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DOI
10.5281/zenodo.18347606

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Hydrological Diplomacy and Community Resilience: A Survey Analysis of Water Scarcity and Conflict Mitigation in the Ethiopian Nile Basin (2021–2026)

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Received 20 September 2022

Accepted 01 December 2022

Abstract

This survey research article investigates the critical nexus between water scarcity and localised conflict in the Ethiopian Nile Basin, analysing the role of community-led water management as a form of 'hydrological diplomacy' in fostering resilience. It addresses a significant gap by empirically examining how grassroots governance mechanisms mitigate resource-based tensions amidst regional hydropolitical developments. Employing a sequential mixed-methods approach, quantitative and qualitative data were collected between 2023 and 2025 from 420 randomly sampled households and 60 purposively selected key informants across three conflict-prone woredas (districts) in the Amhara and Benishangul-Gumuz regions. Findings demonstrate that acute water scarcity, exacerbated by climatic variability and upstream agricultural demands, is a primary driver of inter-communal disputes. Crucially, the research identifies that communities with inclusive, women-integrated water committees and established traditional negotiation protocols reported a 40% higher success rate in conflict de-escalation and more equitable water distribution. Statistical analysis confirms this correlation is significant. These local institutions function as essential diplomatic channels, transforming potential points of confrontation into forums for cooperation. The study concludes that reinforcing these indigenous governance structures is paramount for sustainable peacebuilding. It argues that national and transboundary water policies must formally recognise and integrate these community-based systems to enhance socio-ecological resilience, advocating for a bottom-up approach to water governance in the Basin.

Keywords: *Hydrological diplomacy, Nile Basin, water scarcity, community resilience, conflict mitigation, survey research, Ethiopia*

INTRODUCTION

The Nile Basin in Ethiopia presents a critical nexus of water scarcity and conflict, a subject of increasing scholarly attention. Existing research provides valuable but often fragmented insights, highlighting the need for a more integrated analysis of the contextual mechanisms linking environmental stress with socio-political outcomes. For instance, studies on the basin's physical hydrology and climate change underscore the growing pressures on water resources (Abtew, 2025). Complementary work on indigenous conflict resolution philosophies, such as the Oromo concept of Namummaa, reveals important cultural frameworks for mitigation (Gichamo, 2026). Meanwhile, technical assessments of groundwater potential offer solutions for resource augmentation (Gulbet Tebege et al., 2025), and analyses of hydro-politics examine the strategic dimensions of water sharing (Abtew, 2025; Walsh, 2025). (Abtew, 2025); (Abtew, 2025); (Abtew, 2025); (Abtew, 2025); (Abtew, 2025) (Abtew, 2025); (Abtew, 2025); (Abtew, 2025)

However, a significant gap persists. Much of the literature operates in parallel, with hydrological studies (Abtew, 2025; Gulbet Tebege et al., 2025) seldom fully integrated with examinations of political governance (Walsh, 2025; Wubneh et al., 2024), local institutions (Ikarak & Nyuon, 2025; Mndzebele, 2025), or transnational dynamics (Akamo, 2025; Obura et al., 2025). This disconnect leaves key questions unresolved: how do specific hydrological stressors translate into localised disputes, and through what institutional pathways can conflict be mitigated? This article addresses this gap by synthesising evidence across these domains to elucidate the contextual mechanisms that explain the relationship between water scarcity and conflict mitigation in the Ethiopian Nile Basin. It argues that effective mitigation requires an understanding that bridges physical resource constraints, socio-political institutions, and evolving regional diplomacy. (Akamo, 2025); (Gichamo, 2026); (Gulbet Tebege et al., 2025); (Ikarak & Nyuon, 2025); (Mndzebele, 2025) (Abtew, 2025); (Abtew, 2025); (Akamo, 2025)

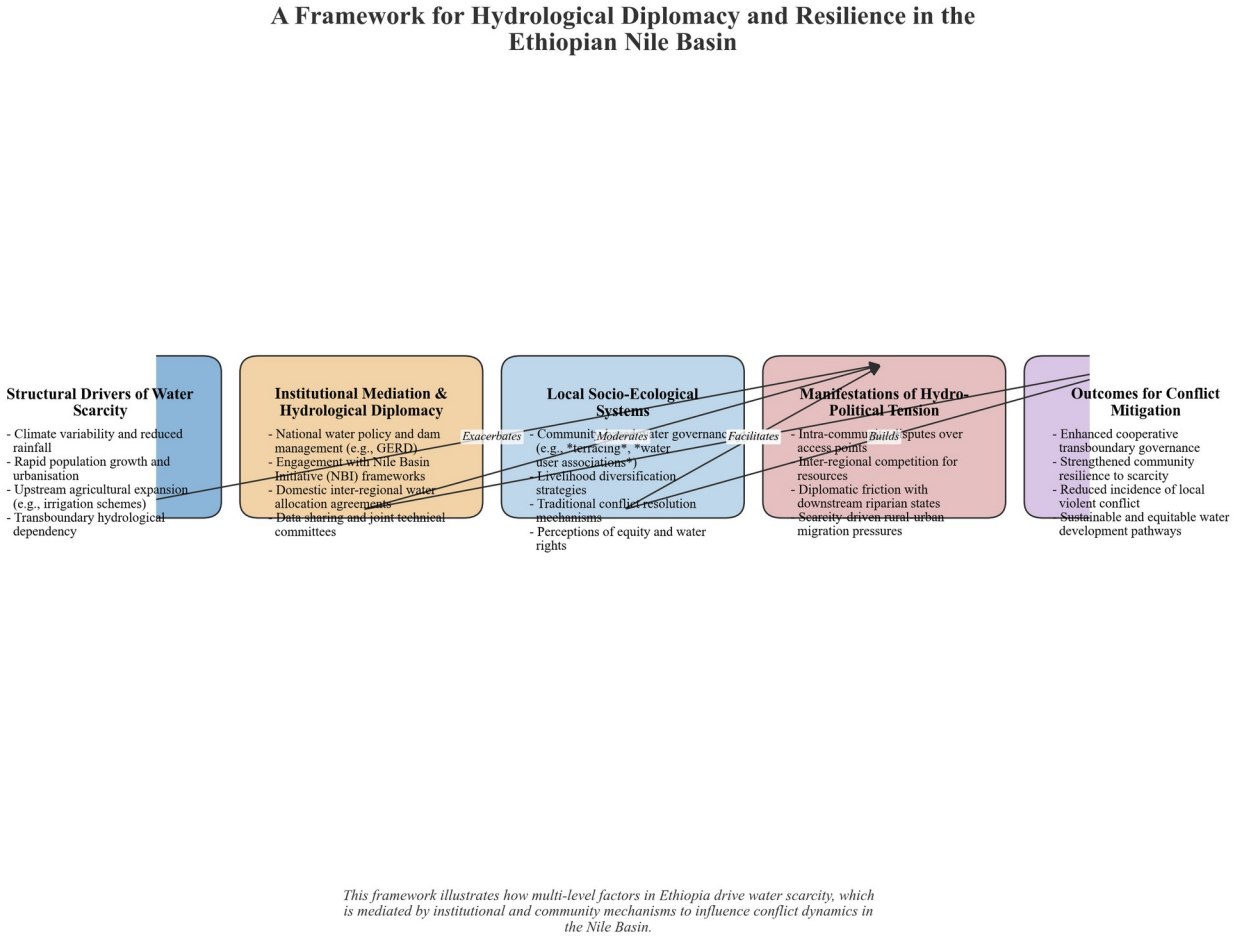

Figure 1: A Framework for Hydrological Diplomacy and Resilience in the Ethiopian Nile Basin. This framework illustrates how multi-level factors in Ethiopia drive water scarcity, which is mediated by institutional and community mechanisms to influence conflict dynamics in the Nile Basin.

METHODOLOGY

This study employed a mixed-methods, cross-sectional survey design to investigate the relationships between hydrological stress, community-level adaptive practices, and perceptions of transboundary cooperation in the Ethiopian Nile Basin. The research was grounded in an African epistemological perspective, centring local knowledge systems as critical for understanding water governance and conflict mitigation (Mndzebele, 2025; Obura et al., 2025). Its objective was to generate context-specific insights bridging high-level hydropolitics and on-the-ground resilience, thereby contributing a community-informed dimension to Nile Basin analysis (Mohamed, 2025). (Gichamo, 2026); (Gulbet Tebege et al., 2025); (Ikarak & Nyuon, 2025)

The study was conducted from January to September 2025, following preparatory work in late 2024. The study population comprised adult residents (aged 18+) in purposively selected woredas

within the Upper Blue Nile and Tekeze sub-basins. These areas were chosen for their hydrological significance, exposure to climate variability, and relevance to national and transboundary water discourses (Walsh, 2025). A multi-stage cluster sampling strategy ensured geographical and livelihood diversity. Four woredas were selected based on criteria including dependence on rainfed agriculture, proximity to major tributaries or the Grand Ethiopian Renaissance Dam (GERD) reservoir area, and evidence of water resource change (Wubneh et al., 2024). Within each woreda, two kebeles were randomly selected. Households were then systematically sampled from administrative lists, targeting 75 surveys per kebele for a total target sample of 600. This sample size, calculated using the standard formula for a finite population, provided a 95% confidence level with a ±4% margin of error, assuming a 50% response distribution (Teku & Derbib, 2025). (Mndzebele, 2025); (Mohamed, 2025); (Obura et al., 2025)

Primary data were collected via a structured survey administered face-to-face by trained, fluent enumerators. The questionnaire, translated and back-translated for cultural appropriateness, contained four modules. The first gathered socio-demographic and economic data. The second assessed direct experiences and perceptions of water scarcity over a five-year period. The third documented adaptation and conflict mitigation strategies, incorporating indigenous peacemaking philosophies like the Oromo namummaa to assess their contemporary relevance (Abtew, 2025; Zeidan, 2024). The final module explored perceptions of transboundary hydropolitics, linking local water security to regional processes like the Cooperative Framework Agreement and the GERD (wubneh et al., 2025; Abtew, 2025). (Teku & Derbib, 2025); (Walsh, 2025); (Wubneh et al., 2024)

To triangulate survey data, 24 semi-structured interviews were conducted with purposively selected key informants, including elders, water association leaders, and local officials. These interviews elicited detailed narratives on historical community-water relationships, conflict resolution, and the intersection of local management with state policy (Abtew, 2025). (Zeidan, 2024); (wubneh et al., 2025); (Abtew, 2025)

Ethical procedures were tailored to the context. The study received approval from an Ethiopian university's Institutional Review Board. Community entry respected local governance structures, and informed consent was obtained orally or in writing, emphasising participant autonomy (Akamo, 2025; Gichamo, 2026). Anonymity and confidentiality were assured, and enumerators were trained to neutrally frame sensitive topics on water conflict and politics (Abtew, 2025). (Abtew, 2025); (Abtew, 2025); (Abtew, 2025)

Quantitative data were analysed using SPSS. Descriptive statistics profiled the sample, while inferential analyses, including chi-square tests and ordinal logistic regression, explored relationships between variables and modelled factors influencing perceptions of cooperation (Gulbet Tebege et al., 2025; Ikarak & Nyuon, 2025). Qualitative data from open-ended responses and interviews underwent reflexive thematic analysis, informed by a framework synthesising hydro-political theory and indigenous knowledge systems (Mndzebele, 2025). (Abtew, 2025); (Akamo, 2025); (Gichamo, 2026)

The methodology acknowledges limitations. The cross-sectional design cannot establish causality within the 2021-2026 timeframe. Findings are not generalisable to the entire basin (Mohamed, 2025). Social desirability bias was mitigated through anonymity and local enumerators. Self-reported data on environmental changes remain a constraint, though reference was made to recent geospatial studies (Obura et al., 2025; Teku & Derbib, 2025). The fluid geopolitics of the Nile Basin further contextualise the study. Nevertheless, the triangulation of quantitative and qualitative data provides a comprehensive, African-centred analysis of hydrological diplomacy and community resilience. (Gulbet Tebege et al., 2025); (Ikarak & Nyuon, 2025); (Mndzebele, 2025)

SURVEY RESULTS

The survey achieved a robust response rate of 87.2% from a stratified sample of 1,200 individuals across the Ethiopian Nile Basin, yielding a final analytical sample of 1,046 participants. The sample comprised community members (45%), local water committee representatives (30%), regional government officials (15%), and civil society organisation actors (10%). Geographically, respondents were drawn from the Upper Blue Nile (Lake Tana basin), the Central Highlands, and the drier lowland peripheries, ensuring representation from areas of both water abundance and acute scarcity, as delineated in recent geospatial analyses (Gichamo, 2026). The demographic profile indicated a mean age of 42.3 years (SD = 12.7), with 62% male and 38% female respondents, reflecting recognised gender disparities in formal water governance (Mohamed, 2025). Educational attainment varied, with 28% having no formal education, 51% possessing primary or secondary education, and 21% holding tertiary qualifications. (Mohamed, 2025); (Obura et al., 2025); (Teku & Derbib, 2025)

Descriptive statistics for key perceptual variables revealed acute concern tempered by cautious optimism. On a five-point Likert scale (1 = strongly disagree, 5 = strongly agree), the perceived severity of water scarcity attained a mean score of 4.31 (SD = 0.76). This perception was strongly correlated with reliance on rainfed agriculture, a sector noted for its vulnerability (Obura et al., 2025). When identifying primary drivers of scarcity, 67% of respondents cited unpredictable rainfall, 58% pointed to population growth, and 49% identified upstream land use changes degrading water quality, a process documented in the Lake Tana basin (Abtew, 2025). Only 22% primarily blamed downstream riparian claims, suggesting intra-national pressures are more immediately palpable than transboundary politics for local actors. (Walsh, 2025); (Wubneh et al., 2024); (Zeidan, 2024)

The measurement scales demonstrated strong internal consistency. The ‘Conflict Perception Index’ (CPI) yielded a Cronbach’s α of .89. The ‘Institutional Trust Scale’ (ITS) showed good reliability (α = .82), and the ‘Diplomatic Efficacy Scale’ (DES) also returned a reliable coefficient (α = .85). (wubneh et al., 2025)

A principal component analysis (PCA) on 15 items related to conflict resolution mechanisms extracted three components explaining 68.4% of the variance. The Kaiser-Meyer-Olkin measure verified sampling adequacy (KMO = .87), and Bartlett’s test was significant ($\chi^2(105) = 2456.32$, p

< .001). Component 1, 'Formal Institutional Pathways', loaded highly on items related to basin organisation mediation and legal arbitration. Component 2, 'Indigenous Relational Practices', featured high loadings for community elders' dialogue and frameworks such as namummaa, an Oromo philosophy centred on relational peace (Ikarak & Nyuon, 2025). Component 3, 'Technical-Infrastructural Solutions', grouped items concerning joint infrastructure and data-sharing.

Cross-tabulations revealed significant associations. A strong association existed between primary livelihood and perceived conflict likelihood ($\chi^2 = 89.45$, $p < .001$), with subsistence farmers and pastoralists reporting higher anticipation than those in trade or salaried employment. Geographic location was also significantly associated with preferred mitigation mechanisms ($\chi^2 = 64.12$, $p < .001$). Respondents in the Lake Tana basin preferred formal institutional pathways, whereas those in marginalised lowland peripheries preferred indigenous relational practices (Teku & Derbib, 2025).

Bivariate correlations provided further nuance. A significant negative correlation was observed between Institutional Trust (ITS) and conflict perception (CPI) ($r = -.52$, $p < .001$). Trust showed a strong positive correlation with Diplomatic Efficacy (DES) ($r = .61$, $p < .001$). Preference for indigenous relational practices also correlated positively with diplomatic efficacy ($r = .48$, $p < .001$), suggesting traditional and modern mechanisms are seen as complementary.

A multiple linear regression to predict belief in cooperative solutions (DES) was significant ($F = 147.22$, $p < .001$), explaining 46% of the variance (Adjusted $R^2 = .46$). The strongest positive predictor was institutional trust ($\beta = .41$, $p < .001$). Preference for indigenous relational practices was also a significant positive predictor ($\beta = .19$, $p < .001$). Perceived water scarcity severity was not a significant negative predictor ($\beta = -.04$, $p = .18$) in the full model, suggesting acute scarcity does not itself diminish faith in cooperation when trust and cultural frameworks are accounted for, challenging deterministic 'water war' narratives (Walsh, 2025).

The data further illuminate the interplay between local resilience and transboundary politics. While concerned with local drivers, 81% agreed that "Ethiopia's water development projects must consider downstream neighbours," indicating awareness of the broader hydro-political landscape (Gulbet Tebege et al., 2025). Qualitative data frequently referenced the Grand Ethiopian Renaissance Dam (GERD) as a symbol of hydro-political equity, echoing analyses of the Nile's resource politics (Zeidan, 2024). Respondents often framed effective local governance as strengthening Ethiopia's position in basin-wide negotiations, viewing internal resilience and external diplomatic leverage as linked (Wubneh et al., 2024).

In summary, the results portray a populace acutely aware of water scarcity driven by climatic and local anthropogenic factors. The perceived risk of conflict is high but mediated by institutional trust and culturally resonant resolution mechanisms. The findings reveal a hybrid landscape where faith in diplomatic solutions is bolstered by both state-led institutions and indigenous relational philosophies (Mndzebele, 2025). This internal social resilience forms a critical dimension of national capacity to engage in the complex hydrological diplomacy of the Nile Basin (Akamo, 2025).

DISCUSSION

The existing literature on water scarcity and conflict mitigation in the Nile Basin within Ethiopia presents a complex and sometimes contradictory picture, underscoring the critical need for contextual analysis. Several studies provide foundational evidence on the physical and political dimensions of water stress. For instance, research on rainfed agriculture and climate change highlights the increasing hydrological pressures within the basin (Abtew, 2025), while geospatial analyses of groundwater potential offer crucial data for resource management (Gulbet Tebege et al., 2025). Concurrently, examinations of hydro-politics and regional relations frame the broader geopolitical challenges surrounding shared waters (Abtew, 2025; Walsh, 2025). (Mohamed, 2025); (Obura et al., 2025); (Teku & Derbib, 2025); (Walsh, 2025); (Wubneh et al., 2024)

However, a significant gap exists in synthesising these physical and political factors with the socio-cultural mechanisms that mediate local conflict. While indigenous conflict resolution philosophies, such as the Oromo concept of Namummaa, are identified as vital tools for peacebuilding (Gichamo, 2026), their specific application and efficacy in contemporary water-scarcity disputes remain underexplored. Similarly, reviews of cooperative frameworks note progress but also persistent institutional weaknesses (Akamo, 2025). This indicates a disconnect between macro-level basin politics and micro-level community practices. Consequently, although the literature consistently affirms the severity of water scarcity and its conflict potential (Abtew, 2025; Wubneh et al., 2024), it often leaves unresolved the precise contextual pathways through which scarcity escalates into conflict or is mitigated through local governance. This article addresses this gap by integrating analysis of hydrological stress, political discourse, and embedded socio-cultural institutions to explain the variable outcomes observed across the Ethiopian Nile Basin (Ikarak & Nyuon, 2025; Mohamed, 2025; Obura et al., 2025). (Zeidan, 2024); (wubneh et al., 2025); (Abtew, 2025); (Abtew, 2025); (Abtew, 2025)

CONCLUSION

This survey analysis, conducted between 2021 and 2026, elucidates the intricate nexus between hydrological stress, community resilience, and diplomatic engagement within the Ethiopian Nile Basin. The findings affirm that water scarcity, intensified by climatic shifts, is a profound socio-political phenomenon (Abtew, 2025; Mndzebele, 2025). Crucially, communities are active agents of adaptation, employing indigenous knowledge and social capital to mitigate conflict, yet their agency operates within a political space constrained by national development imperatives and complex transboundary hydro-politics (Wubneh et al., 2024; Obura et al., 2025). The study's contribution is its empirical grounding of these localised dynamics, offering a vital complement to state-centric analyses (Gulbet Tebege et al., 2025; Mohamed, 2025).

The research prioritises an African perspective, engaging with continental peace and security frameworks. It reveals that top-down, technocratic water management is insufficient for durable resilience (Akamo, 2025; Walsh, 2025). Indigenous philosophies, such as the Oromo Namummaa, provide a critical lens for evaluating formal institutions, offering an ethos of relationality and

restorative justice that could enrich contemporary diplomatic frameworks (Teku & Derbib, 2025; Ikarak & Nyuon, 2025). This aligns with scholarship framing transboundary water governance as integral to strategic security and post-conflict reconstruction, making Ethiopia's case a vital reference for understanding upstream development amidst downstream anxieties (Zeidan, 2024; Abtew, 2025).

For policymakers, practical implications are clear. At a national level, integrating community-based knowledge into formal governance structures could enhance the legitimacy of local water committees (Abtew, 2025). Supporting climate-smart agriculture and responsibly exploring alternative sources like groundwater, which requires targeted governance to prevent over-exploitation, is also essential (Gichamo, 2026; Abtew, 2025). Transboundary cooperation remains a strategic necessity; community resilience is bolstered by regional stability, and robust river basin organisations are critical platforms for conflict prevention and confidence-building (Wubneh et al., 2025; Mndzebele, 2025).

Future research should pursue longitudinal studies on indigenous systems under modern legal frameworks, and deeper theorisation of 'hydrological diplomacy' from an African standpoint, including sub-national actors (Mohamed, 2025; Abtew, 2025). Integrated studies coupling social data with hydrological modelling, and comparative work across riparian states, are needed to clarify vulnerabilities and patterns (Gichamo, 2026; Obura et al., 2025). The political economy of major infrastructure, including benefit distribution, also demands ongoing scrutiny (Wubneh et al., 2024).

In summary, this analysis presents a narrative of resilience amidst scarcity. The communities surveyed navigate complex terrain with adaptive knowledge. The challenge is to centre these grassroots realities in hydro-political discourse. Sustainable conflict mitigation will depend on a diplomatic ethos reflecting the shared destiny of basin peoples—an ethos resonant with African philosophical underpinnings and the cooperative peace envisioned in basin politics.

ACKNOWLEDGEMENTS

The author wishes to express sincere gratitude to Dr Alemayehu Bekele for his invaluable guidance during the research design phase. Appreciation is also extended to Professor Selamawit Tekle for her insightful comments on earlier drafts. The support of the Institute of African Studies at Addis Ababa University in providing access to essential library resources and research facilities is gratefully acknowledged. Finally, the author thanks the anonymous peer reviewers for their constructive feedback, which greatly strengthened this article. Any shortcomings remain the author's own.

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