West Science Interdisciplinary Studies
Vol. 4, No. 11, November 2026: pp. 1689-1698

When the Sea Becomes Home: Human–Nature Relations and Local Wisdom of the Bajo Community in Torosiaje, Gorontalo

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ABSTRACT

The relationship between humans and the environment is central to the sustainability of coastal communities that depend on marine resources. The Bajo community of Torosiaje Village, Pohuwato Regency, Gorontalo, has lived in a stilt settlement over the sea since 1901 and has developed local wisdom that shapes how marine resources are used and protected. This study aims to analyze the human–sea relationship of the Bajo community through the lens of local wisdom, to identify the forms and ecological functions of that wisdom, and to examine the pressures that threaten it. A descriptive qualitative design with an integrative literature review was employed. Fourteen scholarly studies on Torosiaje published between 2012 and 2026, together with supporting theoretical and comparative literature, were analyzed thematically and synthesized in a matrix. The results show that the sea functions simultaneously as a livelihood, a social space, and a source of identity. Local wisdom operates through ecological knowledge (reading tides, reefs, and natural signs), selective fishing gear, the *mamia kadialo* seafaring tradition, *pamali* taboos against discharging waste into the sea, a taboo on harming turtles, the return of part of the catch to the sea guardian *Mbo*, and *gotong royong*. These practices are under pressure from overfishing, blast fishing, pollution, mangrove-to-pond conversion, modernization, and the exclusion of local knowledge from governance. The novelty of this study lies in an integrative framework linking ecological, socio-cultural, and ethical dimensions, which indicates that marine conservation in Torosiaje should be co-managed with, rather than imposed upon, the Bajo community.

Keywords: *Bajo Community, Environmental Ethics, Human–Environment Relationship, Local Wisdom, Marine Conservation, Torosiaje.*

1. INTRODUCTION

Humans and the environment are bound in a relationship of mutual dependence. The environment provides food, shelter, and livelihoods, while human activity shapes environmental conditions through both stewardship and degradation. This relationship is particularly visible in coastal areas, which concentrate fisheries, settlements, tourism, trade, and industry within a narrow and physically dynamic zone. Sea-level rise, land subsidence, erosion, and sedimentation continuously reshape coastlines and amplify the vulnerability of coastal ecosystems and the people who rely on them [1]. In Indonesia, these pressures are compounded by threats to coral reefs from overfishing, destructive fishing, and land-based pollution [2], and by the large volume of mismanaged plastic waste that enters the ocean, for which Indonesia has been estimated to be the second-largest contributor globally [3].

A growing body of scholarship recognizes that local and traditional ecological knowledge (TEK) can function as an adaptive form of resource management that complements formal science [4], [5]. Customary rules, taboos, and seasonal practices have been shown to support marine conservation outcomes when they are integrated into, rather than displaced by, conservation programs [6], [7]. The Bajo (or Bajau), often referred to as sea nomads, are among the most sea-oriented peoples of Southeast Asia. Their relationship with the sea is so long-standing that genetic adaptations to breath-hold diving, including enlarged spleens, have been documented among them [8], while conservation initiatives that disregard their culture have frequently resulted in conflict [9].

In Gorontalo Province, one of the most distinctive Bajo communities lives in Torosiaje Village, Popayato District, Pohuwato Regency. The settlement consists of stilt houses built over the sea and connected by wooden walkways, and it has been inhabited since 1901 [10], [11]. Previous studies have documented the ecological intelligence embedded in Bajo local wisdom [12], the role of that wisdom in environmental resilience [11], eco-friendly artisanal fishing [13], settlement architecture [14], [15], the tension between tradition and modernity [16], and the exclusion of indigenous knowledge from marine governance [17].

These studies, however, are scattered across disciplines such as ecology, architecture, civic education, and fisheries, and each addresses only one facet of the community's relationship with the sea. Few attempts have been made to synthesize them into a single human–environment perspective that connects ecological knowledge, socio-cultural practice, and environmental ethics, and that also accounts for the pressures currently eroding that relationship. Meanwhile, household numbers are growing, traditional boat dwellings are disappearing, and parts of the surrounding mangrove have been converted into fishponds [11], [15], making such a synthesis increasingly urgent.

Accordingly, this study aims to (i) describe the characteristics of the relationship between the Bajo community of Torosiaje and the marine environment, (ii) identify the forms of local wisdom and their ecological functions, (iii) examine how these practices reflect environmental ethics and which pressures threaten them, and (iv) formulate an integrative framework with implications for community-based conservation. The novelty of this study lies in its cross-disciplinary synthesis of the Torosiaje literature into a framework that links ecological, socio-cultural, and ethical dimensions of the human–sea relationship.

2. LITERATURE REVIEW

2.1 Human–Environment Relations and Cultural Ecology

Cultural ecology, introduced by Steward, explains how societies adapt their technology, social organization, and settlement patterns to the specific resources of their environment [18]. Contemporary social–ecological systems thinking extends this view by treating people and nature as coupled systems whose resilience depends on the capacity to absorb disturbance, learn, and reorganize [19]. Ostrom's work on the commons further shows that local communities can sustainably govern shared resources, such as fisheries, when they possess clear boundaries, collective rules, monitoring, and graduated sanctions [20]. Together, these perspectives frame the Bajo settlement in Torosiaje as an adaptive social–ecological system rather than as a population that merely occupies a marine space.

2.2 Local Wisdom and Traditional Ecological Knowledge

Local wisdom refers to the knowledge, values, norms, and practices that develop within a community through long interaction with its environment. In the international literature, it is closely related to traditional ecological knowledge, a cumulative body of knowledge, practice, and belief transmitted across generations [5]. TEK often functions as adaptive management because it relies on continuous observation and feedback from ecosystems [4]. In marine settings, TEK has supplied information on species behavior, spawning grounds, and habitat condition that is useful for conservation planning [7]. In coastal and small-island communities, integrating local and indigenous knowledge with science has also been shown to strengthen disaster risk reduction and climate adaptation [21].

2.3 Environmental Ethics

Environmental ethics concerns the moral principles that govern how humans treat nature. Naess distinguished "shallow" ecology, which protects the environment for human benefit, from "deep" ecology, which recognizes the intrinsic value of all living beings [22]. Taylor's biocentric ethic of respect for nature similarly argues that every organism has a good of its own that deserves moral consideration [23]. Keraf formulates principles of environmental ethics that include respect for nature, moral responsibility, cosmic solidarity, care, "no harm," and living simply in harmony with nature [24]. These principles provide a lens for interpreting customary taboos and rules as expressions of an ethic of restraint.

2.4 The Bajo and Marine Resource Management

Across Southeast Asia, Bajo communities have been described as possessing a deep, practice-based knowledge of reefs, currents, and fish behavior [8], [9]. In Wakatobi, the local wisdom of the Bajo Mola community, expressed through practices such as duata sangal, parika, and pamali, has been used as a basis for environmental care education [25]. Studies of customary marine management in the wider Indo-Pacific demonstrate that such institutions can produce conservation benefits when they are recognized by the state [6]. Conversely, conservation policies designed without the participation of Bajo communities have tended to marginalize them and to undermine compliance [9], [17].

3. METHODS

This study employed a descriptive qualitative design with an integrative literature review (library research) approach [26]. This design was chosen because the relationship between humans and the environment in the Bajo community involves social, cultural, economic, and ecological meanings that are better understood through interpretation than through statistical measurement. The object of the study is the human–sea relationship of the Bajo community in Torosiaje Village, Popayato District, Pohuwato Regency, Gorontalo Province, as documented in the existing literature.

Sources were retrieved from Google Scholar, the Garuda national index, publisher websites, and the institutional repository of Universitas Negeri Gorontalo using combinations of the keywords "Bajo," "Bajau," "Torosiaje," "kearifan lokal" (local wisdom), "traditional ecological knowledge," "environmental ethics," and "marine conservation." Sources were included if they (a) addressed the Bajo community of Torosiaje or provided theoretical or comparative grounding on local wisdom, environmental ethics, or marine conservation; (b) were journal articles, conference proceedings, scholarly books, or official and news documents containing verifiable data; and (c) had traceable bibliographic information. The final corpus comprised 14 scholarly studies specifically on Torosiaje

published between 2012 and 2026, one news report used for recent demographic data, and 19 theoretical, methodological, and comparative works.

Data were analyzed using thematic analysis [27]. The procedure consisted of (1) reading and familiarization with each source; (2) coding statements about settlement, livelihood, knowledge, customary rules, ethics, pressures, and conservation; (3) grouping codes into themes; (4) organizing the themes into a synthesis matrix that records each practice, its description, its ecological function, and its sources; and (5) interpreting the themes through the frameworks of cultural ecology, traditional ecological knowledge, and environmental ethics. Source triangulation was carried out by comparing descriptions and figures across studies. Quantitative figures were extracted only as reported by the original authors; because they originate from different years and methods, they are treated as indicative rather than as a time series.

4. RESULTS AND DISCUSSION

4.1 Social-Ecological Profile of Torosiaje

Table 1 summarizes the socio-ecological profile of Torosiaje compiled from the reviewed literature. The village lies approximately 500–700 m offshore and can be reached from the mainland in 5–10 minutes by boat [11], [12], [15]. Houses stand on wooden posts in water 1–8 m deep and are arranged linearly along a main walkway about 1.5 m wide, which also serves as a space for gathering, children's play, and customary events [12], [15].

Table 1. Socio-ecological profile of Torosiaje Village

Indicator	Value	Source
Location	Popayato District, Pohuwato Regency, Gorontalo Province	[11]
Start of settlement over water	1901 (four stilt houses initially)	[10], [12]
Distance from mainland	±500–700 m; 5–10 min by boat	[11], [12], [15]
Water depth beneath houses	1–8 m	[12]
Population, 2011	1,334 people; 338 households	[12]
Population, 2023	1,489 people; 441 households	[10]
Ethnic composition	>99% Bajo	[12]
Fishers among working-age residents (2011)	24.1%	[12]
Mangrove canopy cover; density	80–91%; 5,700–6,000 trees/ha	[11], [12]
Mangrove vs fishpond area (surroundings)	92.84 ha vs 247.09 ha	[11]
Families still living on leppa boats	3 (elderly)	[15]
Status	Marine tourism village (since 2007)	[10]

Source: Compiled from the reviewed literature (2012–2025). Figures come from different years and methods and are indicative.

Two figures in Table 1 deserve attention. First, between 2011 and 2023 the population increased by about 11.6% (from 1,334 to 1,489), whereas the number of households increased by about 30.5% (from 338 to 441), reducing the average household size from roughly 3.9 to 3.4 persons. Although the two figures come from different sources, the pattern suggests the formation of new nuclear households, which implies growing demand for building space over the water, timber for posts and walkways, and household waste management. Second, the fishpond area around the village is about 2.7 times larger than the remaining mangrove area [11], indicating that the ecological buffer on which the settlement depends is already under conversion pressure. At the same time, only

three elderly families still live on traditional *leppa* boats [15], marking the near-completion of the transition from a mobile to a sedentary maritime life.

4.2 The Sea as a Source of Livelihood and Identity

For the Bajo, the sea is not merely a geographical space but the center of economic, social, and cultural life. This is expressed most clearly in the mamia kadialo seafaring tradition, which distinguishes three groups of fishers: palilibu, who go to sea for one or two days in small paddle boats (soppe) and share part of their catch with relatives; bapongka (babangi), who sail for weeks to months in larger boats (leppa or sopek, about 4 × 2 m), sometimes accompanied by their families; and sasakai, who travel for months with several boats between islands [12], [13]. The tradition organizes the time, space, and social relations of fishing and transmits knowledge from experienced fishers to younger generations.

Long dependence on the sea has produced a detailed ecological knowledge. Bajo fishers recognize reef waters by a calm surface, weak currents, white foam, a fishy smell, and a distinctive sound when paddles strike the water; they locate reefs at night by the reflection of moonlight; and they read the descent of sea eagles toward the water surface as a sign that the tide is falling and prey is exposed [11], [12]. From a cultural-ecology perspective [18], this knowledge is an adaptation that enables efficient and relatively low-risk resource use. It also shows that the community does not perceive the sea as an object separate from itself but as a living space with which it continuously interacts.

4.3 Forms of Local Wisdom and Their Ecological Functions

The thematic synthesis identified ten forms of local wisdom with direct or indirect ecological functions, as presented in Table 2.

Table 2. Synthesis matrix of Bajo local wisdom in Torosiaje and its ecological functions

Practice	Description	Ecological function	Source
Pamali on waste during mamia kadialo	Prohibition on discharging sea-cucumber wash water, kitchen ash, cigarette butts, chili, ginger, or lime water and on washing cookware in the sea; waste is taken to land	Prevents pollution; maintains water quality	[11], [12], [28]
Turtle taboo	Turtles must not be killed or eaten because they are believed to help people in distress at sea	Protects threatened species	[12], [28]
Offering to Mbo	Two fish from each catch are returned to the sea guardian	Reciprocity; restraint in harvesting	[11]
Limited fishing range	Fishing restricted to the distance reachable by paddling	Limits fishing effort	[11]
Sacred reefs	Older generations avoid fishing on reefs regarded as resting places of ancestral spirits without a ritual	Functions as informal no-take zones	[12]
Mangrove taboo	Young or growing mangroves are not cut; formerly only dead mangrove wood (posi-posi) was used	Conserves mangrove habitat	[12], [28]
Selective fishing gear (yaiyai pangala daya)	Bina (hookless thread for needlefish), bubu traps, spears, and ringgi nets kept away from reefs and seagrass	Selectivity; allows juvenile fish to mature; protects habitat	[12], [13], [29]
Spirit beliefs and Tibaanca tradition	Belief system and customary tradition that regulate conduct at sea	Normative restraint on exploitation	[30]
Gotong royong	Communal house building using local materials	Social capital for collective environmental action	[16], [31], [32]

Practice	Description	Ecological function	Source
Community conservation groups	Paddakuang and sipakullong groups combine local knowledge with formal rules	Community-based governance	[33]

Source: Authors' synthesis of the reviewed literature.

Table 2 shows that Bajo local wisdom operates on several ecological fronts at once. The *pamali* taboos during *mamia kadialo* act as a customary pollution-control rule; the taboos on turtles and young mangroves protect key species and habitats; and sacred reefs and limited fishing ranges function as informal spatial and effort controls. Selective gear such as *bina*, which catches needlefish by entangling their serrated beaks rather than by hooks, and *bubu* traps, which retain mainly larger fish, allow juveniles to reach maturity [12], [13]. Mayang et al. likewise found that the community's knowledge of aquatic ecosystem management, water zoning, and environmentally friendly gear underpins sustainable aquaculture in Torosiaje [29]. These findings are consistent with the argument that TEK can serve as a form of adaptive management [4].

Local wisdom is also visible in how the settlement itself is managed. Posts and walkways have been built from water-resistant wood sourced from outside the mangrove zone, and residents opposed a government plan to extend a concrete bridge into the village because they feared the loss of boat-taxi income, damage to mangroves and seagrass, and noise and pollution from motorbikes [12]. Vernacular strategies, such as communal construction, local materials, and house designs adapted to sea humidity and wind [14], [32], show that adaptation to the marine environment is embedded in architecture as well as in fishing.

4.4 Environmental Ethics in Bajo Practice

Interpreted through environmental ethics, these practices express an ethic of restraint and reciprocity. Taboos on polluting the sea and on harming turtles correspond to the principles of "no harm" and respect for nature [23], [24]. Returning part of the catch to *Mbo* reflects cosmic solidarity, the recognition that humans and the sea belong to one moral community, while the limited fishing range and selective gear embody the principle of living simply in harmony with nature [24]. Unlike modern ethical theories, however, these norms are enforced through beliefs about supernatural sanctions such as storms, misfortune, or empty catches [12]. The Bajo ethic is therefore relational and practice-based rather than abstract: it does not separate the intrinsic value of nature from human use, as in the deep-ecology debate [22], but regulates use so that the sea remains able to support future generations. Setyaningsih et al. emphasize that such knowledge strengthens environmental resilience and should be combined with scientific knowledge in conservation [11].

4.5 Pressures on the Marine Environment and on Local Wisdom

Despite this rich body of local wisdom, the Torosiaje area faces significant environmental pressures. Table 3 summarizes the main pressures identified in the literature and their implications

Table 3. Pressures on the Torosiaje socio-ecological system

Pressure	Evidence in the literature	Implication
Overfishing and blast fishing	Reported in the Torosiaje area together with coral reef damage [30]	Decline of fish stocks and reef habitat
Pollution	Household and plastic waste in coastal waters [30]; Indonesia is a major source of marine plastic [3]	Lower water quality; risk to biota and health
Mangrove conversion	Fishponds (247.09 ha) exceed mangroves (92.84 ha) around the village [11]	Loss of nursery habitat and coastal protection
Climate change and coastal dynamics	Sea-level rise, erosion, and freshwater scarcity [1], [11]	Greater exposure of over-water settlements

Pressure	Evidence in the literature	Implication
Erosion of local knowledge	Local wisdom dismissed as unscientific [11]; weaker influence of elders and changing needs [34]	Weaker customary restraint
Epistemic exclusion	State-led technocratic policies marginalize Bajo knowledge [17]	Low legitimacy of conservation programs

Source: Authors' synthesis of the reviewed literature.

These pressures operate on two levels. At the ecological level, overfishing, blast fishing, pollution, and mangrove conversion directly degrade the reefs, seagrass, and mangroves that sustain fisheries [11], [30]. At the cultural level, part of the local wisdom is being abandoned because it is considered outdated or unscientific [11]. Yunus et al. attribute the "disorientation" of Bajo character to changing community needs, the declining influence of traditional leaders and elders, and the government's incomplete understanding of Bajo local wisdom [34]. Tamu et al. go further, arguing that the exclusion of Bajo ecological knowledge from marine governance is not accidental but rooted in structural power imbalances and epistemological bias [17]. Environmental degradation in Torosiaje is therefore not only a matter of damaged ecosystems but also of weakened knowledge systems that once regulated resource use.

4.6 Modernization and Adaptation

Modernization has altered transport, communication, household needs, and economic activities in Torosiaje. The literature indicates, however, that the community does not reject change wholesale. Yunus et al. found that the Bajo adopt modern technology selectively while maintaining maritime traditions, marriage customs, traditional healing, and *gotong royong*, with local leaders and education playing central roles in transmitting cultural values [16]. The community has also begun to engage in land-based economic activities and to develop floating tourism that highlights Bajo identity [31]. The main dilemma lies in internal demands for better modern facilities, which may conflict with the traditions that define the community [16]. From a social–ecological perspective [19], such selective adoption is a form of adaptive capacity, provided that technology, such as weather information or wider market access, is used to improve welfare without removing the restraints that protect habitats and stocks.

4.7 The Role of the Bajo Community in Conservation

Because the Bajo possess direct, experience-based knowledge of the marine environment, they are well placed to act as primary stewards of conservation. Hendra et al. show that combining local knowledge with formal rules through the *paddakuang* and *sipakullong* conservation groups has produced a more adaptive and just model of community-based resource management, supported by cross-village collaboration, participatory ecotourism, and culture-based education [33]. Kusmiati and Wijayanti similarly conclude that spirit beliefs, the *Tibaanca* tradition, and traditional gear help protect biodiversity and control pollution [30]. These findings agree with regional evidence that customary management produces conservation benefits when recognized by the state [6] and with the process proposed by Hiwasaki et al. for integrating local knowledge with science [21]. In practical terms, conservation in Torosiaje can be strengthened through routine community clean-ups of the settlement and its waters, community-based waste management, the maintenance of selective gear, the protection of mangroves, seagrass beds, and coral reefs, the involvement of young people in environmental education that draws on Bajo knowledge [25], [28], and the recognition of customary rules within government conservation programs and marine tourism planning.

4.8 An Integrative Framework of the Human–Sea Relationship

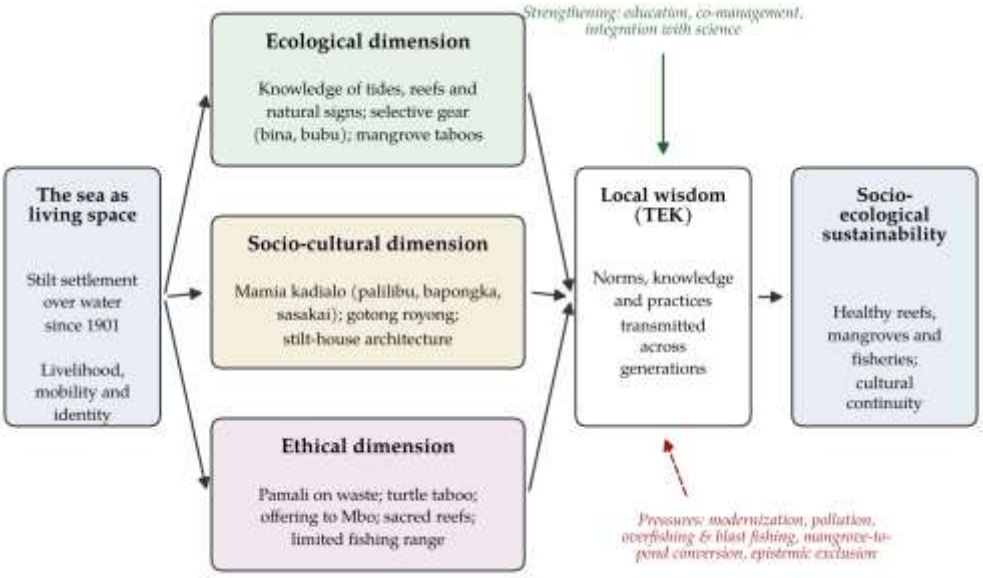


Figure 1. Integrative framework of the human–sea relationship in the Bajo community of Torosiaje

Synthesizing the preceding findings, the relationship between humans and the environment in the Bajo community of Torosiaje can be understood through three interrelated dimensions, as illustrated in Figure 1. The ecological dimension comprises knowledge of tides, reefs, and natural signs, together with selective gear and mangrove taboos. The socio-cultural dimension comprises the *mamia kadialo* tradition, *gotong royong*, and stilt-house architecture transmitted across generations. The ethical dimension comprises *pamali* taboos, the turtle taboo, offerings to *Mbo*, sacred reefs, and the limited fishing range, which together express responsibility toward the sea.

The three dimensions converge in local wisdom, which mediates between the sea as a living space and socio-ecological sustainability. The framework also highlights that this mediation can be strengthened by education, co-management, and integration with science, or weakened by modernization, pollution, overfishing, mangrove conversion, and epistemic exclusion. It thus shows that environmental sustainability in Torosiaje cannot be separated from the sustainability of culture and social life, a conclusion consistent with commons and social–ecological systems theory [19], [20].

CONCLUSION

The relationship between the Bajo community of Torosiaje and the marine environment is a social–ecological relationship formed over more than a century of living above the sea, in which the sea serves at once as a source of livelihood, a social space, and a foundation of identity. This relationship is mediated by local wisdom that combines ecological knowledge of tides, reefs, and natural signs; socio-cultural institutions such as *mamia kadialo* and *gotong royong*; and an ethic of restraint expressed through *pamali* taboos on polluting the sea, the turtle and mangrove taboos, offerings to *Mbo*, sacred reefs, and selective fishing gear. These practices perform real ecological functions, including pollution prevention, species and habitat protection, and limits on fishing effort, but they are under pressure from overfishing, blast fishing, pollution, mangrove-to-pond conversion, modernization, and the exclusion of Bajo knowledge from governance. Marine conservation in Torosiaje should therefore be built with the community rather than imposed upon

it, by recognizing customary rules in conservation policy and integrating local knowledge with science.

Based on these findings, local governments are advised to incorporate Bajo customary rules and community conservation groups into coastal zoning, mangrove protection, and marine tourism policies; schools and universities are advised to develop environmental education based on Bajo local wisdom; and the community is encouraged to strengthen waste management and the transmission of ecological knowledge to young people. As this study relies on secondary literature with figures from different years, future research should conduct field studies, including interviews with customary leaders, fishers, and youth, as well as ecological monitoring of reefs, seagrass, and mangroves, to measure how far local wisdom is still practiced and how it affects ecosystem condition.

ACKNOWLEDGEMENTS

The authors thank the Population and Environmental Studies Program, Postgraduate Program, Universitas Negeri Gorontalo, for its academic support during the preparation of this article, and the researchers whose work formed the basis of this review.

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