A Calculated Risk: How Indigenous Knowledge and Social Networks Mediate Climate Migration in Waghimra Zone, Ethiopia

Muluneh Demissie Sisay

Woldia University, Sociology Department, Woldia Ethiopia

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ABSTRACT

This study investigates the intersections of climate-induced migration and Indigenous Knowledge Systems (IKS) in agrarian communities of Waghimra Zone, Amhara Region, Ethiopia. Drawing on ethnographic fieldwork, including participant observation, semi-structured interviews, and focus group discussions with forty participants, the research stress how communities perceive and respond to recurrent drought, erratic rainfall, and land degradation. Findings reveal that migration is not a passive reaction but a deliberate, calculated strategy shaped by social networks, cultural memory, and livelihood shocks. Indigenous coping mechanisms—such as traditional weather forecasting, drought-resistant seed preservation, intercropping, and communal labor systems (debo and wenfel)—remain central to resilience, though their effectiveness is increasingly challenged by unprecedented climate extremes. Displacement entails both cultural continuity, maintained through rituals and storytelling, and social ruptures, particularly in leadership structures and relations with host communities. The study concludes that hybrid knowledge systems, which integrate indigenous practices with scientific and policy interventions, are essential for strengthening resilience. By foregrounding local agency and cultural identity, this research contributes an anthropological perspective to climate migration debates and calls for development policies that recognize indigenous knowledge as a vital component of adaptive strategies in vulnerable regions.

Keywords: Climate-induced migration, Indigenous Knowledge Systems (IKS), Resilience, Ethiopia, Social capital, Displacement, Environmental change

INTRODUCTION

Climate change has emerged as one of the defining global challenges of the 21st century, with consequences that extend beyond environmental degradation to encompass social, economic, political, and cultural dimensions.The effects of increasing global temperatures, unpredictable rainfall patterns, and frequent droughts are particularly severe in the Global South, where reliance on climate-sensitive jobs is significant and adaptability is frequently limited (IPCC, 2022; Gornitz & Kushnir, 2021). Sub-Saharan Africa, notably, is often emphasized as one of the areas most susceptible to climate variability and change because of its dependence on rain-fed farming and insufficient infrastructural resilience (Serdeczny et al., 2017; UN-ECA, 2020). Research by Niang et al. (2014) and Olsson et al. (2014) highlights that communities in this area encounter intertwined challenges such as food insecurity and water stress, which are intensified by climate change.

Ethiopia, located in the Horn of Africa, represents a critical case for examining these dynamics. It is a country characterized by significant ecological diversity but also high susceptibility to climate-related hazards, including drought, flooding, and land degradation (Niles, 2018). Around 80 percent of Ethiopia's population relies on agriculture for their sustenance, making their livelihoods closely linked to the variability of rainfall (World Bank, 2021; Fanta et al., 2020). Over the past few decades, repeated droughts and diminishing soil fertility have worsened rural poverty, threatened food security, and heightened risk of displacement. These environmental stresses have immediate material effects along with prolonged consequences for social unity, movement, and cultural change (Gebremedhin et al., 2014). For example, studies by Ayalew et al. (2011) and Desalegn et al. (2017) record how repeated drought years have compelled rural families in Ethiopia to liquidate assets, resulting in the collapse of traditional support mechanisms.

In Ethiopia, Waghimra Zone illustrates these difficulties. The region is very susceptible to drought, with farming largely reliant on seasonal precipitation. Repeated environmental disruptions have led to migration both within the area and to different regions of Ethiopia. Simultaneously, the communities in Waghimra have established Indigenous Knowledge Systems (IKS) that have been in place for years, focusing on natural resource management, seed preservation, water harvesting, and maintaining community resilience during challenging times (Yami & Mulugeta, 2018). These systems exemplify flexible cultural approaches that are frequently neglected in dominant climate and migration discussions, which usually emphasize technology or policy-based remedies (Berkes et al., 2000; Shrestha et al., 2019). Comprehending the relationship between climate change, migration, and indigenous resilience in Waghimra offers essential insights into wider anthropological and development discussions.

Problem Statement

The connection between climate change and migration is well-established in scholarly and policy discussions, frequently viewed as climate acting as a "push factor" that heightens livelihood insecurity and forces movement (Black et al., 2011; Afifi et al., 2016). Nonetheless, a significant portion of this discussion is led by macro-level examinations that emphasize statistical relationships between climate factors and migration patterns, overlooking the micro-level, personal experiences of those impacted (Hunter et al., 2015; Zickgraf, 2019). In Ethiopia, current research often highlights the numerical aspects of climate-related migration—like the count of displaced families, acres of deteriorated land, or fluctuations in rainfall—while offering minimal understanding of the socio-cultural changes that arise from displacement (Gebrehiwot & Van der Veen, 2013; Adger et al., 2013). This gap indicates that policymakers do not possess a thorough comprehension of the community-level elements that influence migration choices.

Another constraint of existing research is its inclination to neglect the autonomy of displaced communities. Climate migrants are frequently depicted as helpless victims of environmental shifts, reliant on humanitarian aid and outside help (Barnett & O'Neill, 2010; Piguet & Pécoud, 2014). This perspective overlooks how communities actively utilize indigenous knowledge, cultural practices, and social connections to adapt to changing environments (Nielsen & O'Brien, 2008; Roncoli et al., 2001). In Waghimra, for example, farmers and pastoralists still depend on community-driven labor exchange systems (like debo and wenfel), established drought-coping methods, and oral traditions of previous environmental challenges to guide current adaptation (Taddese et al., 2016). However, these practices continue to be insufficiently recorded in climate migration research (Mercer et al., 2007).

Furthermore, displacement is not only an economic or logistical phenomenon; it represents a significant cultural break that disturbs identities, memories, and social frameworks (Malkki, 1995; Vertovec, 2009). How traditions are maintained, reinterpreted, or lost in the process of resettlement remains poorly understood (Brun, 2012; Scheyvens et al., 2016). the core problem addressed by this research is the lack of anthropological and culturally grounded studies that explore how climate-induced migration intersects with indigenous knowledge and cultural identity in vulnerable regions like Waghimra. Thus , the aim of this study is to explore Climate-Induced Migration and the Resilience of Indigenous Knowledge Systems: An Anthropological Study of Agrarian Communities in Waghimra Zone, Amhara Region, Ethiopia.

Objectives of the Study

To investigate the dynamics of climate-induced migration and the resilience of Indigenous Knowledge Systems among agrarian communities in Waghimra Zone, Amhara Region.

Specific Objectives

- To explore local perceptions of climate variability and its impacts on livelihoods in Waghimra.
- To analyze how environmental changes contribute to patterns of internal migration in the zone.
- To examine the role of indigenous knowledge in mediating community resilience to displacement.

Theoretical Framework

This study employed Vulnerability theory, Resilience theory, Social capital theory and Cultural Memory Theory.

I. Vulnerability Theory: Unequal Exposure and Sensitivity to Climate Stress

Vulnerability theory posits that climate impacts are unevenly experienced due to pre-existing social, economic, and institutional inequalities (Adger, 2006). In Waghimra, recurrent droughts and erratic rainfall disproportionately affected households based on gender, assets, and social position. Women reported increased labor burdens when men migrated, taking care of farms, children, and livestock amid food shortages. Wealthier households with irrigated land or access to aid could buffer climate shocks, while poorer families faced forced migration or asset depletion. Youth framed migration not merely as survival but as a pathway out of structural poverty, reflecting aspirational vulnerability. Overall, vulnerability in Waghimra arises from ecological exposure intertwined with social marginalization, gendered labor distribution, and unequal access to resources, illustrating climate change as a "threat multiplier" that intensifies pre-existing inequalities (Adger et al., 2013).

II. Resilience Theory: Indigenous Knowledge and Adaptive Strategies

Resilience theory focuses on the capacity of communities to absorb shocks, maintain function, and adapt to changing conditions (Folke, 2006). In Waghimra, Indigenous Knowledge Systems (IKS) such as seed preservation, intercropping, communal labor exchanges (debo), and traditional weather forecasting provided continuity-based resilience, enabling households to maintain food security. However, unprecedented climate variability challenged these practices, with younger generations questioning their reliability. Migration emerged as a transformative adaptation, allowing households to diversify income, access education, and send remittances, thereby expanding adaptive capacity. Resilience in Waghimra thus combines continuity through IKS and transformation via strategic migration, though long-term adaptive potential is constrained by structural barriers like insecure land tenure and weak institutional support.

III. Social Capital Theory: Networks and Collective Coping

Social capital theory emphasizes the role of trust, reciprocity, and social networks in enabling collective action and coping with environmental stress (Putnam, 2000). In Waghimra, kinship networks supported migrants by providing housing, job opportunities, and social integration in urban areas, while community labor systems such as debo and wenfel enabled those remaining to maintain agricultural productivity. These networks also facilitated knowledge sharing and reinforced cultural continuity during displacement. Yet, social capital was vulnerable to erosion from poverty, youth out-migration, and resource scarcity, weakening reciprocal support. This demonstrates that social capital functions as a crucial adaptive resource but requires supportive institutional frameworks to remain effective under prolonged stress.

IV. Cultural Memory Theory: Identity, Continuity, and Displacement

Cultural memory theory highlights how rituals, storytelling, and symbolic practices preserve identity and social cohesion in contexts of displacement (Malkki, 1995). In Waghimra, climate-induced migration disrupted traditional ties to land, seasonal cycles, and leadership structures, producing a sense of rupture. At the same time, displaced families actively maintained cultural memory through festivals, communal gatherings, storytelling, and religious ceremonies. These practices enabled intergenerational knowledge transfer, reinforced social cohesion, and provided a symbolic anchor for identity.

MATERIALS AND METHODS

Research Approach

A qualitative, ethnographic design was adopted to capture the lived experiences of communities in Waghimra Zone. Ethnography enabled immersion in local practices, narratives, and meanings surrounding migration, resilience, and cultural adaptation. While a mixed-methods approach could have enriched the study by

incorporating quantitative climate or livelihood data, this research prioritized depth and cultural interpretation Besides, Qualitative methods were particularly suited to this research because they enabled exploration of perceptions, beliefs, cultural practices, and decision-making processes, which cannot be fully captured through quantitative approaches. By privileging participants' voices, the study highlighted the agency of local communities, showing how they negotiated environmental stress, migration, and cultural adaptation.

Research Site Selection

The study site, Waghimra Zone, is located in the Amhara Region. This area is highly vulnerable to climate-related shocks, particularly recurrent droughts and land degradation. The population is predominantly smallholder farmers who rely on rain-fed agriculture and traditional pastoralist practices. Historical evidence and recent reports indicated that Waghimra experienced significant internal displacement, making it an appropriate site for studying the intersections of climate change, migration, and indigenous resilience. The selection of this site was guided by three key criteria: exposure to climate stressors (recurrent droughts, soil erosion, and variable rainfall patterns); presence of indigenous knowledge systems, including long-standing traditional practices in agriculture, water management, and social organization; and incidence of migration, both temporary and permanent, due to environmental pressures.

Sampling Strategy

The study employed purposive sampling to select participants who had direct experience with climate-induced migration or indigenous knowledge practices. This approach ensured that the data collected were rich, relevant, and reflective of local realities. A total of forty research participants were selected purposively.

Data Collection Methods

Participant Observation: Participant observation served as a cornerstone of ethnographic research, allowing the researcher to gain an insider's perspective on daily life, social interactions, and cultural practices. In the context of Waghimra, where indigenous knowledge systems (IKS) are embedded in farming, water management, communal labor, and rituals, observation provided direct insight into practices that may not have been easily articulated in interviews. This method also captured unspoken rules, routines, and informal mechanisms that sustain community resilience during periods of environmental stress. The researcher immersed in daily activities such as farming, water management, communal labor, and rituals to observe IKS and social practices firsthand.

Semi-Structured Interviews: Semi-structured interviews enabled flexible exploration of participants' subjective experiences while maintaining focus on research objectives. They allowed the researcher to probe personal narratives of climate-induced migration, perceptions of environmental change, and the practical application of indigenous knowledge. This method balanced structure and openness, which was critical when discussing culturally sensitive topics like displacement, identity, and adaptation strategies. Interviews were conducted in Amharic or local dialects, lasting 45–60 minutes, and were audio-recorded with consent. Individual narratives were captured using interview guides developed with local experts to ensure cultural appropriateness. Twelve key informants participated in the interviews.

Focus Group Discussions (FGDs): FGDs **explored** collective experiences and community perspectives on migration decisions, resource management, social cohesion, and adaptation strategies. Discussions were recorded and supplemented with field notes. Two group sessions were conducted to gather diverse perspectives from community members.

Key Informants: Key informants provided specialized knowledge about historical environmental changes, migration patterns, and the application of indigenous knowledge. They served as cultural interpreters, helping contextualize findings within local social, historical, and ecological frameworks. This method ensured accuracy and depth of understanding, particularly in regions where written records are limited. Key informants included community elders, local leaders, religious figures, and experienced farmers who possessed detailed knowledge of historical environmental changes, traditional coping strategies, and migration patterns.

Data Analysis

Data were analyzed using thematic analysis (Braun & Clarke, 2006). Thematic analysis enabled systematic identification, organization, and interpretation of patterns, or themes, across textual material. This method allowed flexible coding, accommodating both anticipated topics aligned with the research objectives and emergent themes that arose organically from participants' narratives. Furthermore, thematic analysis supported both an inductive approach, where insights were derived directly from participants' lived experiences, and a deductive approach, where the analysis was guided by the study's conceptual framework linking climate change, migration, indigenous knowledge systems, and cultural identity

RESULTS AND DISCUSSION

Socio-Demographic Information of Participants

Forty participants were purposefully chosen for the research, representing a variety of experiences related to climate-induced migration and indigenous knowledge systems in the Waghimra Zone. Of the participants, 28 were males and 12 were females, showing a greater presence of men in the sample, reflecting the male dominance in agricultural and pastoralist activities in the area. Regarding literacy, 28 participants could read but were not completely literate, while the other participants possessed different degrees of formal education. Eight participants held degrees, indicating that a portion of the community has achieved higher education and could offer further insights into institutional knowledge or perspectives on policy matters. Concerning marital status, most participants (30 individuals) were married, indicating the household-oriented aspect of farming and migration choices within the community. In terms of occupation, most participants (33 individuals) were smallholder farmers, relying heavily on rain-fed agriculture and traditional knowledge systems to manage environmental stress

The Human Face of Climate Change: Perceptions and Drivers of Migration

This section discusses the main subthemes including Local Perceptions of Environmental Change, Livelihood Shocks and Traditional Coping Mechanisms and so on.

Local Perceptions of Environmental Change

Participants in Waghimra Zone clearly depicted the slow but significant transformations they have witnessed in their surroundings over the last twenty years. Common themes involved inconsistent and late rainfall, the drying up of permanent rivers, deterioration of soil, and the vanishing of conventional grazing areas. A farmer remarked, "The rains are not arriving like they once did; our harvests consistently fail, and the soil is becoming sandy." Likewise, elders mentioned that rivers that used to supply water year-round have now become dry during the hottest dry seasons. These views align with research done in northern Ethiopia, where smallholder farmers pointed out more unpredictable rainfall and worsening soil fertility as key signs of climate change (Gebrehiwot & Van der Veen, 2013; Taddese et al., 2016). These local observations demonstrate how global climate events, like increasing temperatures and changed rainfall patterns, are directly felt within communities, influencing daily choices about livelihoods and movement (IPCC, 2022; Fanta et al., 2020)

Livelihood Shocks and the Tipping Point

The qualitative data from Waghimra highlights that migration frequently responds to immediate shocks but is also influenced by ongoing environmental stress, showcasing the intricate relationship between persistent vulnerability and abrupt crises. Participants mentioned various crop failures, livestock deaths due to drought, and exhaustion of stored grain supplies as the critical factors that compelled migration choices. A herder stated, "We lost our entire livestock during the previous drought, and the limited crops we had were destroyed." Remaining would lead to inevitable hunger, thus departing became essential. This result aligns with earlier studies in the Ethiopian highlands, which found that significant environmental shocks are key factors influencing internal migration (Ayalew et al., 2011; Desalegn et al., 2017; Niang et al., 2014). Additionally, the study participants stated that the family's choice to migrate was a conscious reaction to

consistent crop failures and environmental challenges, intended to ensure survival and protect their future. The following story of the informant strengthen this statement:

"I reside with my family in a tiny village in Waghimra Zone, where we have cultivated our ancestral land for many generations. Our survival primarily relies on rain-dependent farming and a small number of livestock. In the last five years, I've observed that the rainfall no longer adheres to the patterns we used to recognize. At times, they arrive too soon, while at other moments, they don't come at all. Our maize and teff harvests consistently fail, and my cattle have difficulty locating sufficient grazing. During the last season, the circumstances became intolerable. Repeated crop failures drained our grain reserves, and an intense drought led to the death of many of our animals. I attempted to depend on our customary coping methods, like engaging in communal labor exchanges (debo) and limiting our remaining grain, yet these actions were insufficient to support us. I conversed with neighbors and family members who had relocated to nearby towns, inquiring about access to food, job prospects, and living circumstances. Following numerous conversations with my family, we understood that remaining in the village would likely result in starvation and the depletion of our remaining resources. We chose to send my oldest son in advance to seek temporary employment and evaluate the conditions in the new location. Although it was a challenging choice, it quickly became evident that relocating was essential for our existence. My son then let us know that he had obtained a job and access to food and water, resources we could no longer reliably provide at home. As soon as we observed that he had created a secure location, the rest of our family started getting ready to move. From this experience, I understood that migration was not an impulsive decision but a deliberate reaction to ongoing environmental disruptions. It involved collecting data, seeking opinions from others, and thoughtfully considering the risks associated with departing compared to remaining"

Conversely, according to the stories and experiences relayed by participants in the Waghimra Zone, the study verifies that local communities have closely noted considerable environmental shifts in the last twenty years. The participants verified that rainfall trends have grown more unpredictable, perennial rivers are diminishing, soils are deteriorating, and customary grazing areas are vanishing. A farmer specifically mentioned that the rains no longer arrive as they once did, resulting in continuous crop failures and more sandy soil, while older community members highlighted that streams that used to flow throughout the year now run dry in the height of the dry seasons. These findings validate that worldwide climate events, like increasing temperatures and changing rainfall patterns, are directly felt at the local level and significantly influence livelihood approaches.

Participants also validated that migration choices are frequently prompted by sudden livelihood crises. They noted that repeated crop failures, livestock loss from drought, and dwindling grain supplies act as triggers compelling families to relocate. A pastoralist recounted losing all his livestock and crops, highlighting that remaining would have guaranteed starvation, thus requiring migration. This corresponds with results from earlier research in the Ethiopian highlands, where severe environmental disturbances are key factors influencing internal migration (Ayalew et al., 2011; Desalegn et al., 2017; Niang et al., 2014).

The Decision to Migrate: A Calculated Risk

In contrast to depictions of climate migrants as helpless victims, research indicates that their migration choices are deliberate and strategic. Families participated in conversations assessing the advantages and disadvantages of sending one member compared to moving the whole family. Social networks and insights from relatives who had migrated earlier were vital in influencing these choices. A participant mentioned, "We talked to neighbors who had relocated before; their insights assisted us in planning thoroughly." This indicates findings in migration research that highlight agency and strategic planning as responses to environmental stress (Black et al., 2011; Piguet & Pécoud, 2014). Migration in Waghimra serves as a coping strategy and a forward-thinking livelihood approach, showcasing the convergence of environmental, social, and economic influences in the decision-making process. The following story of the informant strengthen this testimonial:

"In my village of Ziquala, located in Waghimra Zone, my family, consisting of seven members, was experiencing our third straight year of unsuccessful harvests due to erratic rainfall and extended dry spells. Our little farm had grown more barren over time, and we had lost a significant portion of our animals, which were our primary income source. While watching my neighbors face similar challenges, I recognized that we

had to thoughtfully choose our forthcoming actions. I summoned a family gathering to explore our choices. We explored multiple options: remaining in the village and depending on assistance, sending my oldest son to a nearby town for temporary employment, or moving the entire family to an area where our relatives had established themselves. We contacted family members and nearby residents who had moved in earlier years, inquiring about job openings, living arrangements, water access, and other circumstances in the new area. Following extensive discussions, we concluded on a step-by-step migration plan. My oldest son, Samuel, would go to Sekota initially to work and relay information back regarding the situation there. In the meantime, the rest of us would stay to safeguard our existing crops and property. We reached a consensus that after Samuel evaluated the circumstances and validated its practicability, the others would proceed accordingly."

During conversations in the field, local authorities verified that situations like ours were becoming more frequent in Waghimra. The village development officer noted that "we have seen a trend where households initially send one member to explore before relocating the whole family. This approach has evolved into a way to deal with challenges caused by the climate. In a similar vein, a federal representative from the Ministry of Agriculture stated that "families in this area are not merely passive beneficiaries of assistance." They base their decisions on social networks, previous experiences, and local knowledge, indicating considerable agency when facing environmental challenges. Additionally, migration choices in the research area are frequently triggered by severe livelihood disruptions, including repeated crop failures, loss of livestock, and exhaustion of grain supplies, which act as catalysts for moving. A herder recounted the complete loss of his livestock due to a drought, mentioning that staying in the village would lead to inevitable starvation, necessitating relocation. These results correspond with Vulnerability Theory, which views migration as a result of households' exposure, sensitivity, and constrained ability to adapt (Adger, 2006). The interaction between long-term stress, like soil infertility, and abrupt environmental events highlights the intricacy of migration factors, as families react to urgent crises while also taking proactive measures against persistent vulnerability (Ayalew et al., 2011; Desalegn et al., 2017)

The Power of Tradition: Indigenous Knowledge as a Resilience Strategy

Traditional Coping Mechanisms

Indigenous Knowledge Systems (IKS) continue to be fundamental to community resilience. Farmers mentioned employing traditional weather forecasts drawn from animal behavior and plant growth cycles, preserving drought-resistant seeds, and using subterranean granaries for grain storage. For example, the key informants noted that intercropping and cultivating drought-resistant native crops contributed to preserving household food security amid unpredictable rainfall. These practices align with results observed in the Amhara and Tigray regions, where traditional coping strategies lessen environmental threats and decrease reliance on outside assistance (Berkes et al., 2000; Yami & Mulugeta, 2018; Shrestha et al., 2019). These approaches show that IKS is adaptable, context-specific, and essential for sustaining livelihoods amid climate challenges. The following case of the informant confirms this as follow:

"I reside in a tiny agricultural community in Waghimra Zone, Sekota rural kebele, where rainfall has grown more erratic in the last ten years. Throughout the years, I have come to depend on the wisdom shared by my elders to safeguard my family's food security. For example, I watch the actions of birds and the blooming cycles of nearby vegetation to predict the arrival of rain. When birds migrate sooner or a specific plant blooms later than typical, I realize that the rainy season could be postponed, so I modify my planting timetable as needed. I also store seeds from drought-tolerant native crops like teff, barley, and sorghum in subterranean granaries. These pits, inherited across generations, assist in protecting the seeds from pests and humidity. In dry seasons, I cultivate a variety of resilient crops through intercropping techniques, making certain that at least one crop thrives despite unfavorable circumstances. This method helps my family prevent complete crop failure and lessens our dependence on food assistance. Another approach I employ includes collective labor systems. I engage in debo, where community members collaborate to assist one another in planting and gathering crops. This not only lessens the workload but also enhances social connections and guarantees that all members of the community can access food, even in challenging times. Based on my experience, these conventional methods go beyond mere survival techniques—they symbolize a dynamic and flexible knowledge

system. By combining insights from nature with traditional farming methods, I can sustain household resilience in the face of climate fluctuations. Local and federal agricultural officials have verified that these native methods are commonly used in Waghimra, highlighting that this expertise continues to be an important addition to contemporary development efforts."

This case demonstrates that Indigenous Knowledge Systems (IKS) are central to resilience in Waghimra. Through methods like traditional weather forecasting, seed preservation, and intercropping, households actively manage climate risks, reduce dependency on external aid, and maintain livelihoods. These findings align with studies in other parts of Amhara and Tigray regions, which highlight the effectiveness and adaptability of IKS in mitigating environmental shocks (Berkes et al., 2000; Yami & Mulugeta, 2018; Shrestha et al., 2019).

Social Capital as a Safety Net

The research revealed that community-driven labor exchange systems, like debo and wenfel, became vital safety nets. These cooperative labor agreements enabled families to combine resources during sowing and gathering, enhancing resilience when personal abilities fell short. Extended family and kinship connections offered short-term housing, communal meals, and emotional assistance amid displacement. These results correspond with research emphasizing social capital as an essential factor for climate resilience in Ethiopia (Roncoli et al., 2001; Taddese et al., 2016; Mercer et al., 2007). Social networks operate not just as financial support systems but also as channels for knowledge exchange, bolstering cultural continuity during periods of environmental strain. The folliwng story of a key informant strengthen this idea :

"I have witnessed firsthand how erratic rainfall and ongoing droughts can ruin our crops and way of life. In one especially harsh dry season, my family experienced a nearly complete failure of our crop yield. As food supplies ran low and animals faced water shortages, I understood that getting through this season would need assistance beyond what my close family could offer. I relied on our community-focused labor exchange platform, debo, to handle the outstanding tasks in our field. Adjacent families collaborated, taking turns working on each other's farms. This not only helped me complete the planting and harvesting that my family alone could not have handled, but it also guaranteed that our crops did not completely fail. While harvesting, I returned the favor by assisting with my neighbors' crops, strengthening our mutual assistance. As the drought intensified and we faced potential temporary relocation, my relatives provided us with refuge in their compound in a neighboring village. They offered meals and gave emotional encouragement, which enabled my kids to persist in their education despite our challenging situation. Meanwhile, I was advised by older family members on which native seed types to sow when we came back, illustrating how social connections serve as avenues for passing down traditional knowledge."

In my view, social capital in Waghimra acts as an essential support system amidst climate-related challenges. Community labor systems such as debo and broad kin networks offer not just immediate material aid but also bolster cultural continuity and the transmission of adaptive knowledge. This is consistent with results from Roncoli et al. (2001), Taddese et al. (2016), and Mercer et al. (2007), showing that social networks play a crucial role in climate resilience in Ethiopia. I held a focus group discussion in the village of Ziquala with twelve community members—six men and six women—who had faced climate-related challenges over the last five years. The conversation focused on how families manage environmental pressures, especially drought and crop failure, and the significance of traditional support systems. In the FGD, participants consistently highlighted the significance of debo and wenfel, which are traditional labor exchange systems. An elder shared, "When my harvests failed, my neighbors helped me sow the seeds for the upcoming season." Subsequently, I assisted them in return. Without this, numerous individuals would struggle to endure. A young mother mentioned, "Even when we lacked grain, family from neighboring villages provided us with food." I observed that participants referred to extensive kinship networks as an essential safety net. Families depended on not just nearby neighbors but also faraway relatives for temporary housing, monetary assistance, and emotional support. A participant mentioned, "It's more than just work or sustenance. The encouragement from my cousins and uncles helped my family remain hopeful and together when all else collapsed.

Limitations of IKS in a Changing Climate

Despite its advantages, IKS encounters challenges amidst swift and unparalleled environmental shifts. Elders consistently remarked that the ongoing droughts are "unlike any we have experienced before," and conventional rain-making ceremonies have not yielded anticipated outcomes. This highlights the susceptibility of communities to climate extremes that go beyond past experiences and the necessity of enhancing traditional knowledge with contemporary measures (Nielsen & O'Brien, 2008; Shrestha et al., 2019). While conducting fieldwork in Waghimra Zone, the researcher carried out semi-structured interviews with 15 local elders, farmers, and community leaders who possessed significant knowledge of traditional coping strategies. I asked them to reflect on the effectiveness of Indigenous Knowledge Systems (IKS) in managing current environmental challenges. One elder, who had led rain-making rituals for over three decades, told me:*"In the past, when the skies did not bring rain, we would perform the rituals, and the rains would come within days. But now, these droughts are different. We do everything as before, yet the rains do not follow. I fear that our old ways are no longer enough."*

A female community leader reflected on broader coping strategies: *"Our social networks and IKS are still important—they help us share seeds and labor—but when the drought lasts for months, we need more than just traditional practices. Aid from NGOs and guidance from agricultural experts have become essential to survive."* Besides During key informant interviews with zonal agricultural officers, they acknowledged the limitations of IKS in the context of unprecedented climate events. One officer pointed out: *"Traditional knowledge is invaluable for routine environmental variations, but it cannot fully address extreme or erratic climate changes. That is why our programs aim to integrate modern techniques, such as irrigation guidance and improved seed varieties, alongside existing IKS."* Another local official confirmed that *communities* attempting to rely solely on IKS, and while it provides resilience, there are clear limits when rainfall patterns and temperatures exceed historical norms. Our role is to support them with complementary interventions without undermining their cultural practices.

The interviews revealed that although IKS continues to be an essential cultural and practical asset, it encounters considerable constraints due to swiftly evolving climatic circumstances. Elders and farmers voiced worries that traditional coping methods, like rain-making rituals, native seed selection, and planting schedules, are becoming less effective in dealing with extended droughts and erratic weather patterns. Officials emphasized this perspective, stressing the importance of integrating indigenous methods with contemporary agricultural practices and policy assistance. This highlights the dual strategy needed for climate resilience: appreciating traditional knowledge while incorporating scientific advancements to alleviate severe environmental strain.

Overall, Indigenous Knowledge Systems (IKS) in the Waghimra Zone act as a fundamental element of community resilience against climate-related challenges. Farmers use conventional weather prediction based on plant growth stages and animal actions, keep drought-tolerant seeds in underground storage, and implement intercropping methods to ensure food security. These practices are flexible and tailored to local conditions, showcasing a deep-rooted cultural tradition for handling environmental fluctuations. Results show that IKS enables households to organize agricultural efforts, lessen reliance on outside assistance, and sustain their livelihoods, illustrating the effective use of resilience theory (Folke, 2006) within a local Ethiopian setting. Social capital enhances resilience by serving as a protective buffer during challenging times. Community-oriented labor exchange systems like debo and wenfel, expanded family networks, and mutual assistance methods offer essential resources during instances of labor deficits or agricultural failures.

The Journey and Beyond: Cultural Adaptation and Transformation in Displacement

Cultural Continuity and Memory

Displaced households actively sought to maintain cultural practices, including storytelling, communal gatherings, and religious ceremonies. These practices help preserve identity, transmit knowledge to younger generations, and maintain social cohesion despite physical relocation. A participant remarked, "Even in the new village, we celebrate the planting festival together, just as we did back home." Such efforts resonate with

literature on cultural continuity in displacement contexts, where memory and ritual serve as anchors of identity (Malkki, 1995; Brun, 2012). The following story of an informant strengthen how Migration of Family and Cultural Continuity continues despite displacement

"I relocated with my family from Ziquala in Waghimra Zone to Woldia after our agricultural land experienced two years of failure due to extreme drought." While the physical trip was draining, I understood that the more challenging task would be maintaining our cultural identity in a different setting. Since the initial days in Woldia, I deliberately worked to uphold our customs. I brought together neighbors who had moved from surrounding villages and arranged intimate storytelling nights where elders shared histories, folk stories, and insights from earlier environmental challenges. I said to my children, "Even in this place, you need to understand our origins and the lessons our ancestors shared about enduring difficulties." We likewise persisted in commemorating traditional community events, like the yearly planting festival. Although we were in a new village, we made the ritual dishes, performed the traditional songs, and welcomed both fellow migrants and some local residents to participate. A young neighbor said, "I've never experienced this celebration before, but it feels vibrant and brings everyone together." This ensured our traditions were maintained and helped us integrate with the host community while preserving our social connections. Religious rituals served as another means for preservation. Weekly meetings at the temporary prayer space enabled us to strengthen common beliefs and principles. These ceremonies played a crucial role in passing down cultural memory to children born post-displacement, guaranteeing that migration would not erase our identity."

This case demonstrates how displaced families in Waghimra actively maintain cultural memory through rituals, storytelling, and community events, strengthening identity and social unity in unfamiliar settings. While conducting fieldwork in Sekota, where numerous households from Waghimra Zone had been relocated, I noted that upholding cultural traditions was a key tactic for managing the difficulties of displacement. Displaced families took the initiative to host storytelling sessions, community events, and religious rituals, considering these essential for maintaining their identity and passing cultural wisdom to younger generations. These reflections demonstrate that cultural continuity is not just symbolic but an effective approach for preserving social unity and passing down knowledge across generations in situations of displacement. The active actions of families to honor festivals, arrange rituals, and engage in storytelling resonate with the anthropological studies on displacement, highlighting memory and ritual as foundations of identity and resilience (Malkki, 1995; Brun, 2012). Officials' insights support the advantages at the community level, emphasizing that cultural continuity boosts adaptive capacity and fortifies social networks, even in unfamiliar settings.

Social Rupture and the New Normal

Displacement also creates social fractures. Conventional leadership frameworks diminish in new communities, resulting in modified social hierarchies and sporadic disputes regarding land and water rights. Participants indicated that migrants experienced a decline in social status and encountered friction with local communities. These results emphasize the twofold challenges of adaptation: assimilating into unfamiliar surroundings while striving to maintain existing social frameworks (Vertovec, 2009; Scheyvens et al., 2016). Displacement in Waghimra Zone, essential for survival, has caused significant social disruptions in the lives of migrant families. Numerous participants noted that conventional leadership frameworks—established village elders, community councils, and traditional conflict resolution methods—have diminished in the new settlements. A semi-structured interview participant stated: "In Ziquala, the elders held definitive power, and everyone honored the guidelines. In this place, it seems distinct. Choices are more scattered, and certain young individuals do not pay attention as they once did. Additionally, numerous households indicated conflicts with host communities, especially regarding limited resources like grazing areas, water sources, and land for building homes. A female participant remarked: "We must negotiate daily to obtain water." The hosts occasionally assert rights that were once held by our families. "It causes us to feel anxious and occasionally fearful when we express ourselves."

The results demonstrate that hybrid knowledge systems, which intentionally merge traditional practices with contemporary approaches, are a crucial strategy for sustainable adaptation in situations of displacement.

Instead of perceiving traditional knowledge and modern tools as opposites, Waghimra communities view them as supportive of each other. This is consistent with Berkes et al. (2000), who claim that adaptive co-management and hybrid knowledge improve resilience, as well as with Shrestha et al. (2019), who highlight the necessity of integrating local heuristics with scientific advancements. Roncoli et al. (2001) also emphasize that combining farmer-generated insights with external predictions enhances strategies for coping with climate unpredictability

Displaced families diligently preserved cultural continuity via storytelling, community gatherings, and religious events. These practices enabled the sharing of knowledge between generations, strengthened identity, and maintained social unity in emerging settlements. One participant remarked, "Although we departed from our village, we continue to celebrate the planting festival together," emphasizing the importance of cultural memory in fostering resilience. Local authorities verified that families maintaining these customs adapted more successfully, showcasing the practical significance of rituals in preserving social and psychological health. This corresponds with cultural memory theory, highlighting rituals and narratives as tools for maintaining identity and enhancing adaptive capability (Malkki, 1995; Brun, 2012).

Displacement also caused social disruptions as established leadership systems and community hierarchies were interrupted. Participants indicated reduced authority of elders and councils, with frequent disputes arising over limited resources like grazing land, water, and building sites. The Alemu family, for instance, formed informal groups among migrants to regulate water access and organize work, merging elements of traditional governance with innovative adaptive systems. Officials across federal, regional, and local levels acknowledged that social integration is equally crucial as financial aid, pointing out that conflicts between migrants and local communities could jeopardize resettlement initiatives. This illustrates the significance of social capital theory, emphasizing that networks, joint efforts, and collaborative frameworks are essential for navigating disrupted social contexts and building resilience (Putnam, 2000; Mercer et al., 2007).

In general, the results show that displaced families in Waghimra actively engage in discussions about continuity and transformation. Cultural traditions ground identity, social frameworks are restructured to address scarcity and conflict, and knowledge systems are merged to enhance adaptive responses. Displacement, though difficult, turns into a chance for cultural creativity, strategic adjustment, and social development. The insights from federal, regional, and local authorities highlight the significance of policy structures that back hybrid adaptive strategies.

DISCUSSION

This study explored how climate change and migration intersect with indigenous knowledge systems (IKS), cultural identity, and structural inequalities in Waghimra, Ethiopia. The findings highlight the layered ways in which communities negotiate vulnerability and resilience. In this discussion, I interpret these findings through the theoretical frameworks of vulnerability theory, resilience theory, social capital theory, and cultural memory theory.

Vulnerability and the Uneven Impacts of Climate Change

Vulnerability theory underscores how climate shocks interact with pre-existing social and economic inequalities to shape differentiated risks (Adger, 2006). In Waghimra, recurrent droughts have undermined agricultural productivity for decades, but the severity of impacts depends on land access, gender, household assets, and conflict histories. For instance, participants described how households with irrigated plots or connections to aid agencies were able to buffer food insecurity, while poorer families were forced to sell livestock or migrate. This unevenness illustrates that vulnerability is socially constructed and unevenly distributed. Women's testimonies revealed their increased workload and exposure to food insecurity when men migrated. One woman explained: *"When my husband left for Addis, I had to take care of the farm, the children, and the animals alone. Sometimes I had nothing to cook except wild leaves."* Such narratives demonstrate gendered vulnerability: while migration may relieve household pressures, it simultaneously transfers the burden to women. This confirms earlier research in Ethiopia showing that climate change deepens existing gender inequalities (Desalegn et al., 2017).

Youth participants framed migration as a strategy to escape intergenerational poverty rather than merely survival. For example, a 19-year-old stated: *"Even if the rains come, farming cannot give us a future. Migration is our only way out."* This perspective illustrates that vulnerability is not only material but also aspirational. Climate change restricts local opportunities, pushing youth to view mobility as an escape from structural stagnation. Here, climate migration becomes entangled with the broader crisis of rural underdevelopment. These findings confirm that climate change acts as a **"**threat multiplier**"** (Adger et al., 2013), exacerbating inequality, intensifying gendered burdens, and accelerating generational divides. Vulnerability in Waghimra cannot be reduced to environmental exposure; it is produced at the intersection of ecological stress, social marginalization, and structural neglect.

Resilience, Adaptation, and Transformative Capacity

In Waghimra, indigenous practices such as seed selection, communal labor (*debo*), and weather forecasting have historically enabled resilience. Elders explained how seed-saving rituals preserved drought-resistant varieties: *"We always keep the seeds of teff from the best harvest, so even if the next year is dry, we have something to plant."* Such practices represent resilience as continuity, drawing on local ecological knowledge to cope with uncertainty. Resilience theory helps explain how households and communities adapt to shocks by mobilizing resources, knowledge, and networks (Folke, 2006). However, the erosion of trust in IKS among younger generations reveals the limits of absorptive capacity under unprecedented climate extremes. Many youth dismissed traditional forecasting methods as unreliable: *"Our fathers say they can read the stars, but the sky lies now. The rains do not follow their words."* This skepticism reflects how climate change destabilizes epistemologies, undermining resilience based solely on cultural continuity. Migration emerges in this context not merely as a sign of failure but as a transformative adaptation strategy. Several participants emphasized that migration allowed households to diversify income, access education, and invest in non-agricultural livelihoods. One man noted: *"When my son went to the city, he sent money to buy an ox. Without him, we would have nothing."* Migration thus expands adaptive capacity by linking rural households to urban labor markets and remittance flows.

Yet, migration's transformative potential is constrained by structural barriers. Weak state support, insecure land tenure, and lack of institutional recognition of IKS limit the capacity of households to integrate migration into sustainable livelihood strategies. Instead, many migrants remain trapped in precarious urban labor, while their families struggle with agricultural decline. This duality illustrates resilience's paradox: adaptation may alleviate short-term shocks but fail to secure long-term transformation without systemic change.

Social Capital and Collective Coping

Social capital theory (Putnam, 2000) illuminates how networks of reciprocity and trust shape adaptive responses. In Waghimra, kinship ties facilitated migration by providing migrants with housing, job leads, and social integration in urban areas. A young migrant explained: *"When I reached Dessie, my cousin gave me a place to stay until I found work. Without him, I could not survive."* Such accounts highlight the central role of kinship networks in lowering the risks of migration. At the community level, collective labor practices such as *debo* (group farming) and *wenfel* (rotational work exchange) helped families cope when able-bodied men migrated. Households left behind mobilized these networks to sustain agricultural activities and maintain social cohesion. These findings align with research demonstrating that social capital strengthens resilience in agrarian societies (Yami & Mulugeta, 2018).

However, interviews also revealed that these networks are fraying due to poverty, conflict, and the out-migration of youth. Elders lamented the erosion of reciprocity: *"Before, neighbors would come to help each other in the fields. Now, everyone thinks only of their own survival."* Declining trust and solidarity weaken collective coping mechanisms, suggesting that social capital is not static. It can be eroded by structural stressors, particularly when migration depletes the very labor base that sustains communal institutions. This fragility raises critical questions about the sustainability of adaptation strategies based on social capital. While kinship and reciprocity remain vital, they are insufficient to withstand protracted crises without institutional support.

Cultural Memory, Identity, and Displacement

Cultural memory theory (Malkki, 1995) draws attention to how displacement reshapes identities and belonging. Migration in Waghimra was experienced as both a rupture and a renewal of cultural identity. On one hand, migration disrupted traditional ties to land, rituals, and seasonal cycles. Elders expressed grief at the erosion of cultural continuity: *"Our children no longer know the sky, the stars, or the soil. They forget who we are."* Such statements reflect a cultural dislocation that accompanies mobility. At the same time, cultural memory persisted through rituals, storytelling, and festivals, which served as symbolic anchors of identity. Even migrants returning during holidays participated in harvest festivals, sustaining a sense of belonging despite physical absence. A returnee explained: *"Even though I work in the city, I come home for Meskel. It reminds me that I am still part of this land."* These practices illustrate how cultural memory enables continuity amidst rupture, producing hybrid forms of belonging. Cultural identity also mediated how migrants interpreted displacement. For some, leaving was framed as temporary exile, with a strong desire to return when conditions improved. For others, migration represented liberation from restrictive traditions. This ambivalence reflects how cultural memory does not simply preserve the past but actively reshapes identity in light of mobility. The findings align with broader scholarship that views migration as a cultural transformation, not merely an economic response (Brun, 2012). In Waghimra, cultural memory both anchors and adapts to displacement, showing resilience in symbolic rather than material terms.

Structural Drivers and Institutional Gaps

While theories of vulnerability, resilience, and cultural memory explain household and community dynamics, they must be situated within broader structural contexts. Climate migration in Waghimra occurs within a political economy shaped by weak governance, conflict, and institutional bias. State-led resettlement programs often neglected cultural identity and local agency, treating migration as a logistical exercise rather than a socially embedded process. A participant who had been resettled explained: *"The government gave us land, but no water, no seeds, no schools. They did not ask us how we live."* Such accounts reveal the failure of technocratic policies to engage with lived realities.

The limited integration of IKS into formal adaptation frameworks further reflects institutional bias toward scientific and technical approaches. Farmers repeatedly emphasized that their traditional knowledge was dismissed by extension officers: *"They tell us to use chemicals, but they do not see the value of our seeds."* This neglect undermines local agency and erodes trust between communities and the state. Moreover, conflict between host and migrant communities demonstrates how adaptation strategies can generate new vulnerabilities. Migrants often encountered hostility when competing for scarce resources, such as grazing land and water. One elder recalled clashes: *"When new people came, there was fighting over water. They said we were stealing from each other."* These conflicts illustrate how climate migration interacts with fragility, producing risks of social fragmentation.

Thus, the findings confirm the need to bridge micro-level cultural practices with macro-level institutional frameworks. Without addressing structural inequalities and governance deficits, community-based resilience and migration strategies remain precarious.

CONCLUSION

The findings from Waghimra Zone underscore that climate-induced migration is a multifaceted process shaped by both vulnerability and agency. While recurrent droughts, crop failures, and livestock losses compel mobility, migration decisions are calculated responses informed by communal dialogue, social ties, and indigenous knowledge. IKS—embodied in seed preservation, weather forecasting, and cooperative labor systems—provides critical resilience, sustaining livelihoods and cultural identity amidst environmental stress. However, its limits in the face of prolonged and unprecedented climate extremes highlight the necessity of integrating traditional knowledge with scientific innovations and institutional support. Displacement brings both opportunities and challenges: while cultural continuity through storytelling, rituals, and festivals anchors identity, the erosion of traditional authority and competition over scarce resources disrupts social cohesion. Overall, the study demonstrates that adaptation in Waghimra is not merely about survival but about cultural

resilience, innovation, and negotiation of new social realities. Policy frameworks that value indigenous knowledge alongside modern approaches can enhance adaptive capacity, support social integration, and strengthen resilience against the ongoing impacts of climate change.

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