

Enhancing climate resilience through the Sendai Framework. Case of Tana North Sub-County, Kenya

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Abstract: Implementing global disaster risk reduction (DRR) frameworks in climate-vulnerable regions remains a key challenge for sustainable development. This study examines the application of the Sendai Framework for Disaster Risk Reduction (SFDRR) in enhancing community resilience to climate shocks in Tana North Sub-County, Kenya, an arid and semi-arid area frequently affected by droughts, flash floods, poor infrastructure, and widespread poverty. Employing a mixed-methods approach including household surveys ($n = 216$), key informant interviews, and regression analysis, the study identifies institutional and socio-economic barriers hindering effective SFDRR implementation at the local level. Results highlight significant governance shortcomings and community-level vulnerabilities. Weak institutional coordination, inadequate funding, and poor policy enforcement intersect with challenges including education, gender inequality, substandard housing, and dependence on climate-sensitive livelihoods. Only 33% of respondents knew about SFDRR, revealing a disconnect between global DRR frameworks and grassroots awareness. Adaptive capacity is strongly influenced by infrastructure quality and access to water resources. A strong inverse relationship between vulnerability and resilience ($r = -0.95$, $p < .001$) emphasises the need for integrated strategies. The study concludes that locally tailored, community-led approaches, supported by strong governance, are critical for meaningful SFDRR implementation and for aligning global DRR goals with local development needs.

1. Introduction

Tana North Sub-County, situated in Tana River County, Kenya, faces growing exposure to climate-induced shocks, particularly prolonged droughts and recurrent flash floods (Muthuwatta et al., 2018). Its arid and semi-arid environment, marked by erratic rainfall and a high dependence on climate-sensitive livelihoods, heightens the region's vulnerability (Weingärtner et al., 2019; Lutta et al., 2021). These climatic stresses have led to reduced agricultural productivity, heightened food insecurity, displacement, and intensified competition over limited natural resources, often resulting in resource-based conflicts (Niekerk, 2015; van Niekerk et al., 2020). In light of these challenges, the need for robust and context-sensitive disaster risk reduction (DRR) strategies in regions like Tana North has become increasingly urgent (Nyandiko, 2020; Mburu, 2020).

At the global level, the adoption of the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015–2030 marked a pivotal evolution in DRR policy. Succeeding the Hyogo Framework for Action (2005–2015), the SFDRR outlines four strategic priorities: understanding disaster risk, strengthening disaster risk governance, investing in DRR for

resilience, and enhancing disaster preparedness for effective response and recovery (Saya et al., 2017). The framework promotes proactive, inclusive, and risk-informed approaches that are vital for building resilience in climate-vulnerable communities (Carrington et al., 2021); (Chisty et al., 2022; Namba_s..Pdf, n.d; UNDER, 2023)

A core tenet of the SFDRR is the integration of its principles into national and local governance systems to ensure that DRR efforts are tailored, participatory, and sustainable (Ulbrich et al., 2023; Otworu and Nyandiko, 2024). Yet, despite increased policy attention, translating the framework's priorities into tangible, localised outcomes, particularly in arid and semi-arid contexts, remains inconsistent and constrained (Gall et al., 2015; van Niekerk et al., 2020)

Although Kenya and other climate-affected regions have implemented aspects of the SFDRR, such as early warning systems, community-based resource management, and ecosystem restoration, significant challenges persist, in particular limited financial resources, weak institutional capacity, fragmented governance, and socio-cultural barriers that undermine community engagement and ownership (Onyuro and Ward et al., 2022)

This study investigates the implementation of the Sendai Framework for Disaster Risk Reduction (SFDRR) as a pathway to enhancing community resilience to climate shocks in Tana North Sub-County, Tana River, Kenya. It explores how the SFDRR priorities are operationalised through county-level policies, institutional structures, and community-based initiatives, assessing their effectiveness in addressing local vulnerability and strengthening adaptive capacity.

By focusing on Tana North Sub-County, this research contributes to the broader discourse on climate resilience in dryland regions. It provides practical evidence on how global frameworks such as the SFDRR can be effectively integrated into local policy, planning, and practice. The findings aim to inform Kenya's ongoing commitments under the SFDRR, the Paris Agreement, and the Sustainable Development Goals (SDGs), offering actionable insights for both national and sub-national climate resilience strategies (UNDRR, 2015; United Nations, 2015; UNDRR, 2023.)

2. Materials and Methods

This study employed a cross-sectional research design to assess community resilience to climate-related shocks in Tana North Sub-County (Bura), in Tana River County, Kenya (see Figure 1). The area was purposively selected due to its position within a dryland ecosystem, which is particularly vulnerable to climate-induced stressors such as droughts and floods. These recurrent hazards not only threaten food and water security but also strain the adaptive capacities of local populations. Focusing on this region allows for a contextual analysis of resilience strategies within an environment characterized by chronic exposure to environmental risks.

A representative sample size was determined based on the target population of over 10,000 individuals, as outlined by (Mugenda and Mugenda 2003; Creswell and Creswell (2017). The baseline sample size of 384 respondents was calculated using standard statistical guidelines and then adjusted to 393 using Slovin's formula, which is defined as:

$$n = \frac{N}{1 + N(e)^2} \quad \text{Where:}$$

n = sample size

N = population size e = margin of error

A multi-stage sampling technique was employed. First, the purposive selection of wards was carried out to ensure a diverse representation across ecological zones and livelihood profiles. This approach is particularly suitable when dealing with heterogeneous populations (Mugenda & Mugenda, 2003).

Data collection utilised a mixed-methods approach. Quantitative data were gathered using structured household surveys administered through Kobo Toolbox, a digital platform suitable for remote field data collection. These data were complemented by qualitative insights obtained through Focus Group Discussions (FGDs) and Key Informant

Interviews (KIIs) with local leaders, government officials, and practitioners. The qualitative components aimed to explore underlying vulnerabilities, community perspectives, and institutional responses to climate shocks.

The study's thematic framework was informed by the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015–2030. Research tools were designed to assess resilience outcomes about the four priority areas of the SFDRR, aligning with global climate adaptation goals such as those outlined by the UNFCCC and outcomes from COP21 (2015) and COP25 (2019).

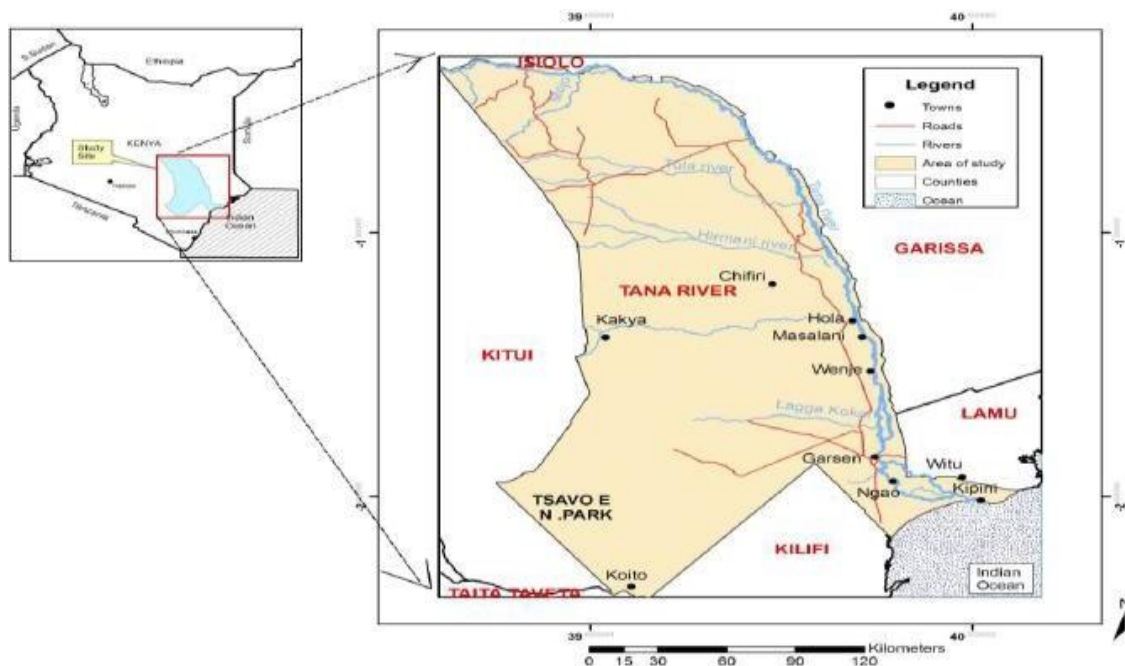


Figure 1. Map of Tana North (Bura), Tana River County (**Source:** Department of Geography, University of Nairobi, as cited in Otieno et al. (2013), via ResearchGate)

Data analysis involved both quantitative and qualitative techniques. Quantitative data were analysed using simple regression models to explore relationships between community exposure to climate shocks and resilience outcomes. Descriptive statistics were applied to present the findings through tables, graphs, and charts. Before analysis, the data underwent normality and reliability tests to mitigate potential biases, including social desirability and leniency errors (Creswell and Creswell, 2017; Apuke, 2017). Qualitative data were analysed using content analysis, which facilitated the identification of recurring themes related to vulnerability, adaptation practices, and institutional frameworks. This dual approach enabled a more comprehensive understanding of how the SFDRR principles are being integrated into local disaster risk reduction efforts in a climate-vulnerable setting

3. Results

3.1 Household and Demographic Characteristics

Tana North Sub-County, located in Kenya's arid and semi-arid lands (ASALs), faces significant challenges related to climate-induced shocks, such as recurring droughts and floods. These environmental stresses have profound impacts on the resilience of local communities, influencing their ability to adapt to ongoing and future climate variability. Understanding the demographic characteristics of this population is essential for identifying vulnerabilities and designing targeted interventions to enhance resilience.

Demographically, the region is characterized by a high proportion of male-headed households, which account for 56.86% of the total number of respondents; female-headed households represent 32.49%, while 10.45% of households are led by children or siblings, reflecting unique family structures often shaped by socio-cultural and environmental factors. The test results conducted on gender-based vulnerability using the Mann-Whitney U test ($U = 2.34$, $p < 0.05$) showed that female-headed households experienced more climate-related hardships due to constrained resource access and limited decision-making autonomy.

Educational attainment in Tana North is generally low, with 59.41% of respondents reporting no formal education, 27.56% having completed secondary education, and 13.03% having attained post-secondary qualifications. To assess the impact of educational attainment on household resilience, a one-way Analysis of Variance (ANOVA) was conducted. The results indicated a statistically significant variation in resilience scores based on educational level ($F = 12.35$, $p < 0.05$). Education also shaped economic participation as respondents with secondary or post-secondary education demonstrated notably higher resilience scores compared to those with no formal education. A Chi-square test ($\chi^2 = 35.89$, $df = 10$, $p = 0.0001$) showed a significant association between education level and type of livelihood, suggesting that those with no formal education were disproportionately involved in climate-sensitive occupations.

3.2 Livelihood Strategies and Climate Vulnerability

Livelihood strategies in Tana North are diverse but predominantly reliant on climate-sensitive activities. A considerable portion of the population, 27.84%, engages in agropastoralism, with 26.61% engaging in pastoralism, respectively. Additionally, 31.94% of respondents participate in petty trade and collection of charcoal or firewood, while 13.61% are employed in formal or casual labour sectors. While livelihood sensitivity to climate shocks was evident, differences in resilience across livelihood types were statistically significant (Kruskal-Wallis $\chi^2 = 15.67$, $p < 0.01$).

Households engaged in formal employment demonstrated the highest resilience, attributed to income stability. Conversely, reliance on traditional livelihoods negatively correlated with resilience ($\beta = -0.43$, $p < 0.01$).

Housing conditions further illustrate the socio-economic context of the region. While 22.27% of households reside in permanent structures, the majority live in semi-permanent (44.73%) or temporary (33%) dwellings, indicative of limited infrastructure and economic resources. Results from Logistic regression ($OR = 2.48$, 95% CI: 1.75–3.52, $p < 0.05$) found that semi-permanent and temporary structures were strongly correlated with higher climate risk exposure. Additionally, a Chi-square test ($\chi^2 = 12.56$, $df = 4$, $p = 0.0137$) highlighted that female-headed households were more likely to live in less secure housing, compounding their vulnerability.

Water availability and access were found to be critical factors influencing the climate vulnerability of households in Tana North Sub-County. Urban households reported better access to piped water (39.57%), while rural households primarily relied on alternative sources such as boreholes, wells and water pans (23.8%) or rivers (24.53%). The distance to water sources emerged as a significant vulnerability factor, with a one-way ANOVA revealing a statistically significant difference in resilience based on proximity to water sources ($F = 9.41$, $p < 0.01$). This finding suggests that greater distances to reliable water sources heighten vulnerability, as households must invest more time and effort in securing water, thus limiting their capacity for adaptive livelihood strategies.

Sanitation conditions also exacerbated vulnerability to climate shocks. Households without adequate sanitation facilities experienced a higher incidence of waterborne diseases, which in turn reduced both productivity and overall resilience. A chi-square test of independence confirmed a statistically significant association between inadequate sanitation and the prevalence of waterborne illnesses ($\chi^2 = 10.82$, $p < 0.05$). This further

highlights the importance of improving sanitation infrastructure to mitigate health risks that undermine community resilience

3.3 Community Vulnerability to Climate Shocks

Local livelihoods have faced significant disruptions due to the cumulative effects of climate-related risks. Figure 1 outlines the most reported impacts, with drought-induced famine and pasture scarcity ranked highest (80%), followed by seasonal or flash floods (43%) and water scarcity (40%).

Table 1. Distribution of Climate Impacts on Livelihoods by Severity

Impact	Frequency (%)
Drought-induced famine/malnutrition	72
Seasonal/flash floods	43
Water scarcity	40
Water and vector-borne diseases	24
High food prices	20
Crop and livestock diseases	20
Poor market prices	19
Inadequate pasture	8
Ethnic conflicts	8
The influx of livestock from outside the Tana North sub-county	5

Figure 2 illustrates the distribution of respondent perceptions across four institutional and knowledge-based dimensions critical to climate resilience in Tana North Sub-County: awareness of drought risk, knowledge of early warning systems, effectiveness of adaptation practices, and inter-agency coordination.

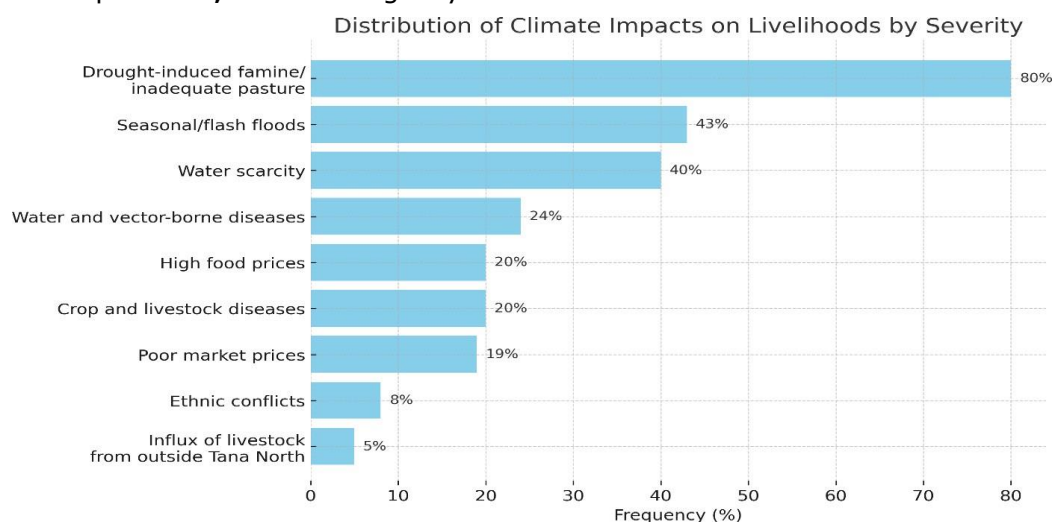


Figure 2. illustrates the distribution of respondent perceptions across four institutional and knowledge-based dimensions critical to climate resilience in Tana North Sub-County

Results from the Chi-square test ($\chi^2 = 190.61$, $df = 8$, $p < 0.001$) indicate statistically significant differences in the frequency of reported climate-related impacts on livelihoods. The analysis highlights drought-induced famine and inadequate pasture (80%) as the most frequently reported and severe threats, followed by seasonal/flash floods (43%) and water scarcity (40%). These findings underscore the disproportionate burden of drought-related stressors in Tana North Sub-County.

The results on the distribution of climate shock impacts were found to be significantly associated with livelihood types. A chi-square test of independence ($\chi^2 = 24.43$, $p < 0.001$) indicated that different livelihood strategies were correlated with varying levels of exposure to climate shocks, underscoring the role of livelihood diversification in shaping vulnerability. Further analysis revealed a strong inverse relationship between vulnerability and resilience. Pearson's correlation coefficient ($r = -0.95$, $p < 0.001$) confirmed this negative association, suggesting that as vulnerability increases, resilience decreases.

A multiple regression analysis reinforced these findings, demonstrating that vulnerability is a significant negative predictor of resilience ($\beta = -0.458$, $p < 0.001$). This model accounted for 77.2% of the variance in resilience ($R^2 = 0.772$), highlighting the importance of reducing vulnerability to improve community resilience to climate shocks. Additionally, one-way ANOVA results ($F = 13.063$, $p < 0.05$) revealed that vulnerability was a major predictor of resilience, further supporting the critical role of minimising vulnerability in enhancing adaptive capacity.

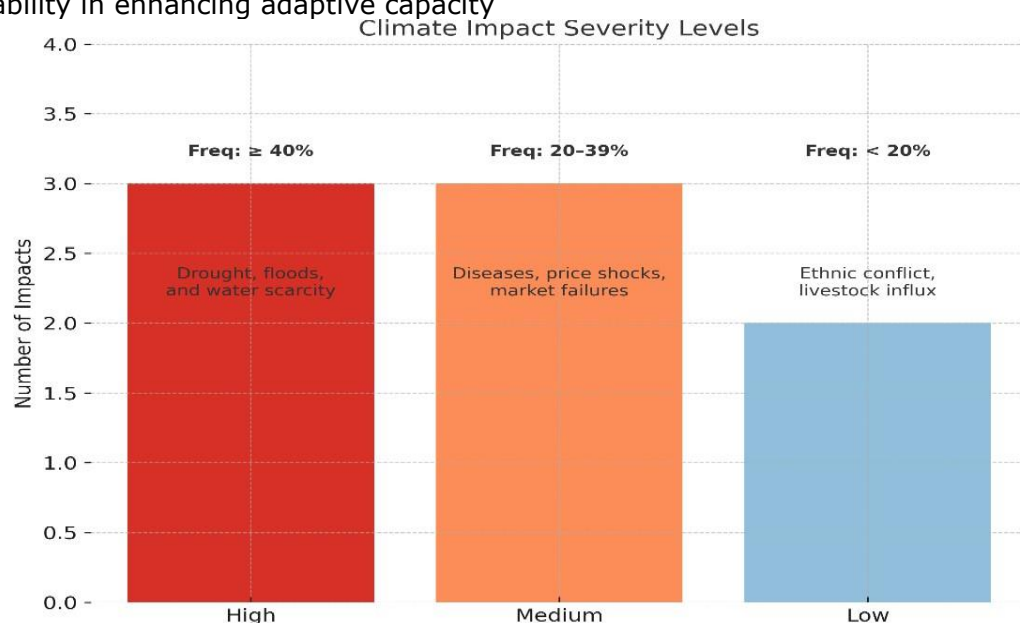


Figure 3. Climate Shocks by Severity Levels

3.4 Institutional Preparedness and Risk Reduction Knowledge

Understanding community-level awareness and institutional preparedness is essential in evaluating resilience to climate-related disasters. Four key parameters were assessed using ordinal data: awareness of drought risk identification, knowledge of early warning systems, perceived effectiveness of adaptation practices, and perceptions of inter-agency coordination. Table 2 presents the frequency distribution of responses across these parameters.

Figure 4 presents the distribution of responses on institutional and knowledge-based preparedness, offering a comparative analysis across four key dimensions: awareness of drought risk, inter-agency coordination, knowledge of early warning systems, and the perceived effectiveness of adaptation strategies. The results reveal notable variations in knowledge and institutional capacity across these domains within the study population.

Results obtained using the chi-square test of independence ($\chi^2 = 356.78$, $df = 9$, $p < 0.001$) revealed statistically significant differences in the distribution of responses across the four parameters. This indicates considerable variability in institutional preparedness and awareness levels among the surveyed households.

An independent samples t-test was used to examine whether awareness of the Sendai

Framework for Disaster Risk Reduction (SFDRR) was associated with differences in household resilience scores. The test revealed a statistically significant difference between respondents who were aware of the SFDRR ($M = 0.7$) and those who were not ($M = 0.5$), $t(98) = 10.15$, $p < 0.001$. This suggests that SFDRR awareness is positively associated with greater resilience.

Table 2. Distribution of Responses on Institutional and Knowledge-Based Parameters (N = 362)

Parameter	No Extent	Little Extent	Moderate Extent	Large Extent	Total
Awareness of drought risk	22.6%	67.7%	5.2%	5.2%	100%
Knowledge of early warning systems	20.4%	40.9%	15.5%	19.0%	100%
Effectiveness of adaptation practices	26.7%	33.9%	19.6%	19.6%	100%
Inter-agency coordination	24.5%	21.8%	51.9%	3.0%	100%

To further examine predictors of resilience, a multiple regression analysis was conducted. The results identified both educational attainment ($\beta = 0.321$, $p < 0.001$) and SFDRR awareness ($\beta = 0.233$, $p < 0.001$) as statistically significant positive predictors of resilience. These findings emphasise the importance of both formal education and targeted awareness campaigns in enhancing household capacity to prepare for and respond to climate-related shocks.

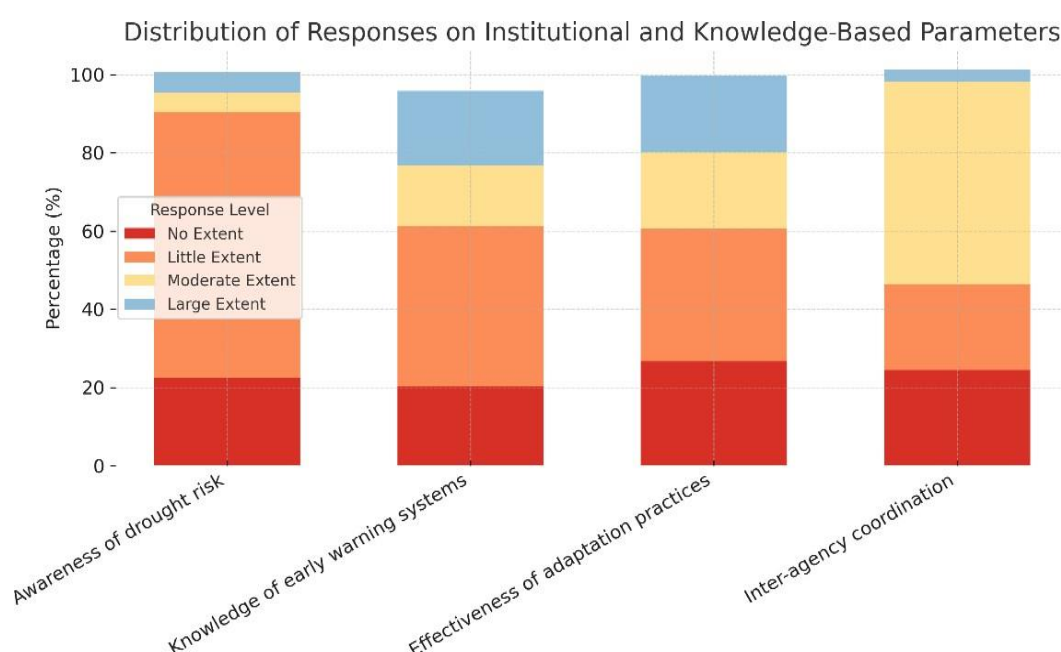


Figure 4. presents the distribution of responses on institutional and knowledge-based preparedness

3.5 Knowledge, Awareness, and Perceptions of the SFDRR Strategy

Understanding the local knowledge and perception of global disaster risk reduction frameworks is critical for assessing institutional readiness and public engagement. Table 4 summarises respondents' knowledge, awareness, and attitudes toward the Sendai Framework for Disaster Risk Reduction (SFDRR).

Table 4. Barriers to Climate Adaptation Implementation

Barriers	Little Extent	Moderate	Large	Very Large	Total
Poor SFDRR implementation	22.0%	24.8%	24.5%	28.4%	362
Budget shortfalls	17.4%	24.0%	26.5%	32.1%	362
Poor service/corruption	21.2%	22.9%	25.1%	30.6%	362
Governance/Decentralisation gaps	36.1%	27.0%	27.3%	8.9%	362

The findings indicate that a large majority of the respondents (91.1%) attributed poor adaptation outcomes under the SFDRR framework to institutional and governance-related barriers, particularly budgetary constraints, corruption, and lack of political commitment. Results obtained using the z-test for proportions confirmed the statistical significance of this perception ($Z = 22.08$, $p < 0.001$), affirming the strong association between systemic governance issues and suboptimal resilience outcomes.

Furthermore, insights from key informant interviews reinforced the quantitative findings, with respondents highlighting weak institutional capacity, limited decentralization, and insufficient integration of SFDRR guidelines at the local level as major barriers to effective implementation. Taken together, the evidence underscores the need for institutional reform and strengthened accountability as essential priorities for enhancing resilience in the region.

4. Discussion

The findings from data obtained from respondents in Tana North Sub-County underscore the complex and interdependent relationship between socio-demographic characteristics, livelihood strategies, institutional dynamics, and the awareness and implementation of the Sendai Framework for Disaster Risk Reduction (SFDRR). These elements collectively shape the community's capacity to withstand and adapt to climate-induced shocks, offering significant implications for both policy formulation and disaster risk reduction (DRR) practice.

4.1 Demographic Vulnerabilities and Exposure

Socio-demographic factors such as gender, household structure, and education emerged as key determinants of vulnerability. These findings are consistent with earlier research emphasising the influence of socio-economic characteristics on vulnerability, particularly within low-income, rural, and dryland contexts (Below et al., 2010; Deressa et al., 2009, n.d)

Notably, gender disparities were evident with female-headed households facing heightened vulnerability due to limited access to productive resources, constrained decision-making power, weaker social networks, and inadequate access to essential services. These results align with earlier studies that underscore the gendered nature of climate vulnerability, in particular among pastoralist and agropastoral communities

across sub-Saharan Africa (Adelekan et al., 2015; Machio et al., 2025). Broader literature also supports this, highlighting the compounded challenges faced by women in adapting to climate risks (Flatø et al., 2017; Omolo et al., 2017; Mubaya et al., 2017; Hagos et al., 2021; Vincent, 2022; F. Moyo et al., 2025)

Education was shown to enhance adaptive capacity. Respondents with higher levels of education were more likely to engage in diversified livelihoods, a key factor in climate resilience. Alarming, nearly 60% of respondents had no formal schooling, correlating with lower resilience and a higher dependency on climate-sensitive subsistence activities. These results mirror findings by (Deressa et al., 2009; Jones and Boyd, 2011; Tazeze and Haji, 2012a), who note that education improves access to climate information and encourages the adoption of adaptive practices. However, Tazeze and Haji, (2012a) caution that education's role in adaptation is often mediated by broader structural factors such as poverty and resource access.

4.2 Livelihood Sensitivity to Climate Shock

Livelihood diversification is a key factor in reducing vulnerability. In Tana North, households engaged in formal employment exhibited higher levels of resilience, benefiting from income stability and reduced exposure to climate-sensitive sectors. This finding is supported by (Ellis, 2000; Bangay and Blum, 2010; (Wamsler et al., 2012), who assert that diversified livelihoods buffer households against environmental and economic shocks. Similarly, (Thornton et al., 2014) emphasise that diversification is essential for resilience in arid and semi-arid regions. Conversely, households dependent on informal or subsistence-based livelihoods experienced heightened vulnerability. These groups are more exposed to climatic risks and are often constrained by poor market access, weak infrastructure, and limited government support (Barrett et al., 2001)

The quality of housing was another critical resilience factor. A significant number of respondents lived in temporary or semi-permanent housing, which offers minimal protection against extreme weather events. These observations align with studies by Paterson et al. (2017) and Zahra et al. (2025), which emphasise the importance of durable housing and infrastructure in enhancing climate resilience. Similarly, Omolo et al. (2017) and Thornton et al. (2014) link poor infrastructure with increased climate sensitivity. However, Cutter, (2020) argues that while physical infrastructure is important, broader socio-political structures often play a more decisive role in shaping resilience.

Water scarcity, exacerbated by erratic rainfall and prolonged dry spells, further compounds vulnerability. Households without reliable access to water faced heightened exposure to both climatic shocks and health-related risks. Consistent with previous studies in arid regions across Africa and globally (Omolo et al., 2017; Lain and Bishop, 2018; Bahadur et al., 2015). Similarly, studies of climate-related shocks have been shown to directly disrupt local production, consumption, and health, especially among climate-sensitive populations (Hallegatte et al., 2014; Wilkinson & King-Okumu, 2019; Fatemi, 2020; E. Moyo et al., 2023; Moore and Colwell, 2025). Reports from the World Bank Group, (2020), Kummu et al. (2010), Okoko (2022) and Amaratunga et al. (2023) underscore how climate variability intensifies existing vulnerabilities such as water scarcity, food production thus disrupting local livelihoods.

4.3 Institutional and Policy Barriers to SFDRR Implementation

Governance challenges were identified as the most significant impediment to effective SFDRR implementation. An overwhelming 91.1% of respondents cited poor service delivery, budgetary constraints, weak inter-agency coordination, and lack of political goodwill as key barriers to SFDRR implementation. These findings reflect broader systemic governance issues similar to those documented in Latin America, Southeast Asia, and across sub-Saharan Africa (Ulbrich et al., 2023; Maru et al., 2014; Cremin et

al., 2023; Nyandiko, 2020; Oduro et al., 2021). Similar studies have shown that inadequate policy implementation and weak institutional frameworks obstruct DRR efforts (van Niekerk et al., 2020); (Onyuro, n.d.). These governance failures are compounded by a lack of proactive planning and alignment with the SFDRR. As (Wilkinson & King-Okumu, 2019; Tiepolo et al., 2021; Otwori and Nyandiko, 2024) argue, many national DRR systems remain reactive, focusing on emergency responses rather than long-term risk reduction. Moreover, the absence of risk transfer mechanisms such as crop and livestock insurance limits the capacity of small-scale producers to absorb shocks. This has been widely documented in both African and global contexts (Birkmann and von Teichman, 2010; Birkmann and McMillan, 2015; Peters, 2022) and (Niekerk, 2015)

4.4 Gaps in Institutional Awareness and Community Participation

Institutional awareness of the SFDRR was generally low, with many community members and even local administrators unfamiliar with its core principles. Only about one-third of respondents demonstrated familiarity with or a positive attitude toward the framework. This lack of awareness correlated with lower resilience outcomes, underscoring the importance of education and outreach. (Gall et al., 2015; Disaster Risk Reduction and Climate Change Adaptation, 2025) (2015) and (Namba_S..Pdf, n.d.). Similarly (Below et al., 2010; Cremin et al., 2023) note that global frameworks often fail to take root at the local level due to limited information dissemination and weak community engagement.

4.5 Empirical Justification for Integrated Resilience Interventions

Statistical analysis further strengthens the findings, revealing a strong negative correlation between vulnerability and resilience ($r = -0.95$, $p < .001$), with the regression model explaining 77.2% of the variance in resilience. Highlighting the critical role of socio- demographic, infrastructural, and institutional variables in shaping adaptive capacity. This robust finding reinforces the need for integrated interventions that simultaneously address structural vulnerabilities and enhance adaptive capacity. Prioritising education, infrastructure, and governance reform is essential for improving disaster preparedness and adaptive outcomes.

4.6 Toward a Context-Specific DRR Strategy

A comprehensive approach to SFDRR implementation in Tana North must address not only the immediate physical and socio-economic vulnerabilities but also the underlying governance barriers that hinder long-term resilience building. This approach aligns with growing advocacy for context-sensitive, inclusive, and adequately resourced DRR strategies that are responsive to local realities (Birkmann and McMillan, 2025; Ouyang et al., 2023)

Conclusion

This study demonstrates that climate vulnerability in Tana North Sub-County is shaped by an intricate matrix of gender disparities, low educational attainment, dependence on climate- sensitive livelihoods, and infrastructural inadequacies. Weak institutional frameworks and limited public awareness further hinder the effective implementation of the SFDRR. To enhance community resilience, it is imperative to invest in education, promote livelihood diversification, strengthen institutional frameworks, and align DRR policies with local contexts. These findings contribute to the expanding discourse on localised, inclusive disaster risk reduction and provide actionable insights for policymakers and practitioners committed to implementing the SFDRR in vulnerable settings.

Addressing these challenges will require a multi-pronged approach that includes targeted policy reforms, capacity-building initiatives, and robust community engagement. These findings contribute to the growing body of evidence advocating for context-sensitive, inclusive, and proactive DRR strategies aligned with global frameworks such as the SFDRR (Hallegatte et al., 2014; Birkmann & von Teichman, 2010; Birkmann and McMillan, 2025)

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