Research, Society and Development, v. 14, n. 11, e56141149930, 2025
(CC BY 4.0) | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v14i11.49930

Structural Equation Modeling applied to the analysis of staying in risk areas: Case study of the Beira city

Modelagem de Equações Estruturais aplicada à análise da permanência em áreas de risco: Estudo de caso da cidade de Beira

Modelización de Ecuaciones Estructurales aplicada al análisis de la permanencia en zonas de riesgo: Estudio de caso de la ciudad de Beira

Received: 10/27/2025 | Revised: 11/06/2025 | Accepted: 11/07/2025 | Published: 11/08/2025

Nelson Mário Banga
ORCID: https://orcid.org/0000-0001-9917-4075
Universidade Zambeze, Moçambique
E-mail: nlsnbanga@gmail.com
Eufrásio João Sozinho Nhongo
ORCID: https://orcid.org/0000-0002-5453-7845
Universidade Zambeze, Moçambique
E-mail: eufrasionhongo@yahoo.com
Jone João Mugondo
ORCID: https://orcid.org/0009-0005-8586-0468
Universidade Zambeze, Moçambique
E-mail:johnsonmugondo@gmail.com

Abstract
Mozambique, and specifically the city of Beira, faces high vulnerability to floods and cyclones, exacerbated by its low coastal elevation and disorganized urban expansion into risk areas. This vulnerability is multidimensional. This study aimed to analyze the determining factors of the population's permanence in Beira's risk zones, despite the threat of recurrent disasters. A quantitative study was conducted, surveying 337 individuals in vulnerable neighborhoods. Structural Equation Modeling (*SEM*) was used to investigate the impact of economic, social/cultural, psychological, and structural factors on the intention to stay. SEM revealed that the main determinant of permanence is the social/cultural factor (β=0.978, $p<0.001$), confirming the direct influence of community ties and territorial identity. This single factor accounted for 89.7% of the variance in permanence. Conversely, economic, structural, and psychological factors were not direct predictors, but exhibited strong positive correlations among themselves, operating as an interdependent cluster. Permanence is primarily a decision of belonging and collective identity, rather than one of individual logic. Disaster risk reduction and resettlement policies must, therefore, prioritize the social and cultural factor, focusing on strategies that rebuild or maintain social networks in new locations to ensure intervention effectiveness.
Keywords: Permanence in Risk; Social and Cultural Factor; Beira.

Resumo
Moçambique e, especificamente, a cidade da Beira, apresentam alta vulnerabilidade a inundações e ciclones, agravada pela baixa altitude costeira e pela expansão urbana desordenada em áreas de risco. Este estudo buscou analisar quais fatores latentes determinam a permanência das populações da Beira nessas áreas de risco, mesmo diante da ameaça de desastres recorrentes. Foi realizado um estudo quantitativo, com a aplicação de questionários a 337 indivíduos em bairros de risco. A análise foi conduzida através da Modelagem de Equações Estruturais (*SEM*), investigando o impacto de factores econômicos, social e cultural, psicológicos e estruturais sobre a intenção de permanência. O *SEM* demonstrou que o principal determinante da permanência é o factor social e cultural (β=0.978, $p<0.001$), validando a hipótese da influência directa dos vínculos comunitários e identidades territoriais. Este factor singular explicou 89,7% da variância da permanência. Em contraste, os factores econômico, estrutural e psicológico não se mostraram preditores directos, mas apresentaram fortes correlações positivas entre si, actuando como um *cluster* interdependente. A permanência é primariamente uma decisão de pertença e identidade coletiva, e não de lógica individual. As políticas de redução de risco e reassentamento devem, portanto, priorizar o factor social/cultural, focando em estratégias que reconstruam ou mantenham as redes sociais nos novos locais para garantir a eficácia da intervenção.
Palavras-chave: Permanência em Risco; Factor Social e Cultural; Beira.

Resumen
Mozambique, y concretamente la ciudad de Beira, se enfrenta a una elevada vulnerabilidad ante las inundaciones y los ciclones, agravada por su baja elevación costera y la expansión urbana desorganizada hacia zonas de riesgo. Esta vulnerabilidad es multidimensional. El objetivo de este estudio era analizar los factores determinantes de la permanencia de la población en las zonas de riesgo de Beira, a pesar de la amenaza de desastres recurrentes. Se llevó a cabo un estudio cuantitativo, en el que se encuestó a 337 personas de barrios vulnerables. Se utilizó el modelo de ecuaciones estructurales (SEM) para investigar el impacto de los factores económicos, socioculturales, psicológicos y estructurales en la intención de permanecer. El SEM reveló que el principal determinante de la permanencia es el factor sociocultural (β=0,978, $p<0,001$), lo que confirma la influencia directa de los lazos comunitarios y la identidad territorial. Este único factor representó el 89,7 % de la varianza en la permanencia. Por el contrario, los factores económicos, estructurales y psicológicos no fueron predictores directos, pero mostraron fuertes correlaciones positivas entre sí, funcionando como un grupo interdependiente. La permanencia es principalmente una decisión de pertenencia e identidad colectiva, más que una decisión basada en la lógica individual. Por lo tanto, las políticas de reducción del riesgo de desastres y reasentamiento deben dar prioridad al factor social y cultural, centrándose en estrategias que reconstruyan o mantengan las redes sociales en los nuevos lugares para garantizar la eficacia de la intervención.
Palabras clave: Permanencia en el Riesgo; Factor Social y Cultural; Beira.

1. Introduction

Mozambique is highly vulnerable to natural disasters, particularly floods and tropical cyclones, due to its geographical location, low coastal elevation, and exposure to extreme weather events (Otto et al., 2022; Mozambique Country Climate Risk Assessment Report, 2020). The city of Beira, located in the central coastal zone, presents a high risk because of its high population density, unplanned urban expansion, and the presence of informal settlements in low-lying areas prone to flooding (Diamantini et al.,2024; Cambanhane et al., 2025). Urban vulnerability is, therefore, multidimensional, involving socioeconomic, cultural, psychological, and structural factors (Manyena & Pelling, 2017; Hassan & Bhamidipati, 2018).

Among the determinants of remaining in place, the literature highlights low income and dependence on informal activities, which limit mobility (Hassan & Bhamidipati, 2019). However, social and cultural ties, such as strong community bonds and territorial identities (Duygan & Welle, 2018), also reinforce resistance to relocation, even in the face of recurring threats. Psychological factors, such as the normalization of risk and a reduced perception of vulnerability (Thaler & Hartmann, 2018), along with structural failures (Macamo et al., 2019; Amal et al., 2018), the occupation of low-lying areas, and insufficient drainage infrastructure, contribute to the so-called "risk trap" (Adger et al., 2011). The behavior of remaining in place is thus the result of the complex interaction between these multiple constraints.

Despite the high risk of recurring disasters, many families in Beira remain in areas highly exposed to flooding. This persistence stems from factors such as financial constraints in obtaining safe alternatives (World Bank, 2017), community ties and local traditions that outweigh fear of the threat, and reduced risk perception. Considering that this persistence is a multidimensional phenomenon resulting from the complex interaction of multiple factors, the central question of this research arises: ‘‘*Which factors determine the persistence of the populations of the city of Beira in flood risk areas, and how does their interaction reinforce this persistence?*’’

Understanding the interactions between the factors that determine remaining in exposed areas is essential for guiding effective public policies on urban planning and planned resettlement. The use of Structural Equation Modeling (SEM) was the chosen tool to analyze the determinants of staying in flood risk areas, as it allows the integration and testing of interrelationships (hypotheses) between multiple latent and observable variables (economic, social, cultural, and psychological), which, on their own, would not explain the complex decision not to relocate. The ability of SEM to capture these interdependent influences is crucial, as demonstrated by studies that reveal the connections between socioeconomic vulnerability, risk perception, and resilience (Ahmed et al., 2020), and how factors such as poverty and infrastructure shape vulnerability (Seng et al., 2018).

This robust approach not only elucidates how the perception of risk severity and the perceived effectiveness of measures influence migration intention (Bubeck et al., 2012), but also underscores the importance of community participation and local knowledge in resilience and protective attitudes (Opere et al., 2021; Arfanuzzaman & Atiq Rahman, 2017), ultimately providing the technical support necessary for resettlement policies and resilient urban planning (Eze et al., 2020). In order to analyze which latent factors determine the persistence of Beira's populations in these risk areas, even in the face of recurring disaster threats, the following hypotheses were tested:

H1: Economic factors positively influence staying in risk areas.

H2: Psychological factors contribute to explaining the decision to stay in risk areas.

H3: Social and cultural factors exert significant influence on staying in risk areas.

H4: Structural factors have a direct or indirect effect on staying in risk areas.

H5: The interrelationships between the factors (economic, social, psychological, and structural) strengthen the tendency to stay in risk areas.

This study aimed to analyze the determining factors of the population's permanence in Beira's risk zones, despite the threat of recurrent disasters. By integrating socio-economic, psychological, cultural, and structural dimensions, the research seeks to provide a comprehensive understanding of the drivers behind continued settlement in high-risk areas. This analytical framework not only supports the formulation of more effective disaster risk reduction and urban resilience strategies but also contributes to evidence-based policymaking for sustainable urban development in climate-vulnerable regions.

2. Methodology

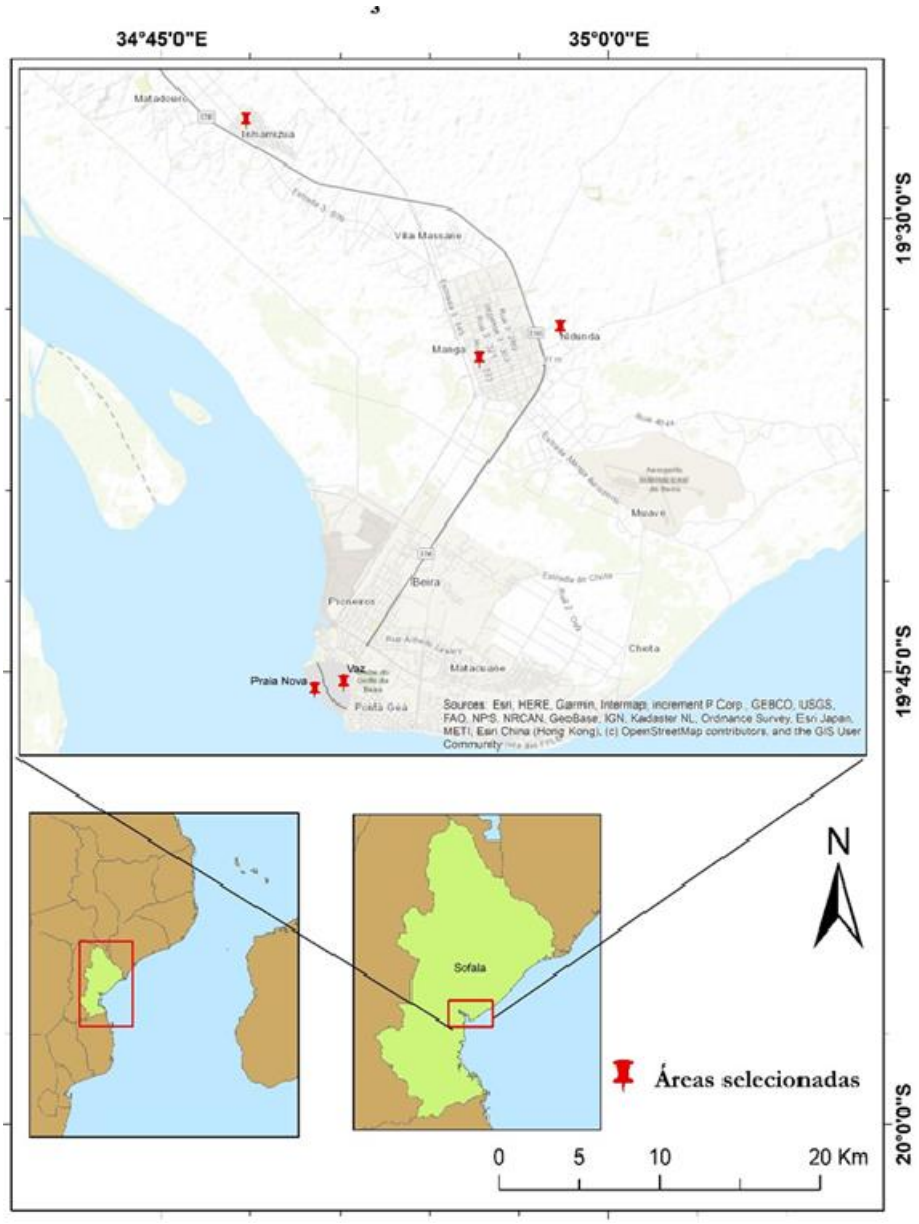
We applied a mixed-method survey design, which combines the strengths of qualitative and quantitative data collection methods. The qualitative component consisted of social research with respondents, while the quantitative part involved field research using a Likert scale (Pereira et al., 2018). Data were analyzed using simple descriptive statistics with variables such as gender, age, and education, as well as mean values, standard deviation, absolute frequency, and relative percentage frequency (Shitsuka et al., 2014).

2.1 Field of Study

The study was conducted in the City of Beira (Figure 1), a coastal area characterized by low altitude and high vulnerability to flooding and cyclones. The research population consisted of 2,138 people aged between 20 and 70 years residing in five high-flood-risk neighborhoods. Participant selection was carried out based on convenience and accessibility in areas of highest exposure to risk. The final sample consisted of 337 individuals, obtained using Slovin's Equation, considering a margin of error (e) of 5% (Equation 1).

$$n = \frac{N}{1+Ne^2} \quad (1)$$

Figure 1 - location of the study area.



Source: Authors.

Data collection was carried out through face-to-face interviews using a structured questionnaire. The instrument covered demographic and socioeconomic data (such as gender, age, income, and household size) and observed variables (items) to measure the reasons for remaining in the risk area. To assess the intensity of these reasons, a five-point Likert scale was used (1 = strongly disagree; 5 = strongly agree). To ensure the validity of the information, the scope of the research and the questions were explained to the respondents prior to collection, ensuring full understanding of the study. The analysis of the observed variables was conducted using Structural Equation Modeling (SEM) in R software, with the observed variables grouped into five latent constructs, or factors (Table 1).

Table 1 - Description of variables to be analyzed and their respective measures.

Latent variables	**Measurement variables**
Economic factors	LF: -"I do not have the financial means to move to a safer place" DR: "My main source of income depends on my staying in this place" IL: -"My survival depends on the existence of services and infrastructure in this place"
Social and cultural factors	RF: "I have family and ancestral roots connected to this community" RS: "My network of friends and neighbors is an important reason for me to stay here" TC: "Cultural practices and traditions of my family are strongly connected to this place"
Psychological factors	RP: "Moving to another place would be riskier than staying here" EP:" I have faced floods before and I believe I can face them again" AR:" I prefer to deal with the risks associated with flooding in this place than to face uncertainties elsewhere"
Structural factors	FA:" My community receives little support from the authorities in situations of risk" AS:" The government does not provide safe housing alternatives for my family" RI:" Resettlement programs are not accessible or do not meet my needs"
Staying in the risk area	PP:" After previous extreme events (cyclone and floods), I remained in this same area." IP:" I intend to continue living here in the coming years despite being aware of the risks" DV:" My routine and way of making a living depend on my staying in this place"

Source: Authors.

The model was adjusted using the WLSMV (Weighted Least Squares Mean and Variance adjusted) estimator, which is most suitable for ordinal variables, such as those obtained through the Likert scale. The robustness and validity of the model were verified based on rigorous fit criteria. Construct Reliability was assessed using Cronbach's Alpha (α) and Composite Reliability (CR), with acceptability generally defined as values ≥0.70. Convergent Validity was verified using the Average Variance Extracted (AVE), with the acceptance threshold set at ≥0.50. The overall model fit was confirmed through the analysis of multiple indices, including $\chi 2$ (Chi-square), CFI (Comparative Fit Index), and TLI (Tucker-Lewis Index) — with values ≥0.90 indicating good fit, RMSEA (Root Mean Square Error of Approximation), and SRMR (Standardized Root Mean Square Residual), both with values ≤0.08 considered acceptable for a parsimonious fit.

3. Results and Discussion

3.1 Socio-demographic characteristics

The study sample consisted of 337 participants (52.5% men; 47.5% women), with the majority concentrated in the 30 to 39-year age group (39.8%) and having a high school education (52.2%) (Table 2). Regarding the descriptive statistics of the latent constructs, participants had mean scores slightly above 3.50 in all dimensions on the five-point scale. The average influence of the determining factors on permanence was 3.57±1.00. The indicator with the highest score was *'I have family and ancestral roots connected to this community*' (3.99±0.98), while the lowest-scoring indicator was *'My routine and way of earning a living depend on my staying in this place'* (3.58±1.11) (Table 3).

Table 2 - Sociodemographic characteristics of the respondents.

Variable	Category	Frequency (%)
Gender	Male	177 (52.5)
	Female	160 (47.5)
Age	20 – 29	45 (13.4)
	30 – 39	134 (39.8)
	40 – 49	98 (29.1)
	50 – 59	34 (10.1)
	60 – 70	17 (5.0)
	They did not answer	9 (2.7)
Schooling	Primary Education of the 1st Level	8 (2.4)
	Second Level Primary Education	29 (8.6)
	Secondary Education	82 (24.3)
	Medium School	176 (52.2)
	High School	42 (12.5)
Income	<4.000,00	104 (30.9)
	4.000,00 – 8.000,00	1 (0.3)
	8.000,00 – 12.000,00	203 (60.2)
	They did not answer	29 (8.6)
aggregate	<4	133 (39.5)
	4 a 8	151 (44.8)
	8 a 15	52 (15.4)

Source: Authors.

Table 3 - Descriptive statistics for indicators and determinants of staying in flood risk areas.

Factor	Indicator	mean ± standard deviation
Economic	LF: "I do not have the financial means to move to a safer place" DR: "My main source of income depends on my staying in this place" IL: "My survival depends on the existence of services and infrastructure in this place"	3.62 ± 1.18 3.75 ± 0.87 3.88 ± 0.90
Social and Cultural	RF: "I have family and ancestral roots connected to this community" RS: "My network of friends and neighbors is an important reason for me to stay here" TC: "Cultural practices and traditions of my family are strongly connected to this place"	3.99 ± 0.98 3.92 ± 1.01 3.79 ± 1.08
Psychological	RP: "Moving to another place would be riskier than staying here" EP: "I have faced floods before and I believe I can face them again"	3.90 ± 0.95

	AR: "I prefer to deal with the risks associated with flooding in this place than to face uncertainties elsewhere"	3.89 ± 0.96 3.73 ± 1.18
Structural	FA: "My community receives little support from the authorities in situations of risk" SA: "The government does not offer safe housing alternatives for my family" RI: "Resettlement programs are not accessible or do not meet my needs"	3.92 ± 0.95 3.97 ± 0.86 3.77 ± 0.94
Staying in the Risk Area	PP: "After previous extreme events (cyclone and floods), I remained in this same area." IP: "I intend to continue living here in the coming years despite being aware of the risks" DV: "My routine and way of making a living depend on my staying in this place"	3.64 ± 0.94 3.74 ± 0.99 3.58 ± 1.11

Source: Authors.

3.2 Reliability and Validity of Constructs

Reliability results showed that the Sociocultural (α=0.77), Psychological (α=0.68), and Retention (α=0.67) factors exhibited reasonable to acceptable levels of internal consistency (Hair et al., 2019). However, the Structural factor (α=0.47) and, to a lesser extent, the Economic factor (α=0.63) showed threshold or unsatisfactory reliability. Regarding the Average Variance Extracted (AVE), only the Social and Cultural factors (0.59) and, closely, the psychological factor (0.49) demonstrated satisfactory evidence of convergent validity. These results suggest a weakness in the measures comprising the Economic and Structural factors, indicating the need to revise their indicators to improve convergent validity and construct robustness in future studies.

3.3 Model Fit Analysis

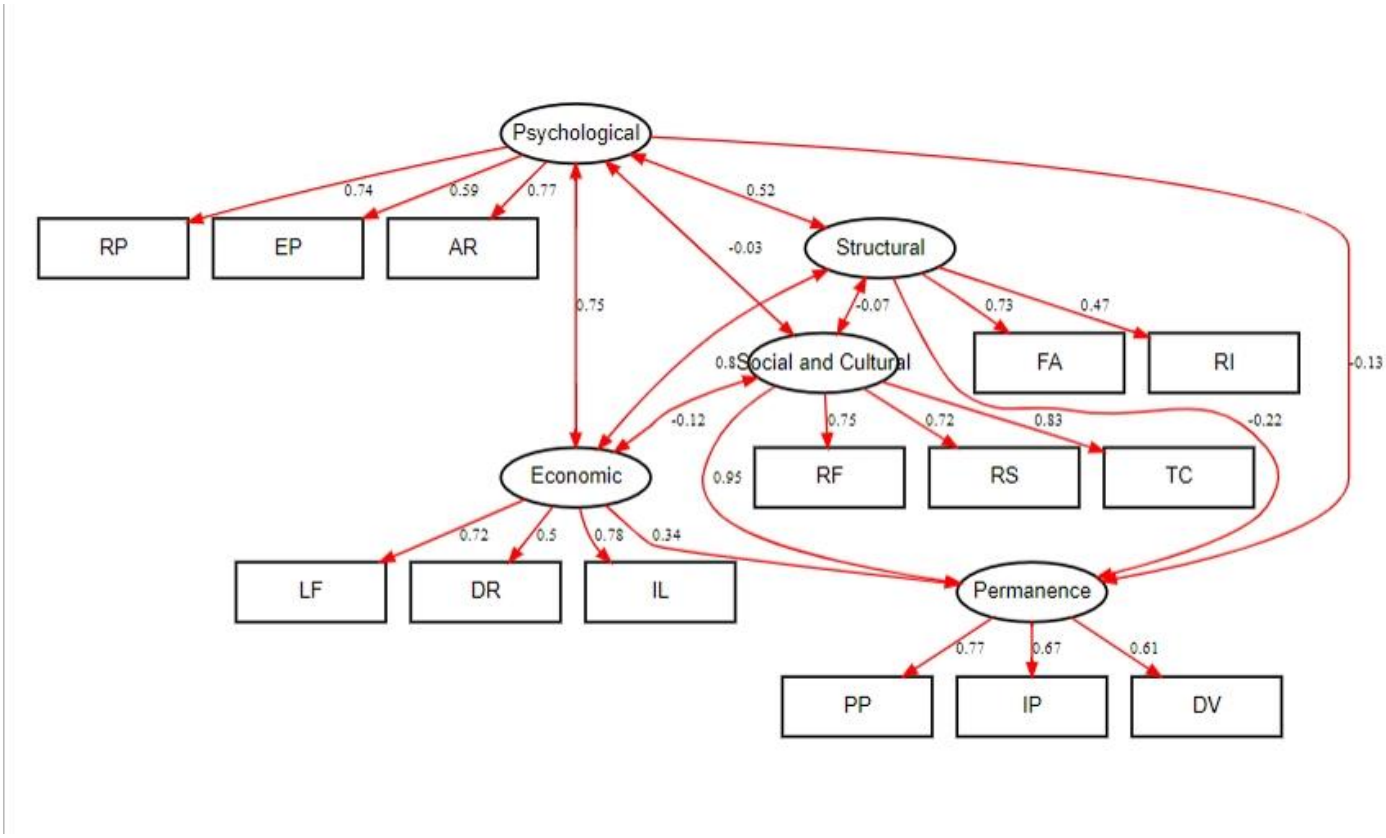
3.3.1 Structural Equation Model Analysis and Hypothesis Testing

The evaluation of the structural equation model fit demonstrated a satisfactory overall fit to the empirical data. The fit indices were robust, with CFI (0.962) and TLI (0.949), exceeding the 0.90 threshold, confirming the high consistency between the theoretical model and the observed data (Gefen et al., 2000; Prasetyo et al., 2021). The standardized root mean square error of approximation (RMSEA) was 0.063 (below the 0.08 limit) and the standardized root mean square residual (SRMR) was 0.056 (below 0.08). These indices indicate that, despite the statistical significance of the $\chi 2$ test (expected for large samples, $p<0.001$), the model is parsimonious and robust in explaining the determinants of population retention.

Figure 2 shows the correlational structure between psychological, structural, social, and cultural factors and the permanence in risk areas. The regression analysis of the latent factors on the intention to stay provided evidence for the rejection of most causal hypotheses, centrally validating the role of social and cultural factors. Hypothesis H3 (Social and cultural factors have a significant influence on permanence) was strongly confirmed by an exceptionally high standardized coefficient ($\beta=0.978$, $p<0.001$). This result indicates that the strength of social ties, family roots, and territorial identities is the central determinant of the decision to stay, outweighing the fear of recurring disasters, corroborating studies that highlight the role of community connections and collective identities in this process (Oliver-Smith, 2009; Aldrich & Meyer, 2015).

In contrast, the hypotheses concerning economic factors ($\beta=0.338$, $p=0.223$), psychological factors ($\beta=-0.130$, $p=0.396$), and structural factors ($\beta=-0.225$, $p=0.285$) were rejected as direct predictors, contrary to expectations (Slovic, 2000; Grothmann & Patt, 2005; Kelman, 2010; Tierney, 2014). This suggests that, in the specific context of Beira, neither financial limitations, individual risk minimization, nor direct institutional deficiency are the main driving forces of persistence, with the strength of social ties being the predominant factor.

Figure 2 - Determinant factors in the permanence of populations in flood-risk areas.



Source: Authors.

Regarding interrelations (H5), the results revealed a clustering among the economic, psychological, and structural factors, with consistently positive and significant correlations ($0.516<r<0.797$, $p<0.001$). This interconnection suggests that these elements are mutually articulated, providing empirical support for hypothesis H5, although they do not directly influence permanence. Notably, the social and cultural factor showed statistically null and insignificant correlations with the psychological and structural factors, and borderline correlation with the economic factor ($r=-0.117$, $p=0.070$). This lack of significant correlation indicates the causal autonomy of the social factor, which is not a byproduct of material security or individual risk awareness.

In terms of explanatory power, the model demonstrated strong predictive capacity: the social and cultural factor explains 89.7% of the variance in permanence ($R^2=0.897$). This finding is consistent with the notion of a "risk trap" (Adger et al., 2011), where community ties function as the main "anchor," confirming that permanence is primarily a decision of belonging and collective identity.

4. Conclusion and Recommendations

The study concludes that the main determinant of the Beira population remaining in risk areas is the social and cultural factor, with staying being a decision of belonging and collective identity. This factor proved to be the main driver of resistance to relocation, regardless of economic situation or risk perception. Therefore, risk reduction and resettlement policies should prioritize the social and cultural factor as a central element of intervention, recognizing its causal autonomy and strong impact. It is imperative to develop strategies that actively rebuild or maintain social networks and community cohesion in new resettlement locations, ensuring that the process is collective and participatory. Additionally, economic, structural, and

psychological factors should be addressed in an integrated manner, not as a primary motivational strategy, but as support for the resilience and sustainability of the population in the new context.

Acknowledgments

This work was partially supported by the Institutional Development Fund (FDI) through the project *"Strengthening Disaster Management Capacity and Adaptation to the Impacts of Climate Change in the Búzi River Basin."* The authors gratefully acknowledge this financial and institutional support, which contributed to the development of this study.

References

Adger, W. N., Brown, K., & Nelson, D. R. (2011). Resilience and the transformation of social-ecological systems. In B. L. Turner II, R. E. Kasperson, P. A. Matson, J. J. McCarthy, R. W. Corell, L. D. Meserow, & L. L. Clark (Eds.), *Global Environmental Change: Human and Policy Implications* (pp. 165–179). Cambridge University Press.

Ahmed, U., & Ahmed, A. U. (2020). *Delineating Flood Zones upon Employing Synthetic Aperture Data for the 2020 Flood in Bangladesh*. (Este é um título provável baseado no snippet, mas o artigo pode ser outro de 2020 do mesmo autor sobre o tema).

Aldrich, D. P., & Meyer, M. A. (2015). Social capital and community resilience. *American Behavioral Scientist*, *59*(2), 254–269. https://doi.org/10.1177/0002764214550299

Amal, S., El Amrousi, M., & El Hajj, M. (2018). Contributions to Architectural and Urban Resilience. In M. A. F. de O. J. C. Neves, A. D. C. M. L. G. Pereira, & A. M. H. F. dos S. F. T. Neves (Eds.), *Resilient cities: The role of local communities in building urban resilience* (pp. 55–69). Springer.

Arfanuzzaman, M., & Atiq Rahman, A. (2017). A conceptual framework for urban flood risk reduction by involving local communities in Dhaka, Bangladesh. *International Journal of Disaster Risk Reduction*, *22*, 268–278.

Bubeck, P., Botzen, W. J. W., & Aerts, J. C. J. H. (2012). A review of risk perceptions and other factors that influence flood mitigation behavior. *Risk Analysis: An International Journal*, *32*(9), 1481–1495.

Cambanhane, N. D. R., & Nhantumbo, B. G. (2025). Spatiotemporal analysis of land use and land cover changes in the city of Beira, Mozambique, between 2014 and 2024. *Future Studies Research Journal: Trends and Strategies, 17,* e930–e930. https://doi.org/10.24023/FutureJournal/2175-5825/2025.v17i1.930

Diamantini, C., Ottaviani, S., Serrao, L., Antonio, A. M., Msopela, A. D. S. V., Chate, H. J., & Zolezzi, G. (2024). Putting urban poverty back on the urban policy agenda: Upgrading an unplanned settlement in Beira, Mozambique. *WIT Transactions on Ecology and the Environment, 262,* 393–404. https://doi.org/10.2495/SC240321

Duygan, M., & Welle, T. (2018). The role of communities in building urban flood resilience: An empirical study from Istanbul. *Natural Hazards and Earth System Sciences*, *18*(6), 1637–1655.

Eze, E. B., Odufuwa, E. O., & Owolabi, S. A. (2020). Assessment of post-disaster resettlement programmes and housing reconstruction in flood-prone areas: A structural equation modelling approach. *Journal of Housing and the Built Environment*, *35*, 1–25.

Gefen, D., Karahanna, E., & Straub, D. W. (2000). Trust in e-commerce vendors: A two-stage model. *Information Systems Research*, *11*(1), 38–53.

Grothmann, T., & Patt, A. (2005). Adaptive capacity and human cognition: The process of individual adaptation to climate change. *Global Environmental Change*, *15*(3), 199–213.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning.

Hassan, S., & Bhamidipati, S. (2018). Navigating a double burden: An integrated framework for disaster risk management and climate change adaptation in urban areas. *Urban Climate*, *24*, 466–478.

Hassan, S., & Bhamidipati, S. (2019). Addressing rural community's risk perceptions and financial protection gaps in the context of climate change. *Climate and Development*, *11*(8), 693–707.

Macamo, S. R. B., Nuvunga, B. L., & Mulhovo, V. S. (2019). Flood risk assessment under population growth and urban land use change in Matola, Mozambique. *Journal of Integrated Disaster Risk Management*, *9*(1), 1–17.

Manyena, B., & Pelling, M. (2017). Vulnerability and resilience in a complex and chaotic context. In M. Pelling & D. Manuel-Navarrete (Eds.), *The Routledge handbook of disasters and risk reduction* (pp. 53–64). Routledge.

Oliver-Smith, A. (2009). Disasters and anthropological discourse: Changing cultural, political, and historical contexts. In *Global forces, local realities: Anthropological perspectives on cultural transformation* (pp. 37–52). Carolina Academic Press.

Opere, N. S., Ogungbenro, O. E., & Opere, S. B. (2021). Risk perception and protective behaviours towards natural hazards in an urban coastal city. *International Journal of Disaster Risk Reduction*, *64*, 102506.

Otto, F. E., Zachariah, M., Wolski, P., Pinto, I., Nhamtumbo, B., Bonnet, R., … & Harrington, L. J. (2022). Climate change increased rainfall associated with tropical cyclones hitting highly vulnerable communities in Madagascar, Mozambique & Malawi. *Environmental Research Letters, 17(4),* 041001. https://doi.org/10.1088/1748-9326/ac5b72

Pereira, A. S. et al. (2018). Metodologia da pesquisa científica. [free ebook]. Santa Maria: Editora da UFSM.

Prasetyo, Y. T., Salonga, L. N., & Seneta, F. (2021). Analysis of consistency on structural equation modeling: A review and comparison of CB-SEM and PLS-SEM. *International Journal of Modern Manufacturing Technologies*, *13*(2), 65–84.

Seng, D., Sokha, T., & Samreth, V. (2018). Examining the interaction of flood vulnerability determinants in Cambodia and Vietnam using partial least squares structural equation modeling. *Water Policy*, *20*(6), 1184–1199.

Shitsuka, R. et al. (2014). Matemática fundamental para a tecnologia. (2ed). Editora Érica.

Slovic, P. (1987). *Perception of risk.* Science.

Thaler, T., & Hartmann, T. (2018). Dynamic vulnerability in the face of floods: A conceptual framework. *Natural Hazards and Earth System Sciences*, *18*(9), 2351–2368.

Tierney, K. (2014). *Disasters: A sociological approach*. Polity Press.

World Bank. (2017). *Mozambique: Lessons learnt from Beira*. World Bank.
https://documents1.worldbank.org/curated/en/969931585303089862/pdf/Lessons-Learnt-from-Beira.pdfPut space between one reference and another. Remember that we use the APA standard. (fonte TNR 8 - justified)