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The Settlement Resilient Assessment Framework (SRAF) As A Tool for Enhancing Settlement Resilience in Kwazulu-Natal

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ABSTRACT

The April 2022 floods in KwaZulu-Natal, South Africa, exposed deep systemic vulnerabilities in human settlements, infrastructure, and governance systems. In response, the Department of Cooperative Governance and Traditional Affairs (CoGTA), in partnership with the University of KwaZulu-Natal (UKZN), initiated the *KwaZulu-Natal Programme of Action for Planning Resilient Human Settlements*. This paper synthesises findings and methodological insights from the application of the Sustainable Resilient Assessment Framework (SRAF), a diagnostic and planning tool developed to evaluate settlement resilience across five key themes: social, environmental, governance, physical, and spatial. The SRAF was piloted in five case study settlements, Hopewell, Edendale, Umdloti, Dassenhoek, and Dakota Beach through a mixed methods approach combining focus group discussions, municipal stakeholder interviews, field observations, and participatory workshops. Findings reveal differentiated vulnerabilities across settlement types, with both governance coordination gaps and community-level adaptive capacities shaping resilience outcomes. The paper contributes methodologically by operationalising resilience assessment into measurable outcome indicators and conceptually by advancing a holistic settlement-level lens for disaster risk reduction (DRR) in the South African context.

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Introduction

The unprecedented flooding that struck KwaZulu-Natal (KZN) in April 2022 highlighted the acute vulnerabilities of human settlements to climate-induced disasters. With over 300 lives lost and widespread infrastructural damage, the disaster underscored the urgent need for integrated disaster risk reduction (DRR) strategies that address the multifaceted challenges faced by urban and rural communities in the province (KZN Department of Human Settlements, 2022). In response, the Department of Cooperative Governance and Traditional Affairs (CoGTA), in collaboration with the University of KwaZulu-Natal (UKZN), initiated the *KwaZulu-Natal Programme of Action for Planning Resilient Human Settlements*. This initiative aimed to develop and field-test the Settlement Resilient Assessment Framework (SRAF), a diagnostic tool designed to evaluate and enhance the resilience of settlements across five key themes: social, environmental, governance, physical, and spatial.

The SRAF was developed as part of a broader Memorandum of Understanding between CoGTA and UKZN, which sought to strengthen municipal and traditional authority urban management and planning functions in settlements, with a particular focus on reducing climate change disaster vulnerabilities and increasing settlement resilience (University of KwaZulu-Natal, 2023). The framework was piloted in five diverse case study settlements: Hopewell (Richmond Municipality), Edendale (Msunduzi Municipality), Umdloti (eThekwini Municipality), Dassenhoek (eThekwini Municipality), and Dakota Beach (eThekwini Municipality). These settlements were selected to reflect a range of urban and rural contexts, varying levels of infrastructure development, and differing exposure to climate hazards. The primary objective of this paper is to present the SRAF as a comprehensive tool for assessing settlement resilience. By detailing the development process, thematic structure, and field application of the framework, this study contributes to the growing body of knowledge on integrated settlement planning in the context of climate change. The findings highlight the importance of a multi-dimensional approach to resilience that encompasses not only physical infrastructure but also social cohesion, environmental sustainability, effective governance, and spatial planning. Through this lens, the paper aims to inform policy and practice, providing municipalities with a robust framework to guide the development of resilient and sustainable human settlements in KZN and beyond.

Defining Settlement Resilience

The concept of settlement resilience has evolved from a focus on individual infrastructural robustness to a comprehensive understanding that encompasses social, environmental, governance, physical, and spatial dimensions. This shift reflects a broader recognition that resilience is not merely about withstanding shocks but also about the capacity to adapt, recover, and transform in the face of ongoing and future challenges.

In line with the United Nations Human Settlements Programme (UN-Habitat), resilience is defined as the ability of a system, be it a city, community, or settlement to anticipate, prepare for, respond to, and recover from adverse events, while ensuring that these processes contribute to sustainable development [1]. This definition underscores the dynamic interplay between various systems and the necessity for an integrated approach to resilience planning.

The Settlement Resilient Assessment Framework (SRAF) developed in this study operationalizes this integrated approach by identifying five key themes that collectively contribute to settlement resilience: social, environmental, governance, physical, and spatial. Each theme encompasses specific dimensions that reflect the multifaceted nature of resilience.

- **Social Resilience:** This dimension focuses on the strength of community networks, social capital, and the capacity for collective action. It emphasizes the importance of inclusive social structures that can mobilize resources and support during crises [2].
- **Environmental Resilience:** This dimension pertains to the capacity of natural systems to absorb disturbances and maintain their functions. It includes considerations of biodiversity, ecosystem services, and the sustainable management of natural resources [3].
- **Governance Resilience:** This dimension examines the effectiveness of institutional frameworks, policy coherence, and the inclusivity of decision-making processes. It highlights the role of transparent, accountable, and adaptive governance in building resilience [4].
- **Physical Resilience:** This dimension addresses the robustness and adaptability of infrastructure and built environments. It encompasses aspects such as building standards, infrastructure maintenance, and the integration of climate-resilient design principles [5].
- **Spatial Resilience:** This dimension focuses on land-use planning, spatial equity, and the distribution of resources and services. It underscores the importance of spatial configurations that reduce exposure to hazards and enhance access to essential services [6].

The SRAF employs these dimensions to assess the resilience of settlements, providing a comprehensive tool for identifying vulnerabilities and strengths across different thematic areas. By integrating these dimensions, the framework facilitates a holistic understanding of settlement resilience, enabling policymakers and planners to design interventions that address the complex and interconnected challenges faced by communities. The SRAF aligns with international frameworks such as the Sendai Framework for Disaster Risk Reduction, which emphasizes the need for a comprehensive approach to disaster risk management that includes understanding disaster risk, strengthening disaster risk governance, investing in disaster risk reduction for resilience, and enhancing disaster preparedness for effective response (UNISDR, 2015) [7]. By incorporating these principles, the SRAF ensures that resilience assessments are not only context-specific but also aligned with global best practices.

Methodology

This study employed a mixed-methods research design, integrating qualitative and quantitative approaches to develop, refine, and field-test the SRAF. Mixed-methods approaches are suited for examining complex social-ecological systems like human settlements, as they allow for the triangulation of multiple data sources and the capture of both numerical and narrative insights [8]. The research aimed to evaluate resilience across five settlements in KwaZulu-Natal (Hopewell, Edendale, Umdloti, Dassenhoek, and Dakota Beach) and to generate actionable insights for municipal planning. A participatory approach was employed to ensure that both community and institutional knowledge informed the assessment.

Research Design and Study Area

The five settlements were selected to reflect diverse typologies, exposure to hazards, and levels of infrastructure provision. This diversity enabled testing of the SRAF under varying settlement conditions, ensuring its applicability across multiple contexts.

Table 1: Case Study Settlements and Characteristics

Settlement	Municipality	Typology	Key Characteristics	Exposure to Hazards
Hopewell	Richmond	Rural	Limited infrastructure, dispersed population	Floods, drought
Edendale	Msunduzi	Urban	High population density, historical service backlogs	Flooding, service interruptions
Umdloti	eThekwini	Coastal town	Formal housing, tourism-driven economy	Coastal flooding, erosion
Dassenhoek	eThekwini	Peri-urban	Rapid urbanization, environmental degradation	Flooding, soil erosion
Dakota Beach	eThekwini	Informal coastal	Informal housing, limited municipal services	Coastal flooding, storm surges

Source: Field data collected by UKZN researchers in collaboration with municipal spatial development frameworks and disaster risk reports [9]

Data Collection Methods

The mixed-methods approach combined quantitative measurements (e.g., infrastructure, service access, environmental indicators) with qualitative insights (e.g., community perceptions, governance challenges). Table 2 summarizes the methods employed.

Table 2: Data Collection Methods and Participants

Method	Purpose	Participants	Data Collected
Focus Group Discussions (FGDs)	Capture community perceptions of resilience and vulnerabilities	15-20 community members per settlement	Social cohesion, hazard experiences, adaptation strategies
Semi Structured Interviews	Expert perspectives on governance and planning	Municipal officials, planners, ward councillors, traditional leaders	Policies, planning practices, institutional challenges
Participant Observation	Contextualize resilience assessments	Researchers, planners, community members	Observational notes on infrastructure, interactions
Structured Questionnaires	Quantitative measurement of services and infrastructure	Households across settlements	Indicators for water, sanitation, housing, hazard exposure
Workshops	Validation of SRAF	CoGTA planners, municipal officials	Feedback on framework, indicators, field applicability

Source: Developed by authors based on study design; field engagement notes, UKZN-CoGTA Programme of Action, 2025

SRAF Testing and Field Application

The Settlement Resilience Assessment Framework (SRAF) was tested in the field through a comprehensive and participatory process designed to capture the multifaceted dimensions of settlement resilience. The field testing employed a combination of focus group discussions, key informant interviews, and participatory workshops, enabling triangulation of qualitative and quantitative data to strengthen the validity of the framework and its associated outcome indicators.

Two types of focus group discussions were conducted to capture the perspectives of different community segments. First, FGDs were held with households directly affected by the April 2022 floods. These discussions generated in-depth qualitative data on the lived experiences of community members during and after the disaster, including their levels of preparedness, immediate response, recovery processes, and understanding of flood-related risks. The insights gathered were critical in populating the SRAF indicators related to disaster resilience, recovery, and vulnerability, providing a granular understanding of how settlements coped with and adapted to extreme climatic events.

Second, FGDs were conducted with households not directly affected by the floods. These discussions focused on community members' knowledge of disaster preparedness, participation in community decision-making, and perceptions of municipal and local authority responses to the flooding events. The data collected helped identify gaps in disaster resilience at the community level and provided actionable information to inform future planning, mitigation strategies, and capacity-building initiatives. Each FGD comprised 15-20 participants, ensuring a diversity of perspectives while maintaining a manageable group dynamic conducive to meaningful dialogue. The discussions were guided by semi-structured protocols aligned with the five SRAF themes social, environmental, governance, physical, and spatial allowing flexibility to explore emergent themes specific to each settlement context.

Complementing the community FGDs, semi-structured interviews were conducted with officials from various municipal line departments including housing, land use management, disaster management, and infrastructure planning units. These interviews aimed to capture institutional perspectives on resilience planning, hazard mitigation measures, coordination mechanisms, and the effectiveness of response strategies during the April 2022 floods. The insights gained from these interviews were instrumental in validating the governance and spatial dimensions of the SRAF and in identifying systemic gaps in institutional capacity and planning procedures.

Field testing also involved interactive workshops engaging municipal officials, CoGTA planners, UKZN postdoctoral researchers, and other research team members. These workshops served multiple purposes: (1) to co-develop and refine the SRAF indicators based on field observations and stakeholder feedback, (2) to evaluate the framework's applicability across different settlement typologies, and (3) to facilitate knowledge exchange between local government officials, national planners, and academic researchers. Participatory techniques such as scenario analysis, SWOT analysis, and indicator scoring exercises were employed to ensure that the framework was both contextually relevant and operationally feasible.

The data collected through FGDs, interviews, and workshops were systematically analyzed and used to populate the SRAF outcome indicators across all five themes. For example, social and governance indicators were informed by community perceptions and municipal insights, while physical and spatial indicators were triangulated with field observations and existing municipal spatial data. Environmental indicators incorporated both community-reported experiences and expert assessments of hazard exposure, land use, and ecosystem services. By integrating multiple data sources, the SRAF was refined into a robust, evidence-based tool capable of assessing settlement resilience, identifying vulnerabilities, and guiding practical interventions for disaster risk reduction and sustainable planning. The field-testing process not only validated the SRAF but also highlighted key areas for improvement, in strengthening coordination between municipal departments, enhancing community engagement in planning, and increasing public awareness of disaster preparedness measures. These findings are essential for informing both local and provincial planning strategies and ensuring that settlements in KwaZulu-Natal are better equipped to withstand and recover from future climate-related hazards.

Data Analysis

The analysis of data collected through the field-testing of the SRAF followed a mixed-methods approach, integrating both quantitative indicators and qualitative insights to evaluate settlement resilience across five thematic areas: social, environmental, governance, physical, and spatial. This approach allowed for a nuanced understanding of vulnerabilities and capacities, and facilitated the triangulation of findings from multiple sources including focus group discussions (FGDs), key informant interviews, and participatory workshops [8].

Social Theme Analysis

The social theme of the SRAF comprised five dimensions: income, security of tenure, cultural properties, ward committee participation, and safety/crime prevention. Each dimension included multiple quantitative and qualitative indicators, which were analyzed to assess the degree of social resilience in the selected settlements.

Income: Household survey data were used to calculate the percentage of households in each income bracket (low, middle, high), the proportion earning below the R3,500 threshold, and the extent of participation in rent-to-own housing or mixed-income developments. Qualitative FGDs provided context on how income affected households' capacity to prepare for, respond to, and recover from floods. Food security indicators were also assessed by analyzing the proportion of household income allocated to food expenditure.

Security of Tenure: Quantitative data included the presence of acknowledged settlement registers, formal recognition of customary tenure, and the number of unplanned settlements located in high-risk areas. Qualitative interviews with municipal officials and traditional leaders provided insights into tenure security challenges and equitable access to land, particularly in flood-prone zones.

Cultural Properties, National Key Points, and Monuments: Indicators assessed the integration of cultural and strategic assets into Disaster Risk Reduction (DRR) plans, preservation efforts, and the extent to which cultural sites had climate-resilient infrastructure. FGDs and interviews provided contextual understanding of community engagement in preserving heritage assets during disasters.

Ward Committee Participation and Functionality: Indicators included the percentage of committees actively involved in municipal spatial planning, the number of meetings addressing land use priorities, and residents' access to formal and informal social networks. Qualitative data highlighted collective action and community cohesion, essential elements of social resilience [2].

Safety and Crime Prevention: Quantitative measures included the presence of law enforcement, the number of safe shelters or evacuation centres, and the design quality of public spaces. Observational data and FGDs provided insights into perceptions of safety and preparedness, which informed the evaluation of resilience outcomes in the social theme.

Environmental Theme Analysis

The environmental theme comprised six dimensions: biodiversity and conservation, catchment management, groundwater status, waste management, coastal protection, and geology/topography. Both quantitative metrics and qualitative assessments were employed to measure environmental resilience.

Biodiversity, Protected, and Conservation Areas: Indicators measured the percentage of critical biodiversity and conservation zones maintained, inclusion in settlement planning, and the existence of active conservation plans. FGDs and observations informed the effectiveness of local biodiversity preservation and its role in mitigating disaster impacts.

Catchments: Quantitative indicators included the presence of a catchment management plan, maintenance of natural drainage, buffer zones around rivers, and delineation of 20-, 50-, and 100-year flood lines. Qualitative data from community FGDs assessed local awareness of catchment management and involvement in monitoring activities, providing insights into community-level environmental resilience.

Groundwater Status and Dependency: Analysis included the percentage of the population with reliable access to clean groundwater, frequency of water quality testing below national standards, and aquifer recharge rates. Community FGDs and municipal interviews contextualized household reliance on groundwater for domestic and agricultural use, highlighting vulnerabilities during flood or drought events.

Waste Management Systems: Indicators measured coverage of waste collection services, compliance with environmental regulations, and recovery/recycling rates. Qualitative data from FGDs and municipal workshops highlighted community participation and municipal capacity to manage solid waste, a critical factor in reducing environmental hazards during floods.

Coastal Protection Zones: Metrics included the availability of a coastal management system, setback distances, shoreline quality, and sea-level rise trends. Observations and local expert interviews informed the resilience of coastal settlements to erosion and flooding, integrating both scientific and community-based perspectives.

Geology and Topography: Analysis measured adherence of new developments to geological assessments, the proportion of settlements on steep slopes, and alignment of environmental and disaster management policies. This data was triangulated with interviews and field observations to assess exposure to geophysical hazards.

Governance Theme Analysis

The governance theme comprised six dimensions: robust municipal regulatory framework, alignment between approved planning, budgeting and implementation, functional local municipality, functional traditional authority, system for citizen and government recourse, and public participation in governance.

Robust Municipal Regulatory Framework: Quantitative data assessed alignment of municipal planning and disaster management with national and provincial legislation, including SPLUMA, National Housing Act, Disaster Management Act, Sendai Framework, Climate Change Act, NEMA, and related policies. Qualitative interviews with municipal officials explored enforcement mechanisms, monitoring systems, and compliance challenges, which were critical to understanding the effectiveness of regulatory frameworks in shaping settlement resilience.

Alignment Between Planning, Budgeting, and Implementation: Indicators included the proportion of budgeted projects completed according to approved plans, the number and severity of audit findings, and community satisfaction with project outcomes. These indicators were analyzed quantitatively through municipal records, while qualitative FGDs provided insights into community perceptions of service delivery and project effectiveness.

Functional Local Municipality: Metrics included the availability of departments responsible for spatial planning, land-use management, and disaster management; staff qualifications; approval of land use and sector plans; and evidence of collaboration with traditional councils. Qualitative data from interviews helped contextualize the institutional capacity and coordination mechanisms within municipalities.

Functional Traditional Authority: Indicators assessed alignment of traditional authority decisions with formal governance frameworks, disaster risk reduction initiatives led by traditional authorities, and land allocation decisions that mitigate climate risk. Data were derived from municipal records and interviews with traditional leaders to evaluate local governance integration and community-level decision-making.

System for Citizen and Government Recourse: Quantitative metrics included the presence and functionality of Municipal Planning Tribunals and Appeals Tribunals, and the use of public notices and hearings. Qualitative data examined community awareness of recourse mechanisms and their ability to participate in governance processes.

Public Participation in Governance: Indicators included the existence of public participation policies, community understanding of municipal plans, functionality of local committees, and the number of service delivery protests. Qualitative insights provided evidence on the inclusivity and effectiveness of public participation mechanisms in enhancing settlement resilience.

Physical Theme Analysis

The physical theme included five dimensions: accessible transportation and pedestrian systems, surface water management infrastructure, public social facilities, bulk services infrastructure, and essential infrastructure and service provision.

Accessible Transportation and Pedestrian Systems: Indicators measured access to resilient, affordable, and safe transport and pedestrian networks, alignment with spatial plans, and the concentration of functional transport-oriented developments. FGDs and observations provided contextual understanding of mobility patterns and infrastructure adequacy.

Surface Water Management Infrastructure: Quantitative indicators included coverage and resilience of surface water systems, equity of access, and maintenance programs. Qualitative data from municipal workshops assessed community engagement in maintaining drainage and flood prevention measures.

Public Social Facilities: Indicators measured proximity and resilience of schools, health centers, community halls, and open spaces serving as emergency response zones. Observational data and FGDs provided insights on functional access for vulnerable populations.

Bulk Services Infrastructure: Indicators included resilience of water, sanitation, stormwater, waste, road, energy, and ICT systems. Quantitative data were collected through infrastructure audits, while qualitative data captured service continuity challenges during flood and climate events.

Essential Infrastructure and Service Provision: Indicators included access to water, sanitation, electricity, waste management, condition assessments, settlement coverage, household compliance with sustainable waste disposal practices, and restoration times after disruptions. Triangulation of municipal records, household surveys, and FGDs provided a comprehensive evaluation of physical resilience.

Spatial Theme Analysis

The spatial theme comprised five dimensions: disaster management, densification, land use scheme, local area plan (LAP), and urban edge delineation and management systems.

Disaster Management: Quantitative data included mapping of previous flood incidents, availability of weather monitoring technology, early warning systems, GIS-based risk classification, disaster response systems, disaster management plans, and staff qualifications. Qualitative data examined community and institutional capacity to anticipate, respond to, and recover from hazards.

Densification: Indicators assessed the integration of resilient densification models in settlement design and reduction of urban sprawl. FGDs and observations provided insights into community acceptance and feasibility of densification strategies.

Land Use Scheme: Metrics evaluated the resilience criteria of land use plans for flood, landslide, and surge resistance, and the strategic location of emergency response infrastructure. Analysis combined plan reviews, GIS mapping, and stakeholder interviews to assess alignment between spatial planning and hazard mitigation.

Local Area Plan (LAP): Indicators included incorporation of flood risk mitigation measures, stakeholder participation in planning, and alignment with national and regional policies. Qualitative data highlighted community engagement and inclusivity in spatial planning processes.

Urban Edge Delineation and Management Systems: Indicators measured frequency of monitoring, compliance checks, and identification of land for emergency facilities. Data from municipal records and observations were analyzed to assess the effectiveness of land use controls in reducing vulnerability to natural hazards.

Data Integration and Synthesis

Across all five SRAF themes, quantitative indicators were analyzed using descriptive statistics to establish baseline resilience and identify vulnerability hotspots. Qualitative data from FGDs, interviews, and workshops were coded thematically to contextualize the quantitative findings and explore perceptions, institutional capacity, and governance challenges. The integration of both datasets employed a convergent parallel mixed-methods design, allowing for triangulation and cross-validation of results [8-9]. The outcome of this analysis provided a comprehensive evaluation of settlement resilience, highlighted gaps in planning, governance, and infrastructure, and informed targeted recommendations for improving disaster preparedness, adaptive capacity, and long-term sustainability in KZN settlements.

The Settlement Resilience Assessment Framework (SRAF)

The Settlement Resilience Assessment Framework (SRAF) is a comprehensive tool developed to assess and enhance the resilience of human settlements against climatic hazards and socio-environmental vulnerabilities in KwaZulu-Natal. It was conceptualized within the KZN Programme of Action: Planning Resilient Human Settlements, a research-policy partnership between the Department of Cooperative Governance and Traditional Affairs (CoGTA) and the University of KwaZulu-Natal (UKZN), following the devastating floods of April 2022. The SRAF provides a structured, multi-dimensional approach to evaluate resilience at the settlement scale, linking social, environmental, governance, physical, and spatial domains with measurable outcome indicators [10-11].

The framework was designed to operationalize the concept of settlement resilience, which is defined as the capacity of a settlement and its community to anticipate, absorb, recover from, and adapt to hazardous events while maintaining essential functions and structures [12,13].

A settlement in this context refers to a discrete spatial unit, ranging from informal urban communities to peri-urban and coastal towns, where the interplay of social, environmental, governance, physical, and spatial factors influences vulnerability and adaptive capacity. The SRAF integrates these factors to produce a composite assessment of resilience, identifying both strengths and areas requiring intervention.

The SRAF is structured around five interrelated themes, each encompassing multiple dimensions and outcome indicators, allowing for comprehensive evaluation across the settlement system:

- **Social Theme:** Focuses on the human and community aspects of resilience, including income distribution, security of tenure, cultural heritage, social networks, ward committee functionality, and safety/crime prevention. This theme captures the extent to which social structures and capacities enable communities to withstand and recover from hazards [10,11].
- **Environmental Theme:** Encompasses natural and ecological systems, including biodiversity, catchment management, groundwater availability, waste management, coastal protection, and geological suitability. The environmental theme highlights the role of ecosystems and infrastructure in buffering settlements against natural hazards and ensuring sustainability [3,11].
- **Governance Theme:** Evaluates institutional and regulatory capacity, focusing on municipal regulatory frameworks, planning and budget alignment, functionality of local municipalities and traditional authorities, citizen-government recourse systems, and public participation in governance. Strong governance structures are crucial for effective disaster risk reduction and coordinated response [5,14].
- **Physical Theme:** Captures built infrastructure and service provision, including transportation networks, surface water management, public social facilities, bulk service infrastructure, and essential services (water, sanitation, energy). The physical theme assesses the resilience of infrastructure systems to maintain continuity of services during and after disasters [15,16].
- **Spatial Theme:** Focuses on land use planning, settlement design, and hazard-informed spatial organization, including disaster management planning, densification, land use schemes, local area plans, and urban edge delineation. Spatial planning ensures that settlements are organized in ways that reduce exposure to hazards and enhance adaptive capacity [17,12].

Each theme is operationalized through dimensions and outcome indicators, which are measurable and contextually relevant. For example, under the social theme, dimensions such as income and security of tenure are evaluated using indicators like household income brackets, participation in housing schemes, and formal recognition of land rights. In the environmental theme, indicators include percentage coverage of protected biodiversity areas, catchment management compliance, and resilience of coastal infrastructure. Governance indicators assess regulatory alignment, planning and budget execution, and community participation, while physical and spatial themes examine infrastructure functionality, hazard-adaptive design, and planning compliance.

The SRAF was developed to be flexible and scalable, allowing application across diverse settlement typologies from informal coastal communities like Dakota Beach to peri-urban settlements such as Hopewell. Its multi-dimensional approach enables stakeholders to identify priority interventions, guide planning, and monitor progress towards resilient settlements [18,19]. The framework also integrates both quantitative measures (e.g., infrastructure coverage, budget alignment) and qualitative insights (e.g., community perceptions, stakeholder interviews), ensuring that resilience assessments are holistic, evidence-based, and contextually grounded.

Findings and Insights from Field Application

The field application of the SRAF commenced in February 2025, following initial municipal engagements that began in December 2024. These engagements involved collaboration with key municipal line departments across eThekwini, Richmond, and Msunduzi municipalities, as well as workshops with CoGTA planners and UKZN postdoctoral researchers. The primary objective of the field work was to test the SRAF in real-world settlement contexts, evaluate the applicability of its indicators, and capture the lived experiences of residents affected or potentially affected by the April 2022 floods. A total of five settlements were included in the study: Hopewell, Edendale, Umdloti, Dassenhoek, and Dakota Beach.

Table 3: Field Insights from SRAF Application Across KZN Settlements

Theme	Dimension	Indicators	Settlement specific findings	Data source / observation
Social	Income	% households in income brackets; % earning below R3500; % participating in rent-to-own housing	Dassenhoek & Dakota Beach: High proportion low-income households; limited participation in housing schemes due to financial constraints. Hopewell & Edendale: Middle-income diversity, some participation in mixed-income initiatives. Umdloti: Predominantly high-income, residents expressed frustration at lack of tangible action from prior research.	FGDs, Ward Councillor interview (Umdloti)
	Security of Tenure	Recognized settlement register; customary tenure recognition; unplanned settlements in high-risk zones	Dassenhoek: Informal settlements identified on floodplains. Hopewell & Edendale: Mostly formalized tenure with recognized property rights. Umdloti: Tenure secure, formal recognition, no informal settlements.	Municipal land records, FGDs, interviews
	Cultural Properties, Natural Monuments, & National Key Points	Integration into DRR plans; preservation efforts; climate-resilient infrastructure	Edendale & Hopewell: Limited integration of cultural heritage in disaster planning. Umdloti: Well-integrated; residents expressed pride in heritage but demand proactive interventions.	FGDs, workshops, municipal cultural records
	Ward Committee Participation	% committees actively involved; number of meetings; community access to networks	Dassenhoek & Dakota Beach: Ward committees active but resource-limited; informal networks essential. Hopewell & Edendale: Better coordination with municipal planning processes. Umdloti: Active but residents disengaged due to perceived research fatigue.	FGDs, municipal meeting minutes, interviews
	Safety and Crime Prevention	Presence of law enforcement; design of public spaces; safe shelters	Low-income settlements had visible policing but limited evacuation centers. Umdloti reported well-maintained public spaces; concern centered on emergency preparedness rather than crime.	Observations, FGDs, municipal safety plans
Environmental	Biodiversity and Protected Areas	% protected zones maintained; integration into settlement planning	Umdloti & Dakota Beach: High preservation, coastal biodiversity zones intact; integrated into planning. Hopewell & Edendale: Some protected zones impacted by development; partial integration. Dassenhoek: Minimal enforcement; floodplain encroachment noted.	GIS mapping, municipal environmental records, FGDs, workshops
	Catchment management	Existence of management plans, infrastructure maintenance, community education, buffer zones	Dassenhoek: Poor maintenance; community engagement limited by resources. Edendale & Hopewell: Some buffer zones maintained; community education ongoing but inconsistent. Dakota Beach: Partial plan implementation; active local monitoring.	FGDs, municipal interviews, field observations

	Groundwater status	% population with reliable access; water quality compliance; recharge rate	Lower-income settlements (Dassenhoek, Dakota Beach): Seasonal contamination reported. Hopewell & Umdloti: Reliable access and monitoring; recharge managed.	Municipal water records
	Waste Management	Coastal management plan availability; setback compliance; shoreline condition	Umdloti & Dakota Beach: Setbacks enforced; erosion managed; infrastructure aligned with climate projections. Hopewell: Not coastal, N/A. Dassenhoek & Edendale: Limited coastal exposure, minor riverbank issues noted.	Municipal plans, GIS, field observations
	Coastal Protection	Coastal management plan availability; setback compliance; shoreline condition	Umdloti & Dakota Beach: Setbacks enforced; erosion managed; infrastructure aligned with climate projections. Hopewell: Not coastal, N/A. Dassenhoek & Edendale: Limited coastal exposure, minor riverbank issues noted.	Municipal plans, GIS, field observations
	Geology and Topography	Adherence to suitability assessments; slope development restrictions	Umdloti & Hopewell: Developments aligned with topography; risk mitigated. Dassenhoek: Some housing on high-risk slopes; erosion observed. Edendale: Moderate adherence; some low-lying flood zones affected.	GIS mapping, municipal planning records, field observations
Governance	Robust Municipal Regulatory Framework	Alignment with SPLUMA, Housing Acts, Disaster Management, Climate Change Acts; enforcement & compliance	Dassenhoek & Dakota Beach: Regulatory frameworks exist but enforcement limited due to staffing and budget constraints. Hopewell & Edendale: Partial compliance; key DRR regulations incorporated in planning but not consistently monitored. Umdloti: Full alignment; regulations enforced but residents frustrated with perceived slow response to hazards.	Interviews with municipal officials, workshops, municipal compliance reports
	Alignment Between Approved Planning, Budgeting, and Implementation	% budgeted projects completed as per plans; community satisfaction; audit findings	Dassenhoek: Partial implementation; delays due to financial and capacity constraints; low community satisfaction. Edendale & Hopewell: Moderate project execution; community satisfaction moderate. Umdloti: Projects executed on schedule; high alignment with plans; residents emphasize need for faster action.	Municipal budget and project reports, interviews, FGDs
	Functional Local Municipality	Availability of planning units, qualified staff, land-use plans, SDFs, IDPs, LAPs, LUMS; collaboration with traditional councils	Dassenhoek: Limited units and staff; planning capacity low; some land-use plans outdated. Edendale & Hopewell: Functional units; planning documents available; partial collaboration with traditional councils. Umdloti: Fully functional units; all plans updated and aligned; strong municipal-traditional council coordination.	Municipal organizational charts, interviews, workshops

	Functional Traditional Authority	Alignment of traditional authority decisions with formal governance; DRR initiatives	Dassenhoek & Edendale: Traditional authorities actively engaged in DRR initiatives and land allocation decisions. Umdloti & Dakota Beach: Limited involvement due to urban context and formal governance dominance.	Interviews, municipal records, workshops
	System for Citizen Recourse	Functional municipal planning tribunals, appeals tribunals, public notices	Dassenhoek & Dakota Beach: Limited awareness of tribunals; formal mechanisms underutilized. Hopewell & Edendale: Mechanisms present but variable citizen engagement. Umdloti: Awareness high; residents use formal channels but express frustration over slow resolution.	Interviews, municipal records, FGDs
	Public Participation in Governance	Existence of public participation policy; committee functionality; citizen understanding of municipal plans	Dassenhoek & Dakota Beach: Low participation; IDP forums underutilized; community understanding limited. Hopewell & Edendale: Moderate participation; ward committees functional but constrained by resources. Umdloti: Residents disengaged due to research fatigue; ward committees active but limited interaction with community.	FGDs, workshops, municipal records
Physical	Accessible Transportation and Pedestrian Systems	% community with safe, resilient, affordable, and accessible transport; TOD promotion; alignment with spatial plans	Hopewell & Umdloti: Good road networks, pedestrian-friendly areas, transport-oriented development implemented; flood-resilient routes maintained. Dassenhoek & Dakota Beach: Limited transport infrastructure; key routes prone to flooding; pedestrian accessibility poor. Edendale: Moderate access; some TOD initiatives partially implemented.	Field observations, municipal transport records, FGDs
	Surface Water Management Infrastructure	Resilience to extreme weather; equity in access; infrastructure maintenance	Dassenhoek & Dakota Beach: Stormwater drains poorly maintained; flooding frequent; infrastructure inequitable. Hopewell & Edendale: Partially functional; minor flooding during heavy rainfall. Umdloti: Infrastructure resilient; minimal flooding; regular maintenance observed.	FGDs, municipal infrastructure records
	Public Social Facilities	Proximity to vulnerable populations; resilience to hazards; emergency functionality	Dassenhoek & Dakota Beach: Limited access; some schools and clinics double as emergency shelters during floods. Hopewell & Edendale: Facilities accessible; some at risk from flash floods. Umdloti: Adequate social infrastructure; resilient and accessible.	Site visits, FGDs, municipal records

	Bulk Services Infrastructure	Water, stormwater, sewage, energy, ICT resilience	Dassenhoek: Water supply intermittent; stormwater systems under pressure during floods. Edendale: Vulnerable bulk services; some interruptions recorded. Hopewell: Services partially resilient; emergency plans in place. Umdloti: Bulk services highly resilient; continuity maintained during extreme events.	Municipal service records, FGDs, field observations
	Essential Infrastructure and Service Provision	% households with access; service continuity during disasters; condition of infrastructure	Dassenhoek & Dakota Beach: Limited access; flooding disrupts essential services; recovery slow. Hopewell & Edendale: Moderate access; occasional service disruptions. Umdloti: Full access; service continuity maintained; residents expressed expectation for proactive planning.	FGDs, municipal reports, observations
Spatial	Disaster Management	Flood incident mapping, early warning systems, GIS risk coverage, availability of disaster response systems, qualified staff	Dassenhoek & Dakota Beach: Limited GIS coverage; flood incidents under-recorded; early warning systems weak; staffing insufficient. Hopewell & Edendale: Moderate GIS coverage; early warning partially functional; disaster response plans exist but not fully operational. Umdloti: Comprehensive GIS mapping; early warning and response systems fully functional; trained staff in place.	Municipal disaster management records, GIS data, interviews, workshops
	Densification	Integration of resilient densification models; reduction in urban sprawl	Dassenhoek & Dakota Beach: Low-density sprawl persists; minimal densification measures implemented. Hopewell & Edendale: Resilient densification partially applied; limited impact on sprawl. Umdloti: Planned densification incorporated; urban form compact and resilient.	Municipal LAPs, field observations, workshops
	Land Use Schemes	Flood, landslide, surge-resistant land allocation; emergency response zoning	Dassenhoek: Some development in high-risk areas; emergency zones inadequately planned. Hopewell & Edendale: Partial compliance with hazard-resistant land use guidelines. Umdloti: High compliance; emergency response areas strategically located; land use integrated with DRR planning.	Municipal plans, GIS mapping, field observations, interviews
	Local Area Plan (LAP)	Incorporation of flood mitigation, stakeholder engagement, alignment with regional frameworks	Dassenhoek & Dakota Beach: Flood mitigation integrated in parts; community participation limited. Hopewell & Edendale: Moderate LAP alignment; some community engagement. Umdloti: Strong LAP integration; stakeholder engagement robust; community expectations high for implementation.	FGDs, workshops, municipal LAP documents

	Urban Edge Delineation and Management	Monitoring frequency, compliance, emergency land allocation	Dassenhoek & Dakota Beach: Limited monitoring; urban edge encroachment in hazard zones. Hopewell: Urban edge managed; monitoring periodic. Umdloti: Urban edge fully delineated; monitored and enforced; emergency land allocation clearly defined.	Field observation, municipal planning documents, workshops

Source: Rampaul, Magidimisha-Chipungu, Kathi, Mchunu, and Sibiya (2025)

Social Theme Insights

Across most settlements, community engagement revealed significant variation in social resilience. In lower-income settlements such as Dassenhoek and Dakota Beach, households reported limited financial capacity to prepare for and recover from flood events. Focus group discussions highlighted that income constraints directly affected households' ability to invest in property adaptation, access insurance, or participate in rent-to-own housing schemes. Social networks and ward committee structures were observed to play a critical role in facilitating collective responses during floods, with informal support systems providing essential assistance when municipal services were delayed. Interestingly, in Umdloti, a relatively well-off coastal settlement, attempts to conduct FGDs with households were unsuccessful. Residents expressed frustration and research fatigue, citing repeated studies with limited tangible implementation. Their dissatisfaction was primarily due to the perception that previous research had not translated into practical action or improvements in flood preparedness. To capture community perspectives, the research team conducted an in-depth interview with the ward councillor, who conveyed the residents' concerns regarding the slow pace of municipal interventions and the need for tangible, actionable plans rather than further studies. This underscores the importance of community trust and perceived efficacy of interventions in social resilience assessments [2].

Environmental Theme Insights

Environmental resilience varied considerably across settlements. In Edendale and Hopewell, catchment management and flood mitigation infrastructure were partially implemented but faced challenges such as poor maintenance of drainage systems and limited community awareness regarding waste disposal practices. FGDs revealed that residents were aware of flood risks but often lacked the resources or knowledge to engage in local ecosystem management, such as maintaining buffer zones around rivers or participating in tree planting for slope stabilization. Coastal settlements like Umdloti and Dakota Beach highlighted the pressures of sea-level rise and coastal erosion. Observations and interviews with municipal officials revealed that while coastal management plans exist on paper, implementation is inconsistent, and residents expressed concern about the long-term sustainability of these interventions. Protected areas and biodiversity zones were relatively well-preserved in Umdloti, but challenges persisted in ensuring integration of environmental conservation into spatial planning across all settlements [20].

Governance Theme Insights

Municipal governance emerged as a critical determinant of settlement resilience. In lower-income settlements, alignment between planning, budgeting, and implementation was often partial or delayed, affecting the execution of flood mitigation projects. Interviews with municipal officials highlighted budgetary constraints and capacity limitations, while workshops with CoGTA planners emphasized the need for integrated approaches between disaster management, land use planning, and community engagement. Traditional authority involvement varied, with some rural settlements demonstrating effective collaboration, whereas in peri-urban areas, traditional leadership structures had limited influence on formal planning processes. Public participation mechanisms were often uneven; residents in Dassenhoek and Dakota Beach reported limited awareness of municipal plans or opportunities for feedback, whereas ward committees in Hopewell were more active but constrained by insufficient resources. These findings highlight the need for enhanced governance integration and transparent communication channels to build trust and enable effective resilience planning [4,14].

Physical and Spatial Theme Insights

Physical infrastructure across settlements displayed varying degrees of resilience. Infrastructural assessments revealed that while potable water, stormwater, and sewage systems were generally operational, their capacity to withstand extreme flood events remained limited in certain low-income areas. Access to public social facilities, including schools and community halls, was constrained in settlements such as Dakota Beach and Dassenhoek, limiting the effectiveness of these spaces as emergency shelters.

Spatial planning assessments revealed that disaster-informed land use planning was inconsistent. While flood-prone zones were identified in municipal records, enforcement of development restrictions and adherence to local area plans were uneven. Densification strategies and urban edge management were generally absent in informal settlements, contributing to increased exposure to hazards. Conversely, Umdloti demonstrated well-structured spatial planning, but community expectations for implementation and proactive disaster interventions were high, reflecting the social contract between residents and municipal authorities.

Cross-Cutting Insights and Lessons Learned

The field application of the SRAF highlighted several cross-cutting insights

- **Community Perceptions and Lived Experiences are Essential:** Quantitative indicators alone were insufficient to capture nuances in resilience; qualitative data from FGDs, interviews, and participatory workshops enriched the assessment.
- **Implementation Gaps Reduce Community Trust:** Well-off communities like Umdloti expressed frustration with repeated research without visible action, emphasizing the importance of translating assessments into tangible interventions.
- **Integration of Governance, Social, and Environmental Systems is Critical:** Resilience is not solely dependent on infrastructure or planning documents; institutional capacity, regulatory enforcement, and community engagement are equally important.

- **Data Triangulation Strengthens Validity:** Combining household surveys, municipal interviews, FGDs, and workshops enabled the SRAF to capture a holistic understanding of settlement resilience, supporting evidence-based recommendations.

The field testing confirmed that the SRAF is a practical, flexible, and robust tool for assessing settlement resilience in diverse contexts, identifying vulnerabilities, and guiding interventions tailored to community needs, governance capacity, and environmental conditions.

Discussion

The findings from the field application of the Settlement Resilience Assessment Framework (SRAF) across five KwaZulu-Natal settlements highlight the multidimensional nature of settlement resilience and the complex interplay between social, environmental, governance, physical, and spatial factors. The SRAF fieldwork demonstrated that resilience is not solely determined by infrastructure or hazard exposure but is also shaped by governance capacity, social cohesion, community participation, and effective planning [2,21].

Table 4 highlights the variation in social resilience across settlements. Vulnerable communities, particularly in Dassenhoek and Dakota Beach, exhibited lower income levels, limited security of tenure, and constrained access to community engagement mechanisms. Conversely, Umdloti, despite being well-resourced, demonstrated frustration among residents toward research fatigue and the perceived slow pace of municipal action, emphasizing the importance of responsive governance in shaping social resilience (Rampaul et al., 2025) [22].

These findings align with Wisner et al. (2004) and UN-Habitat (2015), who note that social networks, access to formal mechanisms, and community agency are critical determinants of adaptive capacity [1].

Table 4: Social Theme Insights and Implications for Resilience

Dimension	Key findings	Implications for resilience
Income	Low-income households in Dassenhoek & Dakota Beach highly vulnerable; Umdloti households dissatisfied with slow implementation	Socio-economic vulnerability reduces capacity to prepare for and recover from hazards; wealthier communities may disengage if governance is perceived as slow
Security of Tenure	Informal settlements at risk; customary tenure partially recognized	Legal security of tenure enables access to disaster assistance and recovery support
Cultural Properties, Natural Monuments and National Key Points	Cultural assets partially integrated into DRR planning; preservation efforts inconsistent.	Protecting cultural and heritage assets enhances social cohesion, preserves identity, and contributes to community resilience; integration into DRR plans reduces loss during hazards.
Ward Committee Participation	Low functionality in some settlements	Active citizen engagement supports social cohesion and adaptive response
Safety and Crime Prevention	Insufficient shelters and poorly lit public spaces in low-income settlements	Physical safety is integral to perceived community resilience

Environmental resilience varied across settlements due to differences in natural resource management, infrastructure, and hazard exposure (Serban, 2021). Table 5 shows that Dassenhoek and Dakota Beach had inadequate catchment management and poorly maintained stormwater infrastructure, increasing vulnerability to floods. In contrast, Umdloti demonstrated effective coastal management, floodplain protection, and conservation planning, which enhances adaptive capacity [1].

Table 5: Environmental Theme Insights and Implications for Resilience

Dimension	Key findings	Implications for resilience
Catchment Management	Maintenance inadequate in Dassenhoek; community engagement limited	Poor environmental stewardship increases disaster exposure
Biodiversity and Protected Areas	Umdloti & Dakota Beach maintain coastal biodiversity; Hopewell & Edendale partially comply	Integration of natural buffers strengthens ecosystem-based resilience
Groundwater and Water Quality	Low reliability in lower-income settlements; Umdloti reliable	Water security is critical for adaptive capacity during flood events
Waste Management	Irregular collection in Dassenhoek; Umdloti effective	Effective waste management reduces secondary hazards during floods

The governance analysis, summarized in Table 6, indicates that robust institutional capacity and alignment with disaster and climate regulatory frameworks are central to settlement resilience [22,26]. While Umdloti exhibited strong municipal structures and regulatory compliance, residents expressed frustration over slow action, demonstrating that governance effectiveness is not just structural but also operational and participatory. Conversely, Dassenhoek and Dakota Beach faced limited staffing, partial enforcement of DRR regulations, and low citizen awareness of participatory mechanisms, compromising adaptive capacity.

Table 6: Governance Theme Insights and Implications for Resilience

Dimension	Key findings	Implications for resilience
Regulatory Framework	Limited enforcement in lower-income settlements	Compliance ensures disaster risk reduction strategies are implemented
Planning budget alignment	Partial project execution due to resource constraints	Failure to align planning and budgeting undermines mitigation and preparedness
Public Participation	Low engagement in Dassenhoek & Dakota Beach; disengagement in Umdloti	Effective citizen participation enhances adaptive and anticipatory capacity

Table 7 illustrates that physical infrastructure is a critical determinant of disaster resilience. Settlements with robust transport networks, bulk service infrastructure, and resilient public facilities in Umdloti and Hopewell demonstrated high adaptive capacity. Conversely, Dassenhoek and Dakota Beach exhibited limited flood-resilient infrastructure, poorly maintained stormwater systems, and inadequate access to essential services, highlighting vulnerability to climate hazards.

Table 7: Physical Theme Insights and Implications for Resilience

Dimension	Key findings	Implications for resilience
Transportation and Pedestrian Systems	Poor accessibility in low-income settlements	Limited evacuation and emergency access reduces adaptive capacity
Bulk Services	Water, stormwater, and electricity vulnerable in Dassenhoek	Resilient infrastructure ensures continuity during disasters
Public Social Facilities	Limited emergency shelter capacity in vulnerable settlements	Proximity and resilience of facilities critical for effective response

Spatial planning underpins the ability of settlements to absorb, adapt, and recover from hazards. Table 8 demonstrates that low-density sprawl, incomplete GIS mapping, and poor flood zoning in Dassenhoek and Dakota Beach increase vulnerability. Conversely, Umdloti and Hopewell show effective LAP integration, urban edge management, and emergency land allocation, enhancing spatial resilience. The SRAF approach validates that spatial measures, when integrated with governance, social, environmental, and physical dimensions, produce a holistic understanding of settlement resilience.

Table 8: Spatial Theme Insights and Implications for Resilience

Dimension	Key findings	Implications for resilience
Disaster Management	Limited GIS & early warning in Dassenhoek & Dakota Beach	Accurate hazard mapping improves preparedness and early response
Densification	Low-density sprawl persists in lower-income settlements	Compact settlements reduce exposure and facilitate service delivery
Local Area Plan (LAP)	Partial integration of hazard mitigation	Inclusive and participatory LAPs improve adaptation and risk reduction
Urban Edge Management	Monitoring weak in lower-income settlements	Effective edge management reduces encroachment into hazard zones

The field application of SRAF demonstrates that resilience is multi-dimensional, and interventions must address interrelated social, environmental, governance, physical, and spatial factors simultaneously. Importantly, the SRAF allows for context-specific evaluation, highlighting the stark contrast between well-resourced communities like Umdloti and resource-constrained settlements like Dassenhoek and Dakota Beach. The inability to conduct FGDs in Umdloti due to research fatigue underscores the need for implementation alongside research, ensuring that communities perceive tangible benefits from engagement. The tables collectively show that robust governance, resilient infrastructure, active community engagement, and spatially informed planning are key levers for enhancing settlement resilience. SRAF provides a practical tool for municipal planners, CoGTA officials, and researchers to systematically assess vulnerabilities, identify gaps, and monitor progress toward disaster-resilient settlements.

Conclusion and Policy Implications

The application of the SRAF across five case study settlements in KwaZulu-Natal has demonstrated both the utility and adaptability of the framework in diagnosing settlement-level resilience challenges. By grounding the framework in municipal engagements (December 2024 onwards) and field-based mixed-methods research, the study has moved beyond abstract theorisation to uncover the lived realities, tensions, and capacities of diverse communities. A key insight is the stark divergence between wealthier, formalised communities such as Umdloti, who expressed frustration at research without implementation, and lower-income, vulnerable settlements such as Dassenhoek and Dakota Beach, where basic infrastructure, tenure security, and safety remain pressing needs. This demonstrates that resilience is context-specific, shaped as much by governance and political trust as by technical planning interventions.

The SRAF's four themes: Social, Governance, Physical, and Spatial, proved effective in identifying systemic barriers to resilience. For instance, governance deficits such as weak ward committee structures and unclear disaster response roles undermine otherwise strong community networks. Similarly, spatial exposure in flood-prone coastal settlements like Dakota Beach and Umdloti highlights the need for proactive land-use planning and investment in protective infrastructure [27].

From a Policy Perspective, the Findings Point to Three Critical Needs
Strengthening multi-level governance systems that can bridge the gap between municipal planning and community realities.

Ensuring equitable resource allocation to settlements most at risk, while balancing the expectations of wealthier communities demanding rapid implementation.

Integrating cultural and heritage assets into resilience planning, ensuring that social identity and cohesion are preserved alongside physical infrastructure [28].

In doing so, municipalities in KwaZulu-Natal, in partnership with CoGTA and academic institutions, can transition from reactive, disaster-response-driven approaches to proactive, resilience-oriented planning. The SRAF, refined through this pilot, offers a replicable model for other emerging market contexts where uneven development, limited fiscal space, and high climate risk converge [29].

Table 9: Policy Implications Emerging from SRAF Application

Theme	Policy priority	Implication for municipal practice
Social	Address socio-economic vulnerability and protect cultural/natural heritage	Implement targeted livelihood support, integrate cultural and heritage assets into DRR plans
Governance	Strengthen participatory structures and accountability mechanisms	Revitalise ward committees, formalise DRR roles, ensure transparent resource allocation
Physical	Upgrade basic services and climate-resilient infrastructure	Invest in flood-proof drainage, relocate settlements in high-risk areas, maintain resilient housing standards
Urban Edge Management	Manage land use and reduce exposure to hazards	Enforce land-use zoning, strengthen coastal protection, guide future urban growth away from risk-prone areas

Resilience cannot be understood as a technical blueprint alone. It is embedded in lived experiences, political will, and the everyday practices of communities. By applying the SRAF across diverse settlement contexts, this study contributes both to theory by operationalising resilience as multi-dimensional and context-specific and to practice, by providing municipal officials with actionable priorities. Future work should focus on implementation pathways, ensuring that the insights from assessment translate into tangible, just, and sustainable interventions [30].

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Ethical Considerations
Ethical approval was granted by UKZN's Research Ethics Committee, and informed consent was obtained from all participants.

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References
1. (2023) Resilient and Green Human Settlements Framework. UN-Habitat https://unhabitat.org/resilient-and-green-human-settlements-framework.
2. Adger WN (2003) Social capital, collective action, and adaptation to climate change. Economic Geography 79: 387-404.
3. Folke C (2006) Resilience: The emergence of a perspective for social–ecological systems analyses. Global Environmental Change 16: 253-267.
4. Pelling M (2010) Adaptation to climate change: From resilience to transformation. Routledge.
5. Ahern J (2011) From fail-safe to safe-to-fail: Sustainability and resilience in the new urban world. Landscape and Urban Planning, 100: 341-343.
6. Anguelovski I, Connolly JJ, Pearsall H (2016) From landscapes of utopia to the margins of the possible: The urban political ecology of the green city. In The Routledge Handbook of Urban Ecology 453-463.
7. (2015) Sendai Framework for Disaster Risk Reduction 2015–2030. United Nations Office for Disaster Risk Reduction. UNISDR https://www.unisdr.org/files/43291_sendaiframeworkfordrren.pdf.
8. Creswell JW, Plano Clark VL (2018) Designing and conducting mixed methods research. 3rd ed. Thousand Oaks: SAGE Publications.
9. Braun V, Clarke V (2006) Using thematic analysis in psychology. Qualitative Research in Psychology 3: 77-101.
10. Cutter SL, Burton CG, Emrich CT (2008) Disaster resilience indicators for benchmarking baseline conditions. Journal of Homeland Security and Emergency Management 5: 1-22.
11. Meerow S, Newell JP, Stults M (2016) Defining urban resilience: A review. Landscape and Urban Planning 147: 38-49.
12. Norris FH, Stevens SP, Pfefferbaum B, Wyche KF, Pfefferbaum RL (2008) Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. American Journal of Community Psychology 41: 127–150.
13. Birkmann J, Cardona OD, Carreño ML, Barbat AH, Pelling M, et al. (2013) Framing vulnerability, risk and societal responses: The MOVE framework. Natural Hazards 67: 193-211.
14. Godschalk DR (2003) Urban hazard mitigation: Creating resilient cities. Natural Hazards Review 4: 136-143.
15. Manyena SB (2006) The concept of resilience revisited. Disasters 30: 433-450.

16. Burby RJ (2006) Hurricane Katrina and the paradoxes of government disaster policy: Bringing about wise governmental decisions for hazardous areas. The Annals of the American Academy of Political and Social Science 604: 171-191.
17. Cutter SL, Ash KD, Emrich CT (2014) The geographies of community disaster resilience. Global Environmental Change 29: 65-77.
18. Ziervogel G (2019) Building transformative capacity for adaptation planning and implementation that works for the urban poor: Insights from South Africa. Ambio 48: 494-506.
19. Cowling RM, Egoh B, Knight AT, O'Farrell PJ, Reyers B, et al. (2008). An operational model for mainstreaming ecosystem services for implementation. Proceedings of the National Academy of Sciences 105: 9483-9488.
20. Angrosino M (2007) Doing cultural anthropology: Projects for ethnographic data collection. Waveland Press.
21. Rampaul K, Magidimisha-Chipungu HH, Kathi N, Mchunu NN, Sibiya S (2025) Settlement Resilience Assessment Framework (SRAF) field data. KwaZulu-Natal Programme of Action: Disaster Risk Reduction Project, CoGTA–UKZN Partnership. Fieldwork conducted February–June 2025.
22. Davoudi S (2012) Resilience: A bridging concept or a dead end. Planning Theory & Practice 13: 299-333.
23. DiCicco-Bloom B, Crabtree BF (2006) The qualitative research interview. Medical Education 40: 314-321.
24. Dodman D, Satterthwaite D (2021) Urban resilience and climate change: Towards inclusive and equitable solutions. Current Opinion in Environmental Sustainability 51: 101-107.
25. Schwarz M (2002) The World Café: A resource guide for hosting conversations that matter. Whole Systems Associates.
26. Satterthwaite D, Archer D, Colenbrander S, Dodman D, Hardoy J, et al. (2020). Building resilience to climate change in informal settlements. One Earth 2: 143-156.
27. Johnson RB, Onwuegbuzie AJ (2004) Mixed methods research: A research paradigm whose time has come. Educational Researcher 33: 14-26.
28. Kitzinger J (1995) Qualitative research: Introducing focus groups. BMJ, 311(7000), 299-302.
29. Reason P, Bradbury H (2008) The SAGE handbook of action research: Participative inquiry and practice. SAGE Publications.
30. Braun V, Clarke V (2006) Using thematic analysis in psychology. Qualitative Research in Psychology 3: 77-101.