/n75/0719-2681-rda-75-48.pdf

4. Badamosi, A., Olutumise, A., Olukoya, O., Adegoroye, A. & Aturamu, O. (2024). Socioeconomic Impacts of Flooding and its Coping Strategies in Nigeria: Evidence from Dagiri Community, Gwagwalada Area Council of Abuja. Recuperado el 13 de junio de 2025, de https://www.scopus.com/record/display.uri?eid=2-s2.0-85197496538&doi=10.1016%2fj.nhres.2023.09.010&origin=inward&txGid=7c270afad98327b3126028d4f4c0049f

5. Can Thu, V., Hoang, T., Can The, V., Le Ngoc, A., Vu Thi, V. & Dung Duc, T. (2024). Unveiling Flood Vulnerability in the Vietnamese Mekong Delta: A Case Study of an Giang Province. Recuperado el 3 de julio de 2025, de https://www.scopus.com/pages/publications/85189698378

6. Castro, J., Gómez, L., & Camargo, E. (2023). Applied research and experimental development in the. Retrieved July 1, 2025, from http://www.scielo.org.co/pdf/tecn/v27n75/0123-921X-tecn-27-75-140.pdf

7. International Centre for Research on the El Niño Phenomenon. (2022). Diagnostic Report on the Conditions of Preparedness, Response and Resilience of the Smborondón Canton. CIIFEN.

8. Chen, H., Zhang, H., Jang, S., Liu, X., Xing, L., Wu, Z., Zhang, L., Liu, Y. & Chen, C. (2024). Road Criticality Assessment to Improve Commutes during Floods. Recuperado el 4 de julio de 2025, de https://www.scopus.com/pages/publications/85178494833

9. National Council of Science, Technology and Technological Innovation. (2018). Retrieved June 12, 2025, from CONCYTEC: https://prociencia.gob.pe/wp-

content/uploads/Portal%20de%20Transparencia/2024/Normas%20de%20Creaci%C3%B3n%20de%20la%20Entidad/Ley%2030806.pdf
10. De Cartro, P., Rodrigues, P. & Jatobá, A. (2024). The Climate Tragedy in Rio Grande do Sul and the National Force of the SUS: resilience-centered public policy in the face of new health crises. Recuperado el 9 de julio de 2025, de https://www.scielosp.org/pdf/csc/2025.v30suppl1/e09852024/en
11. Echendu, A. (2024). Applicability of Indigenous knowledge and Methods in Flood Risk Management in a Nigerian City. Recuperado el 4 de julio de 2025, de https://www.scopus.com/pages/publications/85194032534
12. Economic and Social Commissiom for Asia and the Pacific. (2023). Seizen the Moment Targeting Tansformative Disaster Risk Resilience. Recuperado el 12 de mayo de 2025, de https://un-ggim-ap.org/sites/default/files/media/docs/Asia-Pacific%20Disaster%20Report%202023-Full%20report.pdf?utm_source=chatgpt.com
13. Flores, J. & Terán, M. (2022). Validity of Expert Judgment Content on an Instrument to Measure the Influence of Psychosocial Factors on Organizational Stress in Hotel Companies. Retrieved June 12, 2025, from https://www.revistas.espol.edu.ec/index.php/compendium/article/view/1130
14. World Wide Fund for Nature. (2024). How to Adapt to the Extreme Effects of Climate Change: Floods and Droughts. Retrieved May 23, 2025, from https://wwfes.awsassets.panda.org/downloads/adaptacionefectoscc.pdf
15. Fossa, P. (2021). Research Methodology Manual. Retrieved June 7, 2025, from https://psicologia.udd.cl/files/2021/04/Metodolog%C3%ADa-PsicologiaUDD-2-1.pdf
16. Provincial Decentralized Autonomous Government of Guayas. (2024). Provincial Action Plan of the Prefecture of Guayas for Rainy Season and Water Deficit. Retrieved May 25, 2025, from https://guayas.gob.ec/wp-content/uploads/dmdocuments/Plan-Provincial/PLAN-ACCION-PROVINCIAL-2024-2025.pdf
17. Godefoy, E., Cristiá, S., & Travieso, C. (2023). Havana: population, social vulnerability and risk perception of hydrometeorological hazards. Retrieved September 3, 2025, http://scielo.sld.cu/pdf/reds/v11n3/2308-0132-reds-11-03-e30.pdf
18. Green, J., Haigh, I., Quinn, N., Neal, J., Wahl, T., Wood, M., Eilander, D., de Ruiter, M., Ward, P. y Camus, P. (2025). Review Article: A Comprehensive Review of Compound Flooding Literature with a Focus on Coastal and Estuarine Regions. Recuperado el 9 de junio de 2025, de https://nhess.copernicus.org/articles/25/747/2025/nhess-25-747-2025.pdf
19. World Bank Group. (2021). Roadmap for Climate Action in Latin America and the Caribbean 2021-2025. Retrieved on May 22, 2025, https://openknowledge.worldbank.org/server/api/core/bitstreams/1a7421c1-fa2b-58b9-b2ed-b8f6e07bf392/content
20. Guragain, U.P. & Doneys, P. (2022). Social, Economic, Environmental, and Physical Vulnerability Assessment: An Index-Based Gender Analysis of Flood Prone Areas of Koshi River Basin in Nepal. Recuperado el el 2 de de septiembre de 2025, de https://www.mdpi.com/2071-1050/14/16/10423
21. Hernández S, R., & Mendoza, T, C. (2023). Research Methodology: The Quantitative, Qualitative and Mixed Routes. Retrieved September 13, 2025
22. Hernández, B., Vásquez, M., Ariza, E., & Tapia, M. (2023). Applied Research: Creating a Research Culture from Academic Programs. Retrieved June 7, 2025, from https://www.researchgate.net/publication/377775865_INVESTIGACION_APLICADA_CREANDO_CULTURA_INVESTIGATIVA_DESDE_LOS_PROGRAMAS_ACADEMICOS
23. Ibarra, C. y Salazar, J. (2024). Estimation of the economic impact caused by flooding events in dwellings in Sinaloa, Mexico. Recuperado el 15 de mayo de 2025, de https://www.scielo.org.mx/pdf/au/v34/2007-9621-au-34-e4005.pdf
24. Inter-American Development Bank. (2023). Health and Climate Change: How do we protect peoples's health in the climate crisis? Recuperado el 13 de septiembre de 2025, de https://publications.iadb.org/en/health-and-climate-change-how-do-we-protect-peoples-health-climate-crisis
25. Kong, F. (2024). Rising to the Climate Challenge: Better Understanding the Rural Rainstorm Flooding Disaster Risk Management Using Practical Insights from China. Recuperado el 19 de junio de 2025, de https://ascelibrary.org/doi/10.1061/NHREFO.NHENG-1877
26. Koralay, N. & Kara Ö. (2024). Assessment of flood risk in Söğütlü stream watershed of Trabzon province in Turkey using geographic information systems and analytic hierarchy process approach. Recuperado el 3 de julio de 2025, de https://www.scopus.com/record/display.uri?eid=2-s2.0-85191052759&doi=10.1007%2fs11069-024-06594-1&origin=inward&txGid=5c8d4ee64b7b74b9303222e49fd27c3b
27. Maureira, C. & Flores, E. (2024). Manual of Quantitative Research. Retrieved June 7, 2025, from https://www.researchgate.net/publication/346927987_Manual_de_investigacion_cuantitativa_3_edicion
28. Mejía, M., Ruilova, M., & Mendiburu, F. (2023). Risk management plan and its impact on the prevention of natural disasters in the canton of Montalvo. Retrieved June 19, 2025, from https://dialnet.unirioja.es/servlet/articulo?codigo=9048726
29. Meléndez, A. & Gutiérrez, M. (2024). Flood Resilience Quantification Framework of Rural Communities: Case Study of Harlan County, Kentucky. Recuperado el 13 de junio de 2025, de https://www.scopus.com/record/display.uri?eid=2-s2.0-85196733029&doi=10.1061%2fNHREFO.NHENG-1949&origin=inward&txGid=ad6ca8c56e9f1e5f3b4b48807352c281
30. Minguez, B., Ahmed, M., Elgadi, E. & Elkhalifa, A. (2024). Sudan's climate-culture story: a project with HEART – Heritage Empowered Action for Risk in Tuti. Recuperado el 3 de julio de 2025, de https://www.scopus.com/pages/publications/85206350405
31. Morán, N., Zavala, D., Intriago, A., Ávila, R., Guerrero, H., Tuárez, H., Pinargote, B., & Pilay, N. (2025). Scientific Research Methodology: Design of Quantitative Research. Retrieved June 7, 2025, from https://editorialalema.org/libros/index.php/alema/article/view/45/45
32. Munpa, P., Dubsok, A., Phetrak, A., Sirichokchatchawan, W., Taneepanichskul, N., Lohwacharin, J., Kittipongvises, S. & Polprasert, C. (2024). Building a Resilient City through Sustainable Flood Risk Management: The Flood-Prone Area of Phra Nakhon Sri Ayutthaya, Thailand. Recuperado el 4 de julio de 2025, de https://www.mdpi.com/2071-1050/16/15/6450
33. United Nations. (1987). Report of the World Commission on Environment and Development. Retrieved May 30, 2025, from https://www.ecominga.uqam.ca/PDF/BIBLIOGRAPHIE/GUIDE_LECTURE_1/CMMAD-Informe-Comision-Brundtland-sobre-Medio-Ambiente-Desarrollo.pdf

34. United Nations. (2022). Sustainable Development Goals Report. Retrieved September 13, 2025, from https://unstats.un.org/sdgs/report/2022/The-Sustainable-Development-Goals-Report-2022_Spanish.pdf
35. Organization for Cooperation and Economic Development. (2023). Towards Climate Resilience and Neutrality in Latin America and the Caribbean. Recuperado el 18 de mayo de 2025, de https://www.oecd.org/en/publications/towards-climate-resilience-and-neutrality-in-latin-america-and-the-caribbean_278e52e8-en.html
36. Pazhuhan, M. & Amirzadeh, M. (2024). Flood risk perception and disaster preparedness in marginalised flood-prone communities: evidence from Saadi neighbourhood, Shiraz, Iran. Recuperado el 4 de julio de 2025, de https://www.scopus.com/pages/publications/85181725212?inward
37. Pérez, L., Pérez, R., & Seca, M. (2023). Scientific Research Methodology. Retrieved June 7, 2025, from https://www.researchgate.net/publication/370048989_Metodologia_de_la_investigacion_cientifica
38. Pérez, S. & García, S. (2023). Quantitative research. Retrieved June 7, 2025, from https://www.researchgate.net/publication/370658808_La_investigacion_cuantitativa
39. Prada, A. & Arrieta, H. (2024). Analysis of Disaster Risk Management in the Department of Piura to Address the El Niño Phenomenon. Retrieved July 11, 2025, from http://www.scielo.org.pe/pdf/kaw/n14/2709-3689-kaw-14-D-002.pdf
40. Rahman, B., Akmal, M., Muzaffarsyah, T. & Yunanda, R. (2024). Community Participation in Flood Management Systems in Aceh Utara Regency. Recuperado el 3 de julio de 2025, de https://www.scopus.com/pages/publications/85209185290
41. Rameli, N., Majid, N., & Mohamed, A. (2024). Assessing Community Resilience to Flood Disasters: A Case Study of Temerloh, Pahang. Recuperado el 4 de julio de 2025, de https://www.scopus.com/pages/publications/85205125328
42. Official Register - Third Supplement No. 488. (2024). Organic Law for Comprehensive Disaster Risk Management. Retrieved June 29, 2025, from https://strapi.lexis.com.ec/uploads/Tercero_3a2bb56a37.pdf
43. Roco, A., Flores, S., Olguín, M., & Maureira, N. (2024). Cronbach's alpha and its confidence interval. Retrieved June 12, 2025, from https://scielo.isciii.es/pdf/nh/v41n1/0212-1611-nh-41-1-270.pdf
44. Salih, A. & Hassablla, A. (2024). Flash Flood Risk Assessment in the Asir Region, Southwestern Saudi Arabia, Using a Physically-Based Distributed Hydrological Model and GPM IMERGSatellite Rainfall Data. Recuperado el 3 de julio de 2025, de https://www.scopus.com/pages/publications/85197314628
45. Santana, R., Pérez, F., Díaz, P., Hérnández, O., Jova, M., & Rodríguez, H. (2024). Disaster Risk Prevention from Extension. Retrieved June 1, 2025, http://scielo.sld.cu/pdf/edu/v16/2077-2874-edu-16-e2932.pdf
46. Sauer, I., Mester, B., Frieler, K., Zimmermann, S., Schewe, J. y Otto, C. (2024). Limited Progress in Global Reduction of Vulnerability to Flood Impacts over the Past Two Decades. Recuperado el 28 de mayo de 2025, de https://www.nature.com/articles/s43247-024-01401-y
47. Shiwomeh, D., Kantoush, S., Sumi, T., Nguyen, B. & Abdrabo, K. (2024). Holistic Mapping of Flood Vulnerability in Slums Areas of Yaounde. Recuperado el 3 de julio de 2025, de https://www.researchgate.net/profile/Binh-Nguyen-187/publication/385507115_HOLISTIC_MAPPING_OF_FLOOD_VULNERABILITY_IN_SLUMS_AREAS_OF_YAOUNDE_CITY_CAMEROON_THROUGH_HOUSEHOLD_AND_INSTITUTIONAL_SURVEYS/links/67486454876bd17778 2b39db/Holistic-mapping-of-flood
48. Thijs, E., Wouter, B., Hans, dM., Kymo, S., Matthijs, K. & Jeroen, A. (2024). Enhancing resilience: Understanding the Impact of Flood Hazard and Vulnerability on Business Interruption and Losses. Recuperado el 3 de julio de 2025, de https://www.scopus.com/pages/publications/85191999249
49. United Nations Office for Disaster Risk Reduction. (2021). Towards an IGAD Regional Flood Risk Profile. Recuperado el 15 de mayo de 2025, de https://www.icpac.net/documents/749/towards-a-regional-flood-risk-profile.pdf
50. United Nations University: Institute for Environment and Human Security. (2021). Flood risk assessment in Ecuador. Retrieved May 26, 2025, from https://collections.unu.edu/eserv/UNU:8434/VALE_Flood_Risk_Assesment_Report_Ecuador_SPA_FINAL_META.pdf
51. Uwayisenga, A., Adelekan, I. & Oguge, N. (2024). Assessment of impacts of flood and coping strategies among rural households in Gicumbi district, Rwanda. Recuperado el 3 de julio de 2025, de https://www.scopus.com/pages/publications/85194729008
52. Villalba, C. (2022). Comprehensive Disaster Risk Management. Argentine Ministry of Security. Retrieved June 1, 2025, from https://www.argentina.gob.ar/sites/default/files/2022/10/gestion_integral_de_riesgos_de_desastres.pdf
53. Wisner, B., Blaikie, P., Cannon, T. & Davis, I. (2003). At Risk: Natural Hazards, People's Vulnerability and Disasters. Recuperado el 24 de mayo de 2025, de https://www.preventionweb.net/files/670_72351.pdf
54. World Metereological Organization. (2021). WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970–2019). Recuperado el 12 de mayo de 2025, de https://wmo.int/publication-series/wmo-atlas-of-mortality-and-economic-losses-from-weather-climate-and-water-extremes-1970-2019
55. Zambrano, M. & Macías, L. (2021). Social Capacities in Families in the Urban Area of the Canton of Chone in the Face of Physical Vulnerability to the Threat of Floods. Retrieved July 11, 2025, from http://scielo.senescyt.gob.ec/pdf/rehuso/v6n3/2550-6587-rehuso-6-03-00103.pdf
56. Zhang, Y. (2022). Drought and Flood Control of Agricultural Lands and Optimization Method of Planting Structure. Retrieved June 13, 2025, from http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S1794-61902022000400303
57. Zhou, M., Quisheng, H., Gu, Y, Wang, K. & Shen, K. (2025). Urban Flood Resilience Assessment of Prefecture-Level Cities in Yangtze River Delta. Recuperado el 1 de junio de 2025, de https://www.mdpi.com/2220-9964/14/3/108
58. Zhu, Z., Zhang, S., Zhang, Y., Lu, H., Feng, X., Jin, H. & Gao, Y. (2025). Flood Risk Transfer Analysis based on the "Source-Sink" Theory and its Impact on Ecological Environment: A case Study of the Poyang Lake Basin, China. Recuperado el 29 de junio de 2025, de https://www.scopus.com/record/display.uri?eid=2-s2.0-85186270088&doi=10.1016%2fj.scitotenv.2024.171064&origin=inward&txGid=35f675d28e0a51b8595014ce1652add6