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Collaboration Between Communities and Local Technology in Facing the Challenges of Climate Change

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Abstract

The climate crisis in East Nusa Tenggara has shifted from a weather anomaly to an existential threat to agrarian communities' food sovereignty. Amidst increasing subsistence precarity, local communities are resisting through a hybridisation of traditional wisdom and technological innovation. This research aims to deconstruct the phenomenological manifestation of the climate crisis and map the synergy between community social capacity and local technology in building resilience. This research uses qualitative methods with an interpretive phenomenological approach. Data were collected through in-depth interviews and participant observation with key grassroots actors. Data analysis was conducted systematically using qualitative data analysis software (CAQDAS) to map inter-code relationships, narrative proximity, and co-emergence networks. The findings indicate that the climate crisis is felt physically through the intensity of disasters and water crises that directly impact residents' food affordability. However, communities respond by activating social capacity and local knowledge as safety valves. The data network map reveals a strong synergy, where technical innovations are adopted and integrated into local epistemologies to create effective adaptation strategies. Future resilience in NTT does not depend solely on technocratic solutions, but rather on strengthening the synergy between technology and local wisdom.

Keywords: Climate Crisis; Food Security; Social Capacity; Local Technology

Introduction

The global climate crisis has shifted from a mere scientific discourse about rising atmospheric temperatures to an existential threat that is crippling the very fabric of life at the grassroots level. This phenomenon is no longer neutral; it is unevenly distributed, with agrarian communities in East Nusa Tenggara (NTT) particularly vulnerable. NTT's geography, dominated by long dry seasons, makes the region a natural laboratory for

ecological vulnerability. However, the dominant narrative often takes a technocratic approach that reduces people's suffering to statistics of crop failures, without addressing the phenomenological dimension of how the crisis is experienced as part of the precarity of everyday life.

Theoretically, the relationship between humans and their environment under extreme conditions can be understood through the lens of the farmer's moral economy. Scott argues that in subsistence communities, ensuring survival matters far more than accumulating profits (Omvedt & Scott, 1978). In the NTT context, the climate crisis is not simply a matter of declining production, but a threat to the subsistence ethic. Previous research shows that agrarian change amid market and environmental pressures often forces smallholder farmers into a spiral of structural poverty (Dafermos, 2026). In Indonesia, numerous studies have examined climate-induced food vulnerability, but few have specifically examined how social capacity and local knowledge act as safety valves that tame external technologies into appropriate local solutions (Ramadaniar et al., 2024).

This gap in the literature serves as the starting point for this research. On the one hand, the extraordinary pressures of weather anomalies and dwindling water resources create subsistence precarity, a condition of chronic vulnerability where the certainty of tomorrow always hangs in the shadow of failure (Agrawal, 1995). In contrast, communities in NTT demonstrate resilience by activating local epistemologies tested for centuries (Jejak et al., 2025). This phenomenon demands a reading that sees communities not merely as passive victims but also as empowered subjects capable of hybridizing tradition and technological innovation.

This research explores the synergy between communities and local technologies in addressing the climate crisis in East Nusa Tenggara (NTT). Adopting a subsistence approach, an academic stance that prioritises an ethic of care and the preservation of authentic meaning from informants' voices, this study attempts to dissect the structures of vulnerability and community adaptation strategies. Through an in-depth analysis of code relations and discourse networks, this article argues that future resilience in NTT can be achieved only if technical innovation is embedded in local wisdom.

Materials and Methods

This research employed a qualitative method with an interpretive phenomenological approach. This approach was chosen to deeply explore the "lifeworld" of agrarian communities in East Nusa Tenggara (NTT) as they navigate the climate crisis (Sundler et al., 2019). Phenomenology allows researchers to go beyond statistical data and capture the essence of subjects' experiences related to subsistence precarity, as well as

how they interpret the synergy between tradition and technical innovation as a survival strategy (Heidegger, 1962).

The research was conducted in a rural area of NTT significantly impacted by weather anomalies and water crises. The researchers selected informants using purposive sampling, including local farmers, traditional leaders, and community technology activists with direct experience dealing with ecological shocks. The study recruited 65 informants.

Primary data were collected through three main techniques: In-depth interviews, conducted to elicit personal narratives related to climate change, food security, and social capacity; Participatory Observation, where researchers engaged in the community's daily activities to directly understand disaster manifestations and technical adaptation practices in the field; and Documentation, namely the collection of secondary data in the form of field notes and photographs related to the biophysical conditions of the region (Braun et al., 2020).

Textual data were processed using computer-assisted qualitative data analysis software (CAQDAS) to ensure transparency and rigour (De Lerma & de las Mercedes Botija Yagüe, 2022). The analysis process followed these stages: Open Coding: Initial identification of meaning segments related to climate, food, and technology; Relationship and Frequency Analysis: Producing a code relationship matrix (Figure 1) and a distribution map of major themes; Categorical Dissection: Deconstructing major themes into sub-codes and informant segments (Figures 3, 4, and 5) using the Code-Subcodes-Segments Model; Network Analysis: Mapping intersections, proximity, and co-occurrence between codes (Figures 6, 7, and 8) to see the systemic constellation of community resilience (Guetterman & James, 2023).

Results

This research yielded data on the synergy between local communities and technology, based on interviews systematically compiled in tabular format. The interview data were processed using MAXQDA 24 software developed by VERBI GmbH, which allows researchers to code text, identify themes, analyse relationships between categories, and generate data visualisations, as illustrated in the following figure.

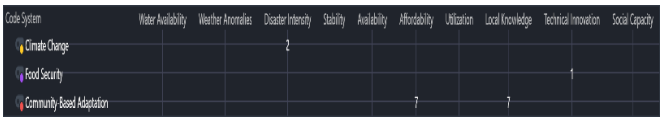


Figure 1. Code Relation

Source: Field Data Processing with MAXQDA 24 Software

Based on the Code Relation matrix analysis, the data narrative reveals interconnected conceptual relationships between environmental threats and community responses. In this context, the discourse on climate change is specifically linked to increased disaster intensity, indicating that climate impacts are most strongly perceived or conceptualised as direct physical threats. To address this vulnerability, particularly in food security, the emerging discourse emphasises technical innovation as a breakthrough for maintaining stable food supplies. Interestingly, this response is most prominent in the Community-Based Adaptation initiative, which shows the strongest relationship in the data. This grassroots adaptation strategy relies on two main pillars in balance: local knowledge and cost considerations. Overall, this mapping depicts an empirical situation in which communities respond to the threat of climate change, manifested in disaster intensity, through affordable adaptations rich in local wisdom, while continuing to encourage technical innovation for food security.

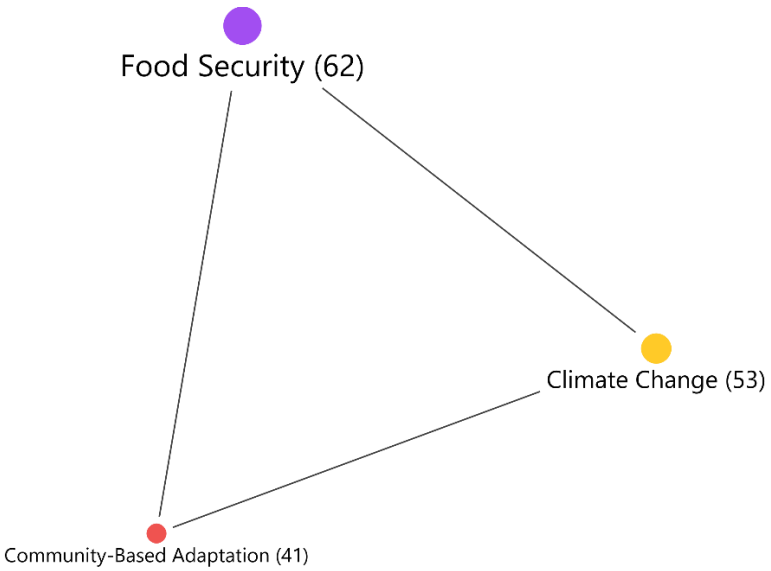


Figure 2. Code Map
Source: Field Data Processing with MAXQDA 24 Software

The Code Map visualisation in Figure 2 emphasises the constellation of relationships among the three main macro themes in this study. This map forms a triad of interconnections, indicating that Food Security, Climate Change, and Community-Based Adaptation are closely interconnected and discussed simultaneously in the data narrative. Interestingly, Food Security emerged as the most dominant discourse with the highest frequency of occurrence (62), making it the epicentre or main focus. This central issue is directly overshadowed by climate change (53), which acts as the underlying environmental threat context. As a practical response to these pressures, Community-

Based Adaptation (41) emerges as a survival mechanism that bridges the two. Overall, this map visualises a narrative cycle in which climate change specifically pressures food stability, which then encourages communities to undertake adaptation efforts to maintain food security.

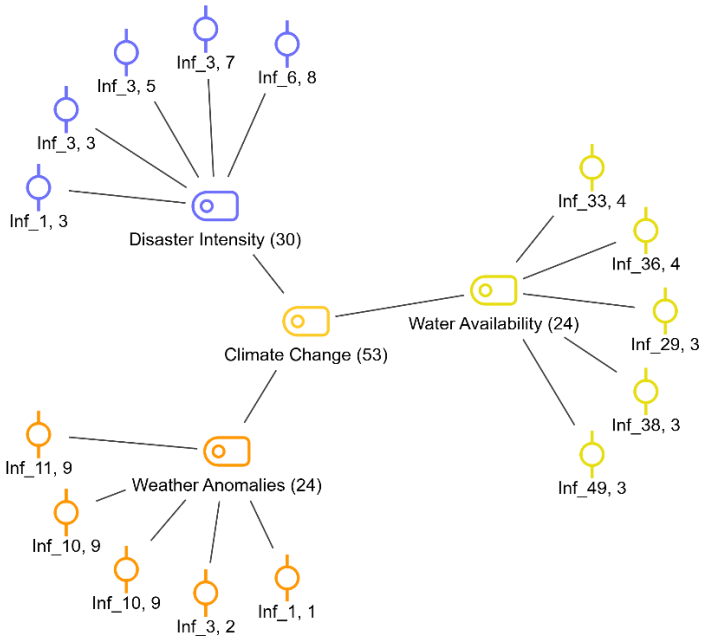


Figure 3. Climate Change - Code-Subcodes-Segments Model
Source: Field Data Processing with MAXQDA 24 Software

The Code-Subcodes-Segments Model visualisation in Figure 3 provides a more in-depth dissection (zoom-in), especially on the macro theme of climate change. In this hierarchical model, climate change (total frequency 53) acts as an umbrella concept, broken down into three specific on-the-ground impact experiences.

Disaster Intensity emerged as the most dominant derivative branch (frequency 30). This aligns with the findings in Figure 1, which reiterates that the main form of climate change participants feel is the physical threat of disaster. In addition, climate change is also interpreted in a balanced way through two other crucial environmental issues: water availability and weather anomalies, each with the same frequency (24). These two sub-themes expand the narrative and show that society faces not only immediate, destructive threats but also gradual threats in the form of erratic seasonal shifts and the depletion of basic water resources.

Furthermore, the outermost points in this diagram represent specific data segments or quotes from informants (such as Inf_3, Inf_10, Inf_33, and so on). This distribution shows that these three impacts originate from various empirical narratives

in the field. Interestingly, experiences cluster: for example, certain informants (such as Inf_3) have many segments related to disasters and weather, while different groups of informants (such as Inf_33 and Inf_36) voice narratives about water availability. Qualitatively, this model translates the macro jargon of "Climate Change" into the multisectoral reality society actually experiences: from traumatic disasters and confusing daily weather to anxiety about the clean water crisis.

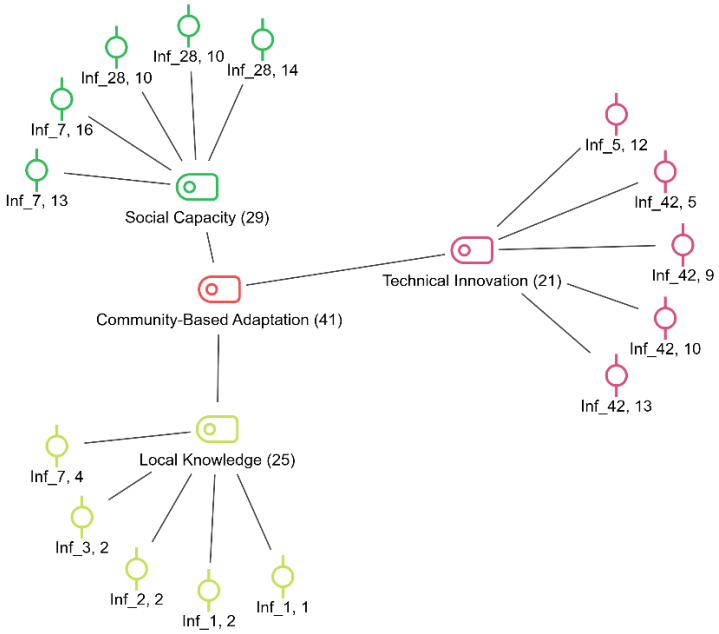


Figure 4. Community-Based Adaptation - Code-Subcodes-Segments Model
Source: Field Data Processing with MAXQDA 24 Software

Figure 4 displays the Code-Subcodes-Segments Model, which analyzes the anatomy of the Community-Based Adaptation theme. While Figure 3 analyzes the structure of environmental threats, this model specifically examines how communities respond and survive on the ground.

As a core concept (frequency 41), this grassroots adaptation strategy is empirically supported by three subcode pillars. The most frequent pillar is Social Capacity (29), followed closely by Local Knowledge (25) and Technical Innovation (21). This constellation shows that community resilience is built on a synergistic combination: maintaining existing organic and cultural capital within the community (social ties and traditional wisdom) while remaining open to adopting external innovations (technological innovation).

The most essential aspect of this Code-Subcodes-Segments model is the visibility of the outermost nodes, which represent the diversity of informants' voices. This

approach allows us to phenomenologically observe how adaptation experiences are distributed: There is a strong clustering of narratives around Social Capacity, where the discourse is strongly driven by the intensity of the experiences of certain informants (such as Inf_28 and Inf_7); a similar pattern occurs for Technical Innovation, where the discourse is highly centralised and dominated by a specific agent in the field, namely Inf_42; in contrast, narratives about Local Knowledge appear to be voiced more evenly and organically by a diverse range of informants (Inf_1, Inf_2, Inf_3, Inf_7).

Qualitatively, this model confirms that adaptation practices are not uniform entities. Communities respond to vulnerability through a variety of actors who take on different roles: some act as anchors, strengthening social solidarity; others maintain past wisdom; and still others drive the adoption of technical innovations for collective survival.

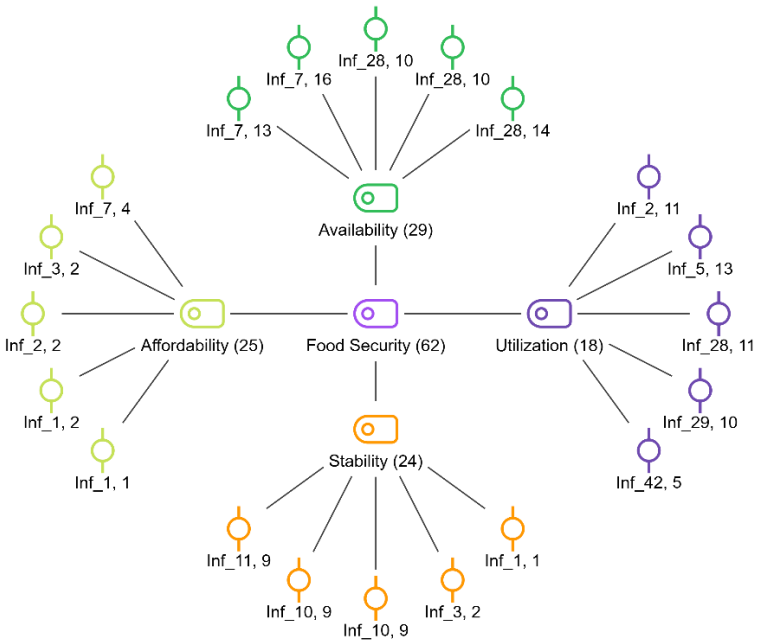


Figure 5. Food Security - Code-Subcodes-Segments Model
Source: Field Data Processing with MAXQDA 24 Software

Figure 5 presents a Code-Subcodes-Segments Model that unpacks the most central theme in this study: food security. With the highest frequency of occurrence (62), this discourse positions itself as the outlet for all discourses on environmental vulnerability and community adaptation.

Availability (29): This subcode emerged as the most dominantly articulated pillar. The narrative of physical food availability was strongly driven by the intensity of the experiences of certain key informants (particularly Inf_28 and Inf_7). Qualitatively, this indicates that the most fundamental anxiety at the grassroots level boils down to the

question: is food available? This narrative, centered on specific actors, may represent the voices of those directly upstream in the production chain, such as farmers or community leaders who provide food.

Affordability (25): Second is the economic dimension of food security. In contrast to availability, informants voiced concerns about the ability to access/purchase food more evenly (Inf_1, Inf_2, Inf_3, Inf_7). This distribution reflects that economic pressures and price fluctuations due to environmental shocks are a daily reality experienced collectively by residents.

Stability (24): This pillar represents the resilience of supply and access over time (vulnerability to shocks). Interestingly, this discourse is heavily dominated by segments Inf_10 and Inf_11. When linked to Figure 3 above, this stability narrative may directly reflect informants' experiences dealing with fluctuations due to weather anomalies or disaster intensity.

Utilisation (18): This pillar, which appears least frequently, relates to the quality, nutrition, and safety of food consumption and is widespread across informants (Inf_2, Inf_5, Inf_28, Inf_29, Inf_42). This frequency position confirms an empirical reality in agrarian communities under vulnerable conditions: fulfilling nutritional needs and consumption quality, although discussed, often becomes a secondary priority when communities still struggle to secure the physical availability and economic ability to access food.

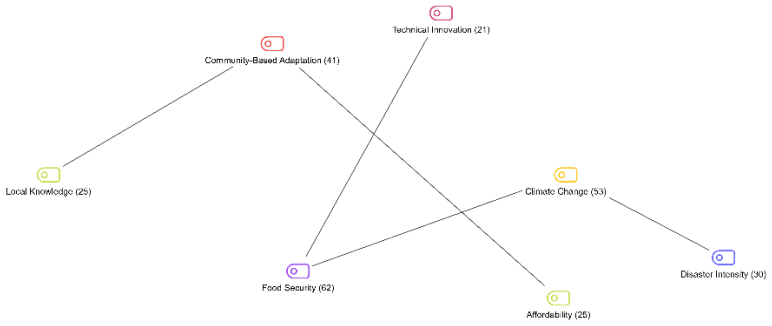


Figure 6. Code Co-occurrence Model (Code Intersection)
Source: Field Data Processing with MAXQDA 24 Software

Figure 6 presents a Code Co-occurrence Model that maps the direct intersections between concepts within participants' narratives. In the tradition of phenomenological research, this co-occurrence model goes beyond frequency; it also reveals how different dimensions of experience intertwine within the same narrative.

This map shows two directly intersecting epicenters of discourse: Climate Change (53) and Food Security (62). The connecting line between the two confirms that

communities explicitly describe ecological shocks as a direct threat to their food systems. This is a central reality of the subsistence vulnerability experienced on the ground.

Examining the Climate Change node, this concept intersects not only with Disaster Intensity (30) as a physical threat, but also directly with Affordability (25). Sociologically, this intersection matters: it shows that climate shocks are experienced as economic shocks. Crop failures or extreme weather events are not only ecologically damaging but also directly impact people's purchasing power for food.

As a central response, the Food Security node generates two intersecting solutions representing community survival strategies: On the one hand, there is the pragmatic need for Technical Innovation (Technical Innovation, 21) to maintain agricultural productivity; on the other, food security relies heavily on Community-Based Adaptation (41) as a social safety net.

This network concludes with a single, essential intersection: Community-Based Adaptation connects only to Local Knowledge (25). This line captures the true essence of communal resilience. When faced with economic precarity and climate threats, community resilience does not rely solely on external technical interventions but is nurtured through local epistemologies. Adaptation practices are driven by traditional wisdom that places socio-ecological harmony above mere economic rationality.

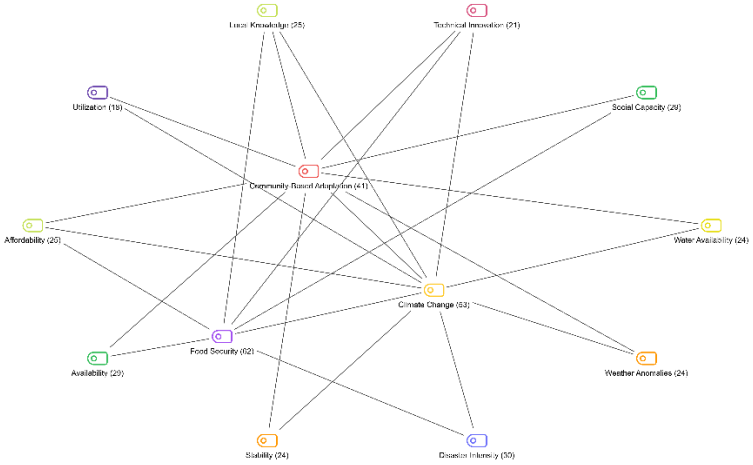


Figure 7. Code Co-occurrence Model (Code Proximity).
Source: Field Data Processing with MAXQDA 24 Software

Figure 7 is built around three main anchors in the centre: Food Security (62), Climate Change (53), and Community-Based Adaptation (41). These three form a relationship that spreads like a spider's web to almost all surrounding sub-codes. Agrosociologically, this structure emphasises that whenever the narrative touches on

climate threats, anxiety about food always arises in the adjacent paragraph or sentence, which is immediately followed by discourse on community coping strategies.

What is striking about this proximity model is the reach of the Climate Change node. This code is not only closely related to its physical manifestations (Disaster Intensity, Weather Anomalies, Water Availability), but its line of discourse also directly penetrates and is adjacent to key food pillars such as Affordability, Availability, and Stability. This is an empirical portrait of precarity; it demonstrates that ecological shocks are perceived and narrated as determinants that directly cripple residents' economic capabilities and access to subsistence.

As a balancing force amid these pressures, Community-Based Adaptation shows a strong line of proximity. Adaptation is not only culturally linked to local knowledge and social capacity, but also closely intersects with rational elements such as technical innovation. This pattern demonstrates the flexibility of communities' adaptive strategies: they strive to maintain the integrity of social ties and traditional ways while still absorbing technical innovations to mitigate vulnerabilities in their food systems.

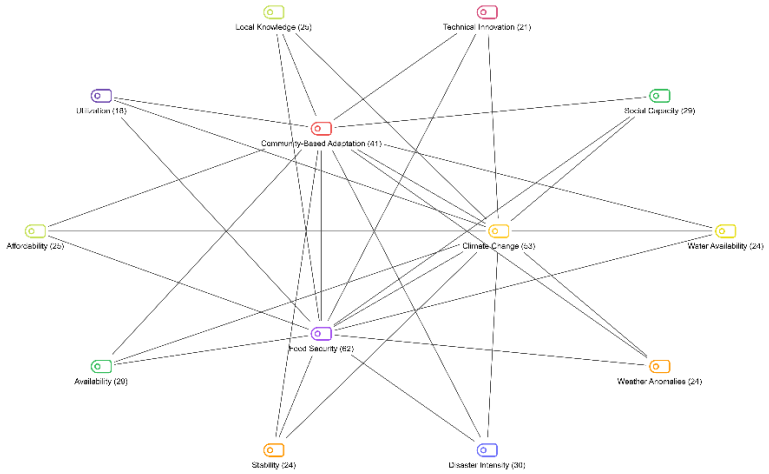


Figure 8. Code Co-occurrence Model (Code Occurrence)
Source: Field Data Processing with MAXQDA 24 Software

Figure 8 shows that nearly every sub-code is interconnected. The three central pillars of Food Security (62), Climate Change (53), and Community-Based Adaptation (41) serve as the primary force holding all peripheral narratives together. This confirms that whenever communities share their lived experiences, narratives about ecological threats, subsistence struggles, and community resilience consistently emerge within a single framework.

Climate change's position in this model is striking because its intersectional lines cut across nearly every dimension. It not only intensifies disasters and weather

anomalies, but its appearance in the data is always accompanied by discussions of food availability, stability, and affordability. Sociologically, this demonstrates that ecological shocks have penetrated the heart of residents' economic precarity. The climate crisis is a crisis in their kitchens and granaries.

In the face of these multidimensional pressures, the Community-Based Adaptation node draws a clear line toward local knowledge, social capacity, and technological innovation. This dense relationship demonstrates collective resilience. Communities do not choose one approach alone; they actively cultivate a legacy of local wisdom and social solidarity while also adopting external technical innovations to survive. This dense interplay of co-emergence reflects complex lived experiences. The availability of clean water is discussed alongside the community's social capacity; nutritional utilisation is intertwined with the ability to afford food. This vivid portrait fully represents the voices and meanings of the research subjects, showing that for agrarian communities, no environmental issue is purely technical; all are intertwined socio-ecological issues.

Discussion

Phenomenological Manifestations of the Climate Crisis: From Disaster Intensity to Water Resource Depletion

The climate crisis is often reduced to macro figures on global temperature fluctuations or shifts in rainfall curves. However, when a phenomenological lens is applied to the agrarian reality of East Nusa Tenggara (NTT), this macro discourse becomes a specific bodily experience and a vulnerability of living spaces. Based on the constellation of discourses in Figure 2 (Code Map), Climate Change is not experienced as an isolated environmental entity, but as one corner of a "vulnerability triangle" that interacts directly with Food Security and Community-Based Adaptation. This mapping confirms that for agrarian communities, natural anomalies always lead to anxiety about the sustainability of subsistence (Scott & Lockwood, 2024).

In NTT's dry-climate landscape, this global crisis is experienced daily through destructive physical manifestations. In Figure 1 (Code Relation Matrix), a specific relationship pattern is visible: the Climate Change code intersects exclusively with Disaster Intensity. This is reaffirmed in the hierarchical model in Figure 3, where participants empirically deconstruct the umbrella concept of climate change into three primary crisis experiences: Disaster Intensity (the most dominant impact), weather anomalies, and water availability.

These findings echo contemporary political ecology perspectives, which emphasize that environmental vulnerability is not simply a neutral natural event, but

rather a shock that amplifies spatial risks for communities already on the brink of vulnerability (Atkins & Hope, 2021; Fletcher, 2026). Furthermore, the distribution of narratives from various informants regarding clean water availability and weather changes in Figure 3 shows that agrarian communities in East Nusa Tenggara (NTT) face dual pressures: they must not only survive immediate destructive shocks but also endure the slow, creeping effects of environmental degradation. This slow degradation is silently undermining the traditional planting calendar that has long guided agriculture in NTT.

Subsistence Precarity: Transforming Ecological Shocks into Economic and Food Pressures

In the discourse of agrarian vulnerability, ecological shocks never remain merely environmental crises; they quickly become crises of living space and livelihoods. For communities in East Nusa Tenggara, climate change manifests as a direct threat to families' livelihoods and financial well-being. Analysing Figure 5, the discourse of Food Security (62) is clear: the community experiences it not through macroeconomic indicators, but through daily anxieties around two fundamental pillars of subsistence: Availability (29) and Affordability (25). The high frequency of these two sub-codes confirms that the most existential questions at the basic level boil down to two things: is the physical supply available in the barn or market? And do we have the purchasing power to access it?

This transformation of climate shocks into economic pressures is aptly captured in the discourse intersection model (Figure 6). This co-occupation map reveals a crucial direct intersection: Climate Change not only intersects with the intensity of physical disasters, but also directly intersects with and is tied to Affordability. Sociologically, this relationship demonstrates the validity of Amartya Sen's theory of the right to food, where hunger or food insecurity is often not solely caused by the absolute absence of food due to weather, but rather by the collapse of residents' "rights of access" or purchasing power due to the loss of income sources (crop failure) (Sen, 2007). Climate threats rob communities of their economic capital, forcing communities into a vortex of precarity, a state of chronic vulnerability where the certainty of future subsistence is always under threat (Beitelmal et al., 2024; Sisto et al., 2016).

This decline in subsistence is further illustrated by the density of proximity and co-occurrence in informants' narratives (Figures 7 and 8). The dense network of relationships between weather anomalies, water crises, and food pillars demonstrates that, in the participants' phenomenological awareness, ecological and economic issues are a single breath of suffering. The failure of natural infrastructure (such as drying up

water sources) is discussed alongside supply instability (Stability, 24) and compromises in the quality of consumed nutrition (Utilisation, 18). When harvests are destroyed by extreme weather, people are forced to sacrifice the quality of their consumption to maintain a meagre quantity of food, a survival strategy in a crisis that risks perpetuating the cycle of structural poverty.

Local Epistemology and Social Capacity as Community Safety Valves

Amidst the pressures of economic precarity and the ecological shocks outlined above, agrarian communities in East Nusa Tenggara did not fall into total resignation. Phenomenological realities on the ground revealed strong collective agency, with communities responding to crises through defence mechanisms rooted in their own cultural heritage. Referring to the analysis of the Code-Subcodes-Segments Model (Figure 4), the discourse of Community-Based Adaptation (41) is solidly supported by two essential non-material pillars: Social Capacity (29) and Local Knowledge (25). The high frequency of these two subcodes confirms that grassroots resilience does not always rely on capital interventions, but on recapitalising social ties and ancestral wisdom.

Social Capacity emerges as a primary safety net when ecological and monetary economic systems fail to support community subsistence. Informant narratives strongly clustered along this dimension (Figure 4) reflect practices of mechanical solidarity, reciprocal exchange, and mutual assistance that act as safety valves during peak crises. This aligns with Pierre Bourdieu's social capital thesis and James Scott's institutionalisation of "moral economy," where vulnerable agrarian communities tend to prioritise the ethics of collective subsistence, ensuring that no community member goes hungry, over the rationality of accumulating individual profits (Edelman, 2015; Mardani & Kusumah, 2018).

More deeply, the intersectional co-occurrence analysis (Figure 6) reveals a crucial epistemological finding: Community-Based Adaptation has a singular, yet essential, intersectional relationship with local knowledge. This visualisation confirms that communities' survival strategies are entirely driven and framed by their local epistemologies. When faced with anomalous weather, communities draw on traditional knowledge systems to read natural signs, adjust planting schedules, or switch to local food varieties that are historically more drought-resistant (Rokhman et al., 2020). This knowledge is not an outdated remnant of the past, but a system of empirical rationality that is continually tested and adapted in the natural laboratory of everyday life.

The density of relations of proximity and co-emergence (Figures 7 and 8) illustrates the holistic orchestration of this safety valve. Social capacity and local

knowledge are consistently discussed in the same breath as efforts to secure food security from the onslaught of climate change. This mapping demands that we, as researchers, adopt an assubsistent academic ethic, acting as guardians of meaning, acknowledging and nurturing these communal voices without reducing them to mere metrics of market competition or technocratic solutions. The resilience of communities in NTT is clear evidence that the best defence against the climate crisis is maintaining harmonious socio-ecological fabrics, a form of silent resistance to the precarity that threatens their living spaces.

Synergy of Technical Innovation and Traditional Wisdom in Weaving Future Resilience

As the culmination of all discourses on vulnerability and adaptation, community narratives in East Nusa Tenggara reveal a new paradigm for viewing technology: future resilience is not built on the ruins of the past, but rather through a hybridisation of novelty and tradition. Based on the Code-Subcodes-Segments Model mapping in Figure 4, Community-Based Adaptation explicitly involves Technical Innovation (21) as a pillar alongside Social Capacity and Local Knowledge. This finding breaks down the rigid dichotomy between "modern" and "traditional" while also showing that agrarian communities in NTT are pragmatically open to adopting technical innovations to protect their food reserves from increasingly extreme climate shocks.

This hybridisation is particularly evident in the proximity and co-emergence models (Figures 7 and 8), where the Technical Innovation node is consistently intertwined with Local Knowledge (25) and the Food Security pillar (62). Sociologically, this phenomenon can be explained through the inculturated concept of "appropriate technology." Innovation does not arrive as a technocratic policy package imposed from above; instead, communities absorb and modify it to suit local value systems and biophysical conditions. For example, communities adopt a simple drip irrigation system or high-yielding, drought-resistant seed varieties not to replace old methods, but to strengthen traditional agricultural practices threatened by dwindling water resources (Figure 3).

This synergy represents what experts call "transformative resilience": the ability of communities not only to return to their original state after shocks but also to leap forward through structural innovations grounded in collective identity (Wiranata & Siahaan, 2019). The line density visualisation in Figure 8 shows how technical innovations address specific issues in the fragile dimensions of food availability and stability caused by weather anomalies. In this context, technology serves as an empowering tool that enables communities to maintain their subsistence autonomy amidst global precarity.

Conclusion

This research has described in depth how agrarian communities in East Nusa Tenggara experience and respond to the climate crisis through a unique phenomenological lens. Based on a series of visual analyses from Figures 1 to 8, several key points emerge: First, the climate crisis at the grassroots level is not experienced as an abstract scientific concept, but as a tangible physical and ecological threat. Figures 1, 2, and 3 consistently show that communities interpret climate change through more intense disasters, weather anomalies, and water availability crises. These three manifestations are the primary triggers undermining traditional planting calendars and threatening community living spaces.

Second, ecological shocks rapidly mutate into economic precarity and threats to food sovereignty. Through the intersection and co-occupation models in Figures 5, 6, and 8, it is clear that each climate stressor directly impacts the pillars of food affordability and availability. This confirms that the climate crisis in NTT is a kitchen crisis that exacerbates the economic vulnerability of farming households already on the brink of subsistence.

Third, amidst the crisis, the community demonstrated extraordinary resilience by activating social capacity and local knowledge. As shown in Figures 4 and 7, social capital in the form of mutual cooperation and local epistemology in interpreting nature served as the primary safety valves, protecting the community from total collapse. This resilience demonstrates that cultural strength remains the most authentic defence at the grassroots level.

Fourth, the future of NTT community resilience lies in a hybrid strategy, namely the synergy between technological innovation and local technology. Figures 7 and 8 show that the community is not anti-technology; they adaptively adopt technical innovations as long as they can tame them and integrate them into their local knowledge framework. This synergy creates a sustainable and effective adaptation model.

Theoretically, this research emphasises the importance of a subsistence approach in sociological studies, committing to nurturing informants' voices and preserving the dignity of data by transforming it from mere numbers into a coherent narrative of humanity. The practical implications of this study call for government policies that are no longer technocratic and uniform, but instead strengthen social capacity and respect the sovereignty of local knowledge in the NTT community as it faces global climate uncertainty.

Research Limitations

Although this study successfully uncovered the phenomenological dimensions of the climate crisis and community resilience in depth, several methodological and contextual limitations must be acknowledged:

First, the limitations of geographic and cultural generalisation (transferability). Given that this study relies entirely on a qualitative phenomenological design centered on rural communities in NTT, the findings regarding the synergy of social capacity and local epistemology are highly context-bound. Therefore, the hybrid model of local wisdom and technology discovered in this study cannot necessarily be precisely replicated in agrarian communities in other regions with different ecological vulnerability profiles and resource governance histories.

Second, the lack of quantitative and climatological data validation. This study draws on participants' subjective perceptions and lived experiences. While MAXQDA software ensures rigour in mapping the frequency and networks of vulnerability discourse, this study does not include objective macro-scale metrics. The lack of triangulation with quantitative empirical data—such as precise measurements of rainfall fluctuations, statistically significant crop losses, or percentage declines in household income—limits this study's ability to gauge the magnitude of the climate crisis in both financial and biophysical terms.

Third, the asymmetric focus on internal actors at the local level. The purposive selection of 65 informants focused heavily on the internal agency of communities (farmers, community leaders, and local activists). As a result, this study underexplored the perspectives of external structural actors, such as local government policymakers or private-sector agricultural technology providers. Yet, bureaucratic and policy barriers from external actors often determine how equitably communities can access technical innovations. This leaves room for further research to examine the dimensions of institutional power relations in local-level climate change adaptation efforts.

Research Recommendations

First, future research should adopt a mixed-methods approach. Combining phenomenological exploration with objective quantitative data collection—such as climatological metrics (rainfall fluctuations, temperature anomalies) and agrarian economic indicators (crop loss volume, household income fluctuations)—will provide more comprehensive empirical validation. This triangulation between lived experience

narratives and hard data is essential for measuring the economic and biophysical effectiveness of technical innovations adopted by communities.

Second, future research needs to broaden the scope of stakeholders and expand the analysis of institutional governance. Studies should not focus solely on internal agencies at the grassroots level, but should also include external structural actors such as policymakers at the local government level, agricultural offices, non-governmental organisations, and the private sector (technology providers). Analysis of these power relations is necessary to understand how structural policy frameworks can facilitate or hinder the hybridisation process between local knowledge and technology at the grassroots level.

Third, given that these findings are strongly tied to the socio-ecological context of Ogan Ilir Regency, cross-regional comparative studies are recommended. Comparing the adaptation strategies of agrarian communities in Ogan Ilir Regency with those of other regions with different climate vulnerability profiles and communal traditions (e.g., coastal or highland areas) would be highly beneficial. This comparative study would help map a more universal resilience typology and test how widely this local wisdom-based technology transfer model can be replicated.

Fourth, participatory action research is recommended, specifically to design and test the adoption of "appropriate technology" with communities. Rather than simply observing, future researchers could facilitate the co-creation of technical innovations, such as water-efficient irrigation systems or the introduction of extreme climate-resistant seeds, designed from the outset to align with local epistemologies and community value systems. This would accelerate the realisation of inclusive and sustainable transformative resilience.

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Author's Contribution

H: Methodology, Writing - Review & Editing, Supervision.

Conflict of Interest

The authors declare no conflict of interest

Data Availability Statement

Data will be made available on request.

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