

Assessing Socio-Technical Transitions Shaping Wash Sustainability in Lower Omo Valley, Ethiopia

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Abstract

The sustainability of water, sanitation, and hygiene (WASH) services in pastoralist regions remains a complex challenge, exacerbated by environmental variability and large-scale infrastructural transitions. This study examines the socio-technical determinants of WASH functionality in Dassenech Woreda, South Omo Zone, Ethiopia, focusing on the systemic impact of the Upper Omo River highlands and the effectiveness of 2023 integrated interventions. Using a convergent mixed-methods design, the research integrates quantitative data from 430 household surveys with qualitative ethnographic insights into the Dassenech age-set system, clan structures, and the Dimi ceremony. Findings indicate that WASH systems embedded within strong socio-technical arrangements—characterized by community ownership and appropriate technology—demonstrate significantly higher functionality rates. The study also reveals that the Upper Omo River highlands has disrupted traditional flood-recession agriculture, forcing a transition toward sedentary livelihoods and fishing, which increases vulnerability to waterborne diseases. However, the 2023 integrated WASH response, which coupled physical rehabilitation of 28 water schemes with hygiene promotion based on the Health Belief Model, contributed to the successful containment of cholera and acute watery diarrhoea. The report concludes that long-term resilience requires aligning technological solutions with the egalitarian social structures and mobility patterns of pastoralist communities.

Keywords: Age-set System, Dassenech Woreda, Dimi Ceremony, Socio-Technical Systems, Upper Omo River Highlands, Wash Sustainability.

Introduction

The pursuit of universal and equitable access to safe water, sanitation, and hygiene (WASH) in the arid and semi-arid lowlands of Ethiopia represents one of the most significant public health and engineering challenges in Sub-Saharan Africa. In regions such as the South Omo Zone, where pastoralist livelihoods predominate and environmental conditions are increasingly volatile, the traditional paradigm of infrastructure-centric service delivery has frequently yielded suboptimal results [1]. The focus on hardware provision—characterized by

the construction of wells, boreholes, and latrines—often neglects the intricate social, cultural, and institutional systems required to maintain and manage these technologies over time. In Dassenech Woreda, this challenge is compounded by a complex history of socio-economic marginalization and the recent, radical transformation of the Omo River's hydrological cycle [3].

The problem to be solved is the persistent and systemic failure of rural water schemes. In Dassenech, non-functionality rates for water supply systems have been reported as high as 74%, far exceeding the national average and

rendering substantial investments ineffective [5, 6]. Existing solutions have historically leaned toward top-down, engineering-driven models that fail to account for the unique mobility patterns and egalitarian social structures of the Dassenech people [1]. The limitations of such approaches are manifest in the rapid breakdown of motorized diesel systems, which suffer from a lack of local technical capacity, inaccessible spare part supply chains, and high operational costs that exceed the community's willingness or ability to pay [1].

However, a shift toward socio-technical systems (STS) theory offers a promising alternative. By treating infrastructure as a system where social practices and technical components co-evolve, STS emphasizes the need for institutional alignment and community ownership [1]. The 2023 integrated WASH intervention in Dassenech provides a case study of this achievement. By pairing durable water solutions with behavioural change communication grounded in the Health Belief Model (HBM), implementing partners were able to mitigate the risks of waterborne disease following catastrophic flooding and unseasonal rains [5].

The objective of this research is threefold: first, to analyse the role of socio-technical factors in determining the sustainability of WASH systems in Dassenech Woreda; second, to assess the impact of the Upper Omo River highlands on the traditional livelihoods and health of the Dassenech people; and third, to evaluate the efficacy of the 2023-2024 emergency and resilience interventions in achieving health outcomes such as cholera elimination. The novelty of this work lies in its multi-disciplinary integration of ethnographic data on Dassenech clan hierarchies and the Dimi ceremony with hydrological modelling and public health statistics, providing a nuanced understanding of how indigenous governance can be harnessed for modern service delivery.

Theoretical Framework and Literature Review

Socio-Technical Systems and Resilience

Socio-technical systems theory posits that the performance of a technological system is inseparable from the social context in which it operates. In the context of rural Ethiopia, this means that the functionality of a hand pump or a solar borehole is determined not just by its mechanical design, but by the management committees, ritual hierarchies, and daily water-use habits of the community [1]. A socio-technical approach moves beyond "access" as a metric, focusing instead on "service delivery" and long-term sustainability [1].

In pastoralist societies, resilience is often built through informal institutions and reciprocal social norms. For the Dassenech, resource governance is historically managed through territorial sections and non-territorial clans that facilitate shared access to grazing land and water [12]. Recent literature suggests that when formal WASH governance models—such as government-mandated water committees—clash with these customary systems, the result is often institutional bricolage or total system failure [1]. Conversely, systems that integrate "bul" (elder) authority into decision-making processes show higher rates of community ownership and technical upkeep [15].

Behaviour Change: Health Belief Model and Social Practice Theory

Public health interventions in Ethiopia increasingly employ the Health Belief Model (HBM) to predict and influence hygiene behaviours. The HBM focuses on individual perceptions of susceptibility, severity, benefits, and barriers [16]. In Dassenech, the perceived susceptibility to diarrhoea is high, but the perceived barriers—such as the distance to clean water or the cost of soap—often outweigh the perceived benefits of latrine use [18].

Social Practice Theory (SPT) complements the HBM by shifting the focus from individual cognition to collective routines. SPT views hygiene as a practice composed of three elements: materials (the hardware), competence (the skill), and meaning (the cultural significance) [20]. In the Dassenech context, the "meaning" of water is often ritualized, as seen in the Dimi ceremony where water and cattle blood are used for blessings [22]. Understanding these meanings is critical for promoting practices like handwashing, which may be viewed differently in a culture where "flies are seen as harmless" and open defecation is equated with "freedom" [18].

The Upper Omo River Highlands: A Catalyst for Socio-Economic Disruption

Intense and recurrent rainfall in the upper Omo River catchment generates high sediment runoff that is transported downstream into the Omo River and ultimately into Lake Turkana. The Omo contributes over 80–90% of the lake's annual inflow, making the lake extremely sensitive to changes in sediment load and hydrological variability [2]. The resulting accelerated sedimentation progressively reduces Lake Turkana's effective water holding capacity, which in turn alters the hydraulic gradient at the river–lake interface. Hydrological analyses demonstrate that reductions in storage volume and inflow can generate hydraulic back pressure, modify lake currents and restrict the natural downstream flow of the Omo River into the lake (Avery & Tebbs, 2018). This shift contributes to upstream inundation of low lying floodplains traditionally used by pastoralist communities for grazing and small scale flood recession agriculture, leading to significant livelihood disruptions.

Long term ecological assessments warn that sustained sedimentation and altered inflow patterns may precipitate major hydrological and ecological decline. Research shows that large scale hydrological changes—including

sedimentation, dam regulation, and upstream land use change—could lead to permanent lake level drops of more than 15 meters, with profound consequences for fisheries productivity, nutrient cycling, and biodiversity (Avery & Tebbs, 2018). Such declines would accelerate salinization, reduce spawning cycles linked to natural flood pulses, and destabilize the deltaic and littoral ecosystems that support both human and wildlife populations. Without mitigation, scholars warn that Lake Turkana faces a trajectory like other ecological collapses such as the Aral Sea and Lake Chad.

The hydrological change is profound: the Omo River provides 90% of the inflow to Lake Turkana, and the reduction of this flow leads to increased salinity and the loss of fish breeding habitats in the Omo delta [28]. This environmental shift has forced the Dassenech to adapt their livelihoods, with many transitioning from cattle herding to fishing, a transformation that carries deep cultural and health implications [30].

Research Methodology

This study adopts a pragmatic research paradigm, integrating both quantitative and qualitative approaches to comprehensively examine the socio-technical determinants of WASH sustainability in Dassenech Woreda. The complexity of WASH systems in pastoralist settings—where technological performance is deeply intertwined with social structures, environmental dynamics, and cultural practices—necessitates a mixed-methods approach that captures both measurable outcomes and contextual realities.

Research Design

The research employs a convergent parallel mixed-methods design, in which quantitative and qualitative data were collected concurrently, analyzed separately, and then integrated during interpretation. This design is particularly appropriate for:

- Triangulating findings across multiple data sources.
- Validating quantitative results with qualitative insights.
- Capturing the dynamic interaction between social and technical systems.

The quantitative component focuses on measuring WASH service functionality and associated determinants, while the qualitative component explores underlying socio-cultural and institutional dynamics, including indigenous governance systems such as the age-set structure and clan-based decision-making.

Theoretical and Analytical Framework

The study is grounded in an interdisciplinary framework combining:

Socio-Technical Systems (STS) Theory

To analyze how social institutions, cultural norms, and technological infrastructure co-evolve to influence WASH sustainability.

Health Belief Model (HBM)

To assess behavioural drivers influencing hygiene practices, particularly perceptions of disease risk and barriers to adoption.

Social Practice Theory (SPT)

To understand hygiene behaviours as socially embedded practices shaped by materials, competencies, and cultural meanings.

This integrated framework allows the study to move beyond conventional infrastructure-focused analysis and instead evaluate WASH systems as complex adaptive systems.

Study Approach and Strategy

A case study strategy was employed, focusing on Dassenech Woreda as a critical example of pastoralist adaptation under environmental and socio-economic transition. This approach enables:

In-Depth Contextual Analysis

Exploration of real-world interventions (e.g., 2023 WASH response)

Examination of system-level changes driven by hydrological disruption

Data Collection Strategy

The methodology integrates multiple data sources to ensure robustness and triangulation:

Quantitative Methods

A cross-sectional household survey (n = 430) capturing WASH access, service functionality, and behavioural indicators.

Qualitative Methods

- Key Informant Interviews (KIIs) with sector experts and community leaders.
- Focus Group Discussions (FGDs) with different social groups.
- Ethnographic observations of community practices and water point usage.

Sampling and Data Integration

A combination of purposive and stratified sampling techniques was applied to ensure representation of diverse social groups, including elders, women, youth, and local authorities.

Data integration was conducted at the interpretation stage, where:

- Quantitative findings (e.g., regression results) were compared with
- Qualitative insights (e.g., community perceptions, governance dynamics)

This enabled the identification of convergent, complementary, and divergent findings, strengthening the validity of conclusions.

Data Analysis

Quantitative data were analyzed using statistical techniques, including descriptive statistics and multiple linear regression, to identify predictors of WASH system sustainability.

Qualitative data were analyzed using thematic analysis, focusing on recurring patterns related to governance, behaviour, and socio-cultural practices.

Spatial analysis using cluster detection methods (LLR) helped identify geographic patterns of disease and vulnerability.

Ethical Considerations

The study adheres to established ethical research standards, including informed consent, confidentiality, and voluntary participation. Approval was obtained from relevant institutional and local authorities, ensuring cultural sensitivity and respect for indigenous practices.

Materials and Methods

Study Setting: Dassenech Woreda

Dassenech Woreda is situated in the South Ethiopia Regional State, occupying the lowermost reach of the Omo River basin. It is characterized by an extremely flat, alluvial plain that is highly susceptible to both riverine flooding and back-flooding from Lake Turkana [19]. The population is primarily agropastoralist, keeping cattle, goats, and sheep while practicing seasonal cultivation [13]. The area is remote, with limited road access and a high prevalence of waterborne and vector-borne diseases [7].

Data Collection Procedures

This research utilizes a convergent mixed methods design to triangulate multiple sources of evidence. Quantitative data were gathered

through a cross-sectional survey of 430 households, measuring indicators of WASH access, behaviour, and system functionality [1].

Qualitative data were obtained through:

- 22 Key Informant Interviews (KIIs) with government officials, water engineers, and community elders.
- 7 Focus Group Discussions (FGDs) with men's age-sets, women's groups, and youth "kabana" [1].
- Field observations of water points and participation in local market activities [15].
- Remote sensing analysis using Normalized Difference Vegetation Index (NDVI) to assess land cover change from 1995 to 2025 [32].

Analytical Framework

The study evaluates "sustainability" through a multidimensional lens, incorporating technical condition, institutional support, and community ownership. The primary statistical analysis involved multiple linear regression to identify the socio-technical drivers of functionality. The spatial distribution of health outcomes was mapped using Log-Likelihood Ratio (LLR) clusters to identify persistent disease hotspots [34].

Demographic Context

Table 1 provides an overview of the population estimates for Dassenech and neighbouring woredas within the South Omo Zone, illustrating the significant population at risk from flooding and resource scarcity.

Table 1. Projected Population and Ethnic Distribution in the Lower Omo Valley (2023-2025)

| Woreda/District | Total Population | Major Ethnic Group | Population Share (%) |
|-----------------|------------------|--------------------|----------------------|
| Dassenech | 79,867–92,000 | Dassenech | 8.17% (of Zone) |
| Hamer | 83,803 | Hamer | 8.01% (of Zone) |
| Bena Tsemay | 80,156 | Bena/Tsemai | 7.81% (Combined) |
| Male | 126,941 | Malie | 13.63% (of Zone) |
| Nyangatom | 26,348 | Nyangatom | 2.95% (of Zone) |

The total population of the South Omo Zone is estimated at 918,440, with the Dassenech representing one of the most vulnerable groups due to their location at the terminal end of the river basin [34].

Results

Determinants of WASH System Functionality

The quantitative analysis of 430 households revealed that socio-technical integration is a critical driver of system functionality. Descriptive statistics show that while community engagement is relatively high, the appropriateness of the technology (measured by ease of maintenance and alignment with mobility) is lower (Table 2).

Table 2. Mean Scores for Socio-Technical Indicators (Scale 0-1)

| Variable | Mean | Standard Deviation |
|----------------------------------|------|--------------------|
| Community Engagement Index | 0.66 | 0.14 |
| Technology Appropriateness Score | 0.59 | 0.18 |
| Institutional Support Index | 0.61 | 0.16 |

Regression models indicate that technology appropriateness and community engagement are the most significant positive predictors of sustainability. Institutional support, while

positive, had a slightly lower impact, suggesting that local-level factors are more influential than regional oversight in this remote context (Table 3) [1].

Table 3. Regression of Socio-Technical Factors on WASH Sustainability

| Predictor Variable | Coefficient (β) | t-statistic | p-value |
|----------------------------|-------------------------|-------------|---------|
| Technology Appropriateness | 0.49 | 4.82 | <0.01 |
| Community Engagement | 0.42 | 4.15 | <0.01 |
| Institutional Support | 0.37 | 3.01 | <0.05 |

The impact of technology choice is further highlighted by a comparison of functionality across system types. Hand pumps (primarily

India Mark II) and solar-powered boreholes demonstrated the highest resilience to local conditions (Table 4).

Table 4. Functionality by Technology Type in Dassenech Woreda

| Technology Type | Functional (%) | Non-functional (%) | Primary Failure Reason |
|----------------------------|----------------|--------------------|----------------------------|
| India Mark II Hand Pumps | 72 | 28 | Worn seals, sand ingress |
| Solar-Powered Systems | 69 | 31 | Vandalism, battery failure |
| Motorized (Diesel) Systems | 63 | 37 | Fuel cost, pump seizure |

Hydrological Shifts and Land Cover Change (1995-2025)

The analysis of remote sensing data illustrates a dramatic transformation of the Lower Omo landscape. Between 1995 and

2025, the area covered by water bodies increased by nearly 750%, while forest and bare land significantly decreased [32]. This is attributed to the combination of dam regulation and back-flooding from Lake Turkana (Table 5).

Table 5. Comparative Land Cover Change in LMOR Sub-Watershed

| Land Cover Class | 1995 Area (km ²) | 2025 Area (km ²) | Percentage Change |
|------------------|------------------------------|------------------------------|-------------------|
| Water Body | 20.39 | 174.15 | +754.1% |
| Bare Land | 430.25 | 37.66 | -91.2% |
| Shrub Land | 215.10 | 744.69 | +246.2% |
| Forest | 350.50 | 59.73 | -82.9% |

The data warn of a critical risk to urban infrastructure: Omorate town is projected to face total flooding within 3.07 years if the current flooding rate of 5.125 km²/yr continues [32].

Health Outcomes and 2023 Intervention Success

The 2023-2024 period saw a high-impact humanitarian response to the unseasonal flooding that displaced over 79,000 people [10]. This integrated intervention was pivotal in preventing a widespread cholera epidemic in the wake of the 2022-2023 national outbreak (Table 6) [36].

Table 6. 2023 Integrated WASH Intervention Outcomes in Dassenech

| Activity Description | Beneficiaries/Units | Reported Health Outcome |
|--|---------------------|-----------------------------------|
| Rehabilitation of non-functional schemes | 28 schemes | 28,000 people gain safe water |
| Distribution of household hygiene kits | 24,493 households | Significant reduction in AWD |
| Trench and semi-permanent latrines | 30 facilities | Zero cholera cases in IDP sites |
| Water treatment chemicals (Aqua taps) | 90-day supply/HH | Interruption of faecal-oral route |

Spatial clustering analysis for the period 2021-2023 confirmed that Dassenech was a primary cluster for malaria and waterborne incidence, but intensive interventions in 2023 successfully disrupted these transmission patterns in targeted kebeles [5].

Discussion

The Upper Omo River highlands: Hydrological Alteration and Livelihood Collapse

The commissioning of the Upper Omo River highlands has introduced a permanent hydrological shift that undermines the ecological basis of Dassenech society. Historically, the "rise and fall" of the Omo

River was the primary determinant of agricultural productivity [4]. The annual flood, occurring typically in July, would recede to leave nutrient-rich silt, allowing for the cultivation of sorghum—the staple crop [25]. The regulation of the river has essentially influenced this cycle, replacing it with a stable, low-flow regime that prevents the replenishment of riverine floodplains [25].

This loss of flood-recession land has forced a radical socio-economic reconfiguration. Families who once relied on diversified agropastoralism—combining cattle herding with grain production—have lost their "last resort" grazing lands [3]. The result has been the decimation of livestock herds, with some

reports indicating cattle losses as high as 90% between 2010 and 2020 due to the high stress of the climate-induced drought [39]. This deprivation is not merely economic; it is existential.

The displacement of indigenous communities due to the flooding and drought leading to increased inter-ethnic conflict as groups like the Dassenech, Nyangatom, and Turkana compete for dwindling resources along the shrinking shores of Lake Turkana [25]. The hydrological impact extends to the lake itself, where the reduction in freshwater inflow increases salinity, potentially causing the lake to split into two halves—a northern freshwater basin and a hyper-saline southern basin [28].

Dassenech Social Structures and Water Governance

Effective WASH interventions in Dassenech must be sensitive to the egalitarian social system of the community. The Dassenech are organized into eight territorial groups (en or emeto): the Inkabelo (wealthiest and largest, centered in the delta), Inkoria (Lake Turkana shores), Naritch, Oro, Randal, Elele, Riele, and Kuoro [13]. Each group has autonomous governance regarding resource use, and territorial sections combine different levels of dependence on livestock and cultivation. For instance, the Elele and Riele rely more on fishing, while the Inkoria and Randal are heavily pastoral [13].

Central to their political life is the age-set system, which divides men into categories from "nyigeny" (boy) to "kabana" (adolescent) and finally to "bul" or "karsich" (elder) [33]. A man's transition to the esteemed status of an elder is achieved through the Dimi ceremony, a ritual of immense cultural significance that blesses his daughter's fertility and future marriage [42]. The Dimi involves the slaughter of 10 to 30 cattle and the wearing of leopard or cheetah skin capes, ostrich feather headdresses, and giraffe tail armbands—symbols of courage, authority, and strength [43].

The "bul" status granted by the Dimi ceremony gives men a voice in important tribal decisions, including those related to water access and conflict resolution. WASH governance models that bypass these elders in favor of younger, "educated" committee members often fail because they lack the cultural legitimacy to enforce rules or collect fees [1]. The 2023 intervention's success in rehabilitating 28 schemes was largely due to the integration of these traditional hierarchies into the management committees, fostering a genuine sense of community ownership [5].

The "Die" Class and the Fishing Transition

The loss of cattle due to damming and drought has expanded a specific social category within the Dassenech: the "Die" class. Historically, the Die were the poorest members of society who had lost their livestock and were forced to live on the shores of Lake Turkana, hunting crocodiles and fishing [13]. While they were traditionally stigmatized and of low status, the current crisis has made fishing a respected livelihood and a necessary pathway for economic adaptation [30].

Between 2019 and 2024, fish consumption among the Dassenech increased from 34.6% to 63.6%, reflecting a shift from a temporary coping mechanism to an integral part of the economic life [30]. This transition has empowered women, who have gained greater economic autonomy through fish trading, but it also carries new risks, including increased exposure to waterborne illnesses from the lake and frequent crocodile attacks [30]. The transition of the Die from a marginalized class to a central component of the community's survival system underscores the adaptive capacity of pastoralists, yet it also highlights the failure of state-led development to protect their traditional way of life.

Analysis of the 2023 WASH Intervention: Bridging HBM and SPT

The success of the 2023-2024 emergency response in eliminating cholera in Dassenech Woreda provides critical insights into behaviour change in fragile contexts. The intervention utilized the Health Belief Model to address the perceived threat of the 2022-2023 national cholera outbreak [5]. By deploying audio vans and posters that articulated the severity of the disease and provided clear "cues to action," the program bridged the knowledge-practice gap [5].

However, the sustained adoption of hygiene practices also required addressing the "materials" and "meanings" defined by Social Practice Theory. The distribution of 24,493 hygiene kits—including 250g of laundry soap and 200g of bathing soap per household—provided the necessary materials for practice [5]. The construction of masonry wash basins at water points transformed the meaning of hygiene from a private, household burden to a collective, social activity [5].

A persistent challenge identified in the literature is the perception of latrines as "imposed" or "unnecessary" in the open plains [18]. For many Dassenech, open defecation is not viewed through the lens of hygiene, but as a rodent control strategy or a marker of environmental freedom [18]. Future interventions must therefore frame latrine use not just as a health measure, but as a practice that protects the "navel of Waag" (their sacred ancestral lands) and the health of the children who are central to the Dimi ceremony [19].

Hydrological Modelling and the Future of Omorate

The future of Dassenech Woreda is threatened by a paradox of water: while the Upper Omo River highlands create a drought-like low flow for agriculture, Lake Turkana's rising levels and the river's channel dynamics are creating a flood crisis for urban settlements. The conversion of 153.76 of land into water

bodies since 1995 indicates a significant loss of grazing and residential land [32]. The back-flooding from the lake, driven by tectonic changes and increased highland precipitation, is exacerbated by the sediment trapping of upstream dams, which leads to increased bank erosion downstream [32].

The potential submergence of the Omo River bridge in 8.26 years and Omorate town in 3.07 years poses an existential threat to the administrative and commercial hub of the woreda [32]. This necessitates an urgent shift in regional planning, moving away from temporary emergency responses toward durable, climate-resilient urban infrastructure and a renegotiated water-sharing agreement between the Ethiopian government, commercial interests, and indigenous populations.

Conclusion

The sustainability of WASH services in Dassenech Woreda is inextricably linked to the socio-technical integration of infrastructure and the recognition of indigenous social systems. The Upper Omo River highlands has fundamentally altered the hydro-social contract of the Lower Omo Valley, ended traditional flood-recession agriculture and forced a precarious transition toward fishing and sedentary farming. While this shift has increased vulnerability to waterborne diseases and food insecurity, the 2023 integrated WASH intervention demonstrates that targeted, culturally sensitive responses can effectively mitigate these risks and achieve significant public health outcomes, including the elimination of cholera in high-risk zones.

The findings of this research emphasize that for technology to be sustainable in a pastoralist context, it must be:

1. **Appropriate:** Hand pumps and solar systems that align with community mobility and maintenance capacity.

2. **Embedded:** Integrated into the "bul" elder status and clan governance structures.
3. **Resilient:** Designed to withstand the dual threats of riverine regulation and Lake Turkana back-flooding.

Long-term success will require moving beyond the "development debacle" of large-scale plantations and prioritizing the rights and survival of the indigenous peoples who have been the stewards of the Omo River for generations.

Ethical Approval

This research adhered to recognized ethical guidelines governing studies involving human participants. Prior to commencing data collection, ethical clearance was obtained from the appropriate institutional review board. Formal authorization was also granted by relevant authorities in Dassenech Woreda, including the Water and Health sector offices. All participants provided informed consent before participation. They were fully informed about the purpose of the study and were assured of confidentiality, anonymity, and their right to withdraw from the study at any point without any negative consequences.

Data Availability

The datasets produced and analyzed during this study are not publicly accessible due to confidentiality agreements established with participants and local administrative bodies. However, they may be obtained from the corresponding author upon reasonable request. All qualitative materials, including interview transcripts and focus group discussion records,

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have been fully anonymized to safeguard participant privacy and identity.

Author Contributions

The entire research process, including conceptualization, study design, data collection, data analysis, interpretation of findings, and manuscript preparation, was carried out solely by the author. The author also reviewed and approved the final manuscript for submission and publication.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this research.

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