Journal of Islamic Mubādalah

DOI: https://doi.org/10.70992/1sf7vm73
Volume 2 Number 2 December 2025

# Human–Nature Imbalance in Sumatera Ecological Disasters: *Mubādalah* as a Framework for a Just and Sustainable Ecological Model

**Iskandar[1], Abu Yazid Abu Bakar[2*], Hakis[3]**

[1.] Universitas Islam Negeri Sulthan Thaha Saifuddin, Jambi, Indonesia
[3.] Universiti Kebangsaan Malaysia (UKM), Malaysia
[2.] Universitas Islam Negeri Abdoel Moethalib Sangadji, Maluku, Indonesia

**Abstract:** Ecological disasters in Sumatra, including flash floods and landslides, demonstrate a profound imbalance in human–nature relations resulting from upstream watershed degradation and development practices that disregard ecological carrying capacity. This article aims to identify the forms of this imbalance, analyze them through the framework of *mubādalah*, and propose an applied ecological model that is both just and sustainable for national environmental governance. The novelty of this study lies in extending *mubādalah* as an ethic of reciprocity beyond interpersonal relations to encompass the human–nature nexus, positioning nature as a relational subject rather than a passive object. Employing a qualitative–analytical approach, the study draws on literature reviews, disaster reports, and Islamic ecological scholarship. The analysis integrates reciprocity-based ecological theory and ecological spatial-planning frameworks. The findings indicate that the failure to cultivate reciprocal relations with nature exacerbates disaster risks and weakens community resilience. Consequently, the study argues for the importance of a reciprocity-oriented ecological paradigm that recognizes nature as a partner in development. Recommendations include strengthening reciprocity-based mitigation policies, advancing upstream landscape rehabilitation, and integrating the ethical principles of *mubādalah* into environmental governance and education as a response to the increasing frequency of ecological disasters at the national level.

**Keywords:** Ecological Disaster, Human–Nature, *Mubādalah*, Reciprocal Ecology, Reciprocal Relations.

**Abstrak:** Bencana ekologis di Sumatera, seperti banjir bandang dan longsor, menunjukkan ketidakseimbangan relasi manusia–alam akibat degradasi hulu sungai dan praktik pembangunan yang tidak selaras dengan daya dukung lingkungan. Artikel ini bertujuan mengidentifikasi bentuk ketimpangan tersebut, menganalisisnya melalui teori mubādalah, serta menawarkan model ekologis aplikatif yang berkeadilan dan berkelanjutan bagi tata kelola lingkungan nasional. Kebaruan artikel ini terletak pada perluasan mubādalah sebagai etika kesalingan tidak hanya antarmanusia tetapi juga antara manusia dan alam sebagai subjek relasional. Artikel ini menggunakan metode kualitatif-analitis diterapkan melalui studi literatur, laporan kebencanaan, dan kajian ekologi Islam. Analisis menggunakan teori ekologi kesalingan, teori tata ruang ekologis. Hasil analisis menunjukkan bahwa kegagalan membangun relasi timbal balik dengan alam memperburuk risiko bencana dan melemahkan ketahanan komunitas. Artikel ini menyimpulkan pentingnya paradigma ekologi kesalingan yang menempatkan alam sebagai mitra pembangunan. Rekomendasi mencakup penguatan kebijakan mitigasi berbasis kesalingan, rehabilitasi lanskap hulu, serta integrasi etika mubādalah dalam pendidikan dan tata kelola lingkungan sebagai respons atas meningkatnya frekuensi bencana ekologis nasional.

**Kata Kunci:** Bencana Ekologis, Ekologi Kesalingan, Manusia–Alam, *Mubādalah*, Relasi Timbal Balik.

**Corresponding author:**
Abu Yazid Abu Bakar*
yazid3338@ukm.edu.my



**How to cite this article:**
Iskandar., Bakar, A. Y. A., Hakis. (2025). Human–Nature Imbalance in Sumatra's Ecological Disasters: *Mubādalah* as a Framework for a Just and Sustainable Ecological Model. *Journal of Islamic Mubadalah*. *2* (2). 114-134.
DOI: https://doi.org/10.70992/1sf7vm73

## Introduction

The frequency and intensity of natural disasters including floods, wildfires, and landslides have increased substantially across many regions of the world over the past decade (Arnall, 2023). Global assessments demonstrate that climate change, land-use conversion, and environmental degradation have collectively heightened the risks of hydrometeorological and geomorphological hazards, thereby affecting human livelihoods, ecosystems, and economic systems (Y. Fan et al., 2022). In the case of landslides specifically, recent studies indicate that climate change and other global drivers have exacerbated uncertainties surrounding landslide hazards, underscoring the need for integrated approaches to risk mitigation (Alcántara-Ayala, 2025). Likewise, the intensification of wildfires has been linked to rising global temperatures, prolonged droughts, and vegetation drying, all of which contribute to extreme fire events across numerous ecological regions (OECD, 2023) (Liu & Zhuo, 2025).

Environmental crises and the increasing scale of natural disasters have emerged as critical global concerns, particularly in light of the growing frequency of extreme climatic phenomena and the widespread deterioration of ecological systems (Cantoni et al., 2025). Contemporary ecological scholarship elucidates that deforestation, land-use change, watershed (Sources: Daerah Aliran Sungai/DAS) degradation, and development practices that disregard ecological carrying capacity have accelerated environmental vulnerability. Floods and landslides are therefore no longer understood merely as natural occurrences but as consequences of an unequal and extractive human–nature relationship (Duc et al., 2025). Within the Islamic intellectual tradition, nature is positioned as an entity endowed with moral and spiritual significance (Khalid, 2010). The concepts of *khalīfah*, *mīzān*, and *ḥifẓ al-bi'ah* articulate humanity's responsibility to maintain cosmic balance, while Islamic environmental ethics emphasize reciprocal relations and ecological accountability (Saniotis, 2012a)(Kula, 2001).

Ecological disasters have likewise manifested in Indonesia, with particularly severe impacts in several regions of Sumatra following intense monsoon rains and associated hydrometeorological events in late November and early December 2025. The floods and landslides that struck Aceh, North Sumatra, and West Sumatra have caused widespread ecological destruction and substantial loss of life, displacing hundreds of thousands of residents and damaging critical infrastructure. According to the latest data from the National Disaster Management Agency (*Badan Nasional Penanggulangan Bencana*, BNPB), as of 11 December 2025 the combined death toll across these three provinces had risen to at least 969 fatalities, with approximately 252 people still reported missing and thousands more injured. The disaster has affected more than 3.3 million people and forced nearly one million individuals into temporary shelters, illustrating the scale of human–nature disruption in the region (Sources: INP | Indonesian National Police)

In North Sumatra alone, the disaster has resulted in hundreds of deaths, with significant impacts concentrated in districts such as Central Tapanuli, South Tapanuli, and Sibolga City, where communities have faced extensive flooding, landslides, and infrastructure loss. Across the three provinces, the emergency has overwhelmed local capacities, prompting coordinated search and rescue operations and large-scale evacuation efforts. The scale of displacement exacerbated by blocked transportation routes and damaged public facilities has underscored the profound disruption of social and ecological systems. These figures reflect the evolving nature of the crisis and highlight the profound implications of ecological imbalance for vulnerable populations, particularly those residing in ecologically sensitive landscapes.

Moreover, thousands of houses were damaged, roads and bridges were severed, and telecommunication lines and other critical infrastructure were disrupted, leaving parts of North Sumatra such as North Tapanuli, Mandailing Natal, and upstream mountainous areas completely isolated. The decline in forest cover, extensive land-use conversion in upstream

zones, and weak spatial planning enforcement were identified as key drivers exacerbating disaster risks and reducing the ecological resilience of local communities. These findings indicate that the disaster was not a random natural event but rather a tangible implication of the failure to preserve balance and harmony in human–nature relations. (Sources: https://url-shortener.me/1FN2)

The empirical conditions above reveal a complex and multidimensional social phenomenon. The impacts of the disaster extend far beyond loss of life or physical destruction; they generate systemic humanitarian, social, and ecological crises. These conditions exacerbate the marginalization of vulnerable groups, deepen inequalities in access to resources, erode social capital, and expose persistent weaknesses in regional environmental governance. The asymmetrical human–nature relationship renders most local communities structural victims rather than mere victims of natural events. This situation underscores a significant gap between the *das sein* the unequal ecological and social realities on the ground and the *das sollen* the ideal of reciprocal human–nature relations envisioned in environmental ethical norms. The divergence between these two conditions highlights the urgency of constructing a new analytical and normative framework capable of bridging ecological destruction with pathways for just and sustainable environmental recovery.

A deeper analysis of the imbalance in human–nature relations in Sumatra is nationally relevant, given the rising frequency of ecological disasters and their profound implications for Indonesia's socio ecological resilience. This study contributes conceptually to the development of contemporary Islamic environmental ethics, particularly the *mubādalah* approach, which emphasizes reciprocity, mutuality, and relational balance. While *mubādalah* has primarily been applied in discussions of gender relations, it has yet to be fully explored as a foundation for ecological ethics or as a lens through which to interpret human–nature interactions. Extending the *mubādalah* framework into ecological analysis offers a significant opportunity to broaden its theoretical scope and introduce a new paradigm for understanding the roots of ecological disasters.

The examination of imbalanced human–nature relations in the context of ecological disasters in Sumatra holds strategic urgency, especially as Indonesia remains one of the countries with the highest hydrometeorological disaster risk globally. An analysis grounded in *mubādalah* as an ecological ethic offers new potential for reorienting climate mitigation and adaptation strategies through a value-based framework that foregrounds reciprocity, ecological justice, and shared responsibility for sustaining nature. The significance of this study extends beyond the national context, as environmental crises and ecological disasters represent global challenges demanding the integration of scientific knowledge, moral frameworks, and public policy. This article contributes to the evolving discourse on religion-based environmental ethics, which is gaining increased attention in interdisciplinary ecological research, and it offers a normative-theoretical perspective adaptable to other countries with similar socio-religious characteristics. By employing *mubādalah* to interpret human–nature relations, the article provides a conceptual contribution to strengthening contemporary Islamic environmental ethics within global academic discourse while simultaneously supporting the development of ecological governance models that are more just, inclusive, and sustainable in Indonesia.

Previous studies have examined the religious and social dimensions of environmental issues, yet none have explicitly integrated the concept of *mubādalah*. Environmental *fatwas* in Indonesian Muslim communities have been analyzed as theological efforts to reduce ecological degradation (Saniotis, 2012b). Other studies have explored disaster theology among coastal communities, highlighting the relationship between religious understanding and disaster response (Ha, 2015). Research on *ecological sin* in Minahasa links moral degradation to the rising frequency of natural disasters (Gosal et al., 2025). Meanwhile, scholarship on

disaster jurisprudence examines ecological justice in the context of coastal abrasion and shoreline transformation (Muhasim et al., 2024). Flood-mitigation analyses in West Sumatra have further identified systemic weaknesses in cross-sectoral coordination in watershed management (Almutairi et al., 2020). Although these five studies offer significant contributions to the understanding of theology, morality, environmental law, and disaster mitigation, they have not centered their analyses on ecological reciprocity as a normative framework. This gap offers an important space for the present article to introduce its novelty: the integration of *mubādalah* as an ecological ethic capable of interpreting the imbalance in human–nature relations while simultaneously proposing an ecologically just and sustainable model.

This study aims to address three central research questions: (1) What forms of imbalance in human–nature relations can be identified in the ecological disasters that occurred in Sumatra? (2) How can the principles of *mubādalah* be applied to analyze and reinterpret human–nature relations within the context of these disasters? (3) What applicable ecological model grounded in *mubādalah* can be proposed to support more just and sustainable environmental governance in Indonesia?

## Method

This research employs a qualitative analytical method to examine in depth the imbalance of human–nature relations within the ecological disasters in Sumatra and to develop an ecological model informed by *mubādalah*. This approach was selected because it allows the integration of empirical disaster data with Islamic environmental ethics, yielding a comprehensive understanding of the roots of ecological degradation while offering value based solutions. Two primary theoretical frameworks are utilized: the theory of ecological reciprocity, which emphasizes reciprocal dynamics between humans and nature; and the theory of *mubādalah*, which interprets reciprocity as both an ethical and operational principle for constructing harmonious relationships between subjects.

The research was conducted in areas affected by the November 2025 disaster, particularly in North Sumatra, Aceh, and West Sumatra, covering Central Tapanuli, South Tapanuli, Sibolga, and severely degraded upstream zones. Site selection was determined using (Sources: BNPB) data identifying these locations as centers of severe ecological damage and highest disaster risk. Fieldwork was carried out over a three-month period to allow repeated ecological observations and to verify the relationship between land-use practices and disaster intensity.

Primary data were obtained through direct observation of ecological degradation, including upstream deforestation, watershed sedimentation, the conversion of agricultural land into industrial zones, and the condition of environmental infrastructure in the aftermath of the disaster. Field observations involved tracing the sites of flash floods and landslides, mapping changes in forest cover, and documenting visible forms of exploitative human–nature interactions, which were also reflected in official disaster reports and public media coverage. In-depth interviews were conducted with affected residents, village officials, volunteers, religious leaders, and regional disaster-management officers (BPBD) to identify the structural causes of ecological imbalance and to explore the potential application of *mubādalah* principles in local environmental governance. Secondary data were collected from (Sources: BNPB) reports, media sources such as *Koran Jakarta* containing casualty figures and damage maps, publications from UNEP and OECD, as well as literature on Islamic environmental ethics and academic references on ecological reciprocity and global climate change. These documents were accessed through official institutional portals, public repositories, and research archives, thereby reinforcing the validity of the field findings.

Data validity was ensured through source triangulation (Sources: BNPB reports, interviews, observation), technique triangulation (observation, interviews, document study),

and member checking with key informants. These procedures confirmed that descriptions of the disaster, patterns of human–nature imbalance, and perceptions of environmental ethics accurately reflected empirical conditions. Inconsistent data were reconciled through cross-comparison between field findings and documentary sources. Field notes were compiled systematically on a daily basis to record the evolving conditions of disaster sites, community activities, and regional policy responses, enabling transparent traceability of the research process. This effort is essential given that the article emphasizes upstream degradation, land-use conversion, and weak spatial planning as the primary empirical drivers of ecological disasters in Sumatra.

Data analysis employed a thematic approach by categorizing findings into themes of human–nature relational imbalance, structural drivers of disaster, relevant *mubādalah* principles, and opportunities for ecological ethical transformation. All field data were then synthesized with the theory of ecological reciprocity and the *mubādalah* framework to develop the *Mubādalah Ecological Model*, which constitutes the central contribution of this study. This model is constructed through three operational components: (1) Structural Reciprocity, involving spatial-planning reforms, upstream watershed rehabilitation, strengthened oversight of land-use conversion, and mitigation policies grounded in reciprocity; (2) Socio-Cultural Reciprocity, referring to the integration of *mubādalah* ethics into environmental education, mosque sermons, community-based ecological literacy programs, and the strengthening of ecological solidarity; and (3) Spiritual Ethical Reciprocity, which repositions nature as a relational subject endowed with moral value in Islam, as emphasized in the article's assertion that nature is a partner in development rather than an object of exploitation. The integration of these three components produces a practical ecological model that advances environmental governance in Indonesia toward greater justice, inclusivity, and sustainability.

## Results

### *Mubādalah* Between Humans and Nature

The reciprocal relationship between humans and nature implies that neither exists as an isolated entity; rather, both form an interconnected ecological unity in which human actions affect the environment, and ecological processes in turn shape human life (Estrada et al., 2022). Within this relationship, humans are not merely consumers of natural resources but also stewards and protectors of ecosystems roles that reflect a bidirectional, interdependent form of interaction (Rozzi, 1999). This notion of reciprocity provides a normative foundation for maintaining ecological balance, resisting exploitative logics, and promoting sustainability. In an era marked by global ecological crisis, the paradigm of reciprocity becomes increasingly relevant as an alternative to anthropocentric modes of domination over nature (Hess, 2024).

In the Islamic tradition, this idea is closely aligned with the concept of *mubādalah*, which literally denotes exchange or mutuality and emphasizes relations of giving and receiving within a framework of justice, balance, and moral responsibility (Rulke et al., 2020). In the context of human–nature relations, *mubādalah* positions nature not as a mere object but as a relational entity endowed with moral significance and entrusted to human care (McKay et al., 2014). Accordingly, humans as *khalīfah* (vicegerents) on earth bear the responsibility to preserve, rather than exploit arbitrarily (Gade, 2015). This concept has been articulated in modern Islamic literature through ecotheological approaches that link religious values with ecological responsibility (Syihabuddin et al., 2023)

Theoretically, *mubādalah* offers an important ethical framework for understanding human–nature relations through the lens of mutuality. The term derives from the verb *bādala*, meaning to exchange, reciprocate, or respond equivalently. In contemporary thought, it has been popularized by Faqihuddin Abdul Qadir (UIN Cirebon), who underscores *mubādalah* as a principle of reciprocity between one subject and another whether between humans or

between humans and other living beings, including nature (Kodir, 2019). Abdul Qadir asserts that *mubādalah* provides a method for interpreting Islamic texts through the perspectives of mutuality (Abdul Kodir, 2019), justice, and balance, recognizing all parties as equal partners within both social and ecological relationships (Qodir, 2019).This approach broadens the horizon of Islamic ethics beyond gender relations to encompass wider ecological relations (Hermanto, 2022).

The legal and theological basis for applying *mubādalah* to environmental contexts is grounded in Islamic law, which affirms that nature is a divine creation that must be protected and not subjected to corruption, in accordance with the principles of *amānah* (trusteeship) and *mīzān* (cosmic balance) found in the Qur'an and Sunnah, as well as in the doctrine of *fiqh al-bi'ah* (environmental jurisprudence) formulated in response to modern ecological crises (Zuhdi, 2015). This theological framework establishes a normative foundation wherein humans possess no absolute dominion over nature but rather hold obligations to maintain and preserve the continuity of life for all creation.

Conceptually, the operational mechanism of *mubādalah* within human–nature relations comprises three principal dimensions (Saniotis, 2012a). First is the structural dimension, which entails regulating the use of natural resources in a fair and balanced manner. Second is the socio cultural dimension, which involves internalizing values of mutuality, responsibility, and respect for nature within community practices. Third is the spiritual dimension, which recognizes nature as a divine creation endowed with moral dignity, while humans, as *khalīfah*, bear the responsibility of fulfilling the trusteeship of environmental care.

This approach is not merely reflective but also practical through sustainable agriculture, forest conservation, ecosystem restoration, and environmental policies that prioritize ecological balance. Contemporary studies have shown that *mubādalah* and *fiqh al-bi'ah* can serve as both normative and operational frameworks for reconstructing human–nature relations in more just and sustainable ways (Arifullah et al., 2024).

In the context of the current ecological disaster in Sumatra, the *mubādalah* approach demands a paradigmatic transformation: from environmental exploitation to ecosystem care; from uncontrolled development to ecologically sensitive planning; and from a dominative human–nature relationship to one in which humans act as responsible *khalīfah* (Rambe et al., 2021). When these principles of reciprocity are applied, upstream watershed degradation, deforestation, aggressive land conversion, and spatial-planning violations factors that trigger landslides and floods can be prevented or at least significantly reduced. Thus, *mubādalah* functions not merely as a moral concept but also as an ethical and regulatory instrument for building ecological resilience, environmental justice, and long-term sustainability. In this regard, the *mubādalah* perspective provides a robust theoretical and ethical foundation for reconstructing human–nature relations in the aftermath of ecological crises .

**Ecological Disaster Data in Sumatra and Patterns of Human–Nature Imbalance**

The findings reveal that the floods and landslides that struck Sumatra from late November to mid-December 2025 constitute one of the most destructive ecological disasters in Indonesia's recent history. According to the latest official reports from the *Badan Nasional Penanggulangan Bencana* (BNPB), the combined death toll from floods and landslides across Aceh, North Sumatra, and West Sumatra has now exceeded 1,050 fatalities, with more than 200 persons still reported missing and thousands injured as direct consequences of the disaster, reflecting both the scale and severity of the event (Sources: BNPB, 2025).

As of 17 December 2025, the BNPB dashboard recorded 1,053 confirmed deaths, 200 missing persons, and an expanding number of injured and displaced residents in dozens of affected districts and cities, illustrating the profound human cost of the disaster (Sources: Databoks Katadata, 2025; Konteks.co.id, 2025).

The disaster also caused extensive infrastructure damage and displacement, with verified field data indicating that more than 147,000 homes sustained damage ranging from light to severe, including tens of thousands of destroyed public facilities and critical infrastructure across the three provinces (Sources: BNPB, 2025).

These updated figures demonstrate that the event cannot be characterized as an ordinary hydrometeorological episode; rather, it represents a multidimensional ecological crisis marked by severe disruptions to human ecosystem dynamics, widespread loss of life, and systemic vulnerability of affected communities. The magnitude of losses underscores the urgent need for integrated socio-ecological governance frameworks that address the underlying drivers of environmental degradation and disaster risk in Sumatra.

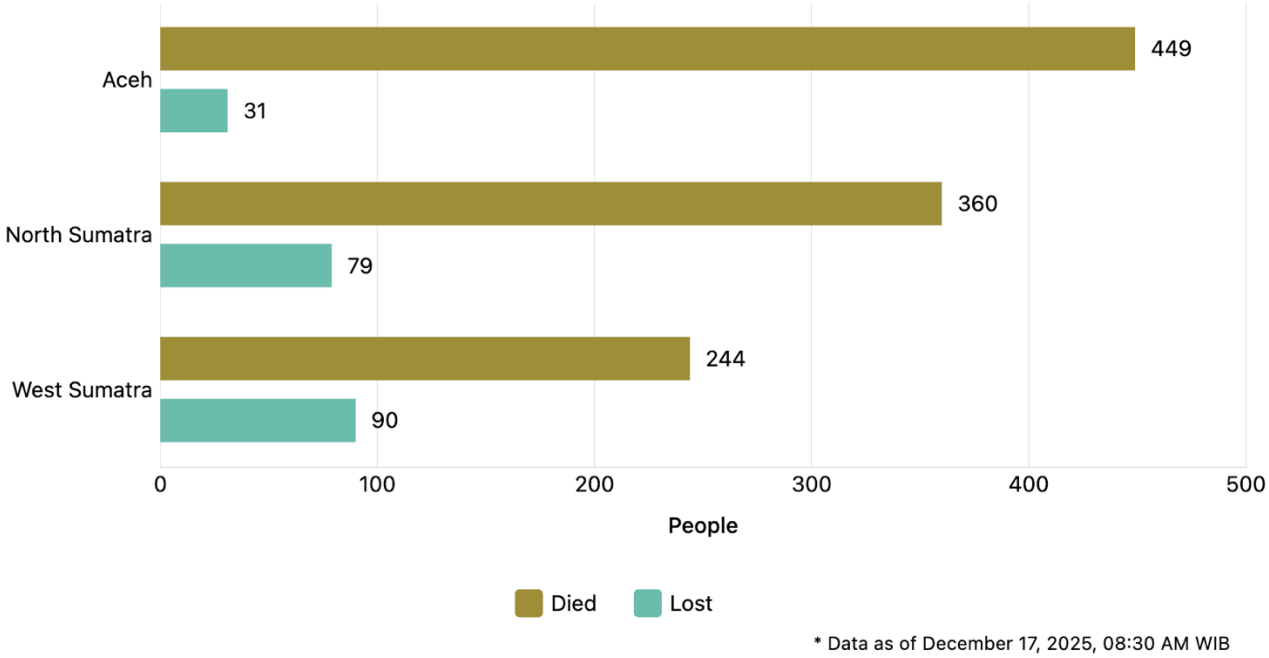


**Image:** Number of Deaths and Missing Persons Due to the Sumatra Disaster (December 17, 2025)

Analysis of the data and field observations further demonstrates that the epicenters of the disaster were located in areas experiencing the most severe ecological degradation, particularly in the upstream regions of northern Sumatra's watersheds. The most significant damage occurred in Central Tapanuli Regency, especially in Barus District, Manduamas District, and villages such as Sorkam Kanan and Sorkam, all of which lie along water runoff pathways from heavily deforested upstream zones over the past decade (Sources: *BNPB*, 2025; *Kompas*, 2025). In South Tapanuli Regency, the most affected areas included Angkola Barat and Saipar Dolok Hole Districts, where sequential landslides were triggered by altered soil structures and the loss of stabilizing vegetation.

Meanwhile, in Sibolga City, flash floods devastated dense residential areas in Aek Manis and Aek Parombunan, illustrating the rising vulnerability of communities living in high-risk flood zones as a result of uncontrolled settlement expansion (Sources: *Detik.com*, 2025). Other regions, such as Mandailing Natal particularly Ulu Pungkut and Pahae Jae Districts experienced complete isolation due to the collapse of road networks and bridges. Collectively, these findings reveal spatial patterns consistent with areas identified in previous analyses as possessing the most severe upstream ecological degradation.

Moreover, updated official data indicate the human toll of these events has increased dramatically, reflecting both the scope of ecological disruption and the vulnerability of exposed populations. According to the latest reports from the *Badan Nasional Penanggulangan Bencana* (BNPB), as of mid-December 2025 the combined death toll from floods and landslides in Aceh, North Sumatra, and West Sumatra has exceeded 1,050 fatalities,

with an estimated 200 persons still missing and thousands more injured, while hundreds of thousands of residents remain displaced across dozens of affected districts and cities (Sources: *BNPB, 2025*).

Housing and infrastructure damage is extensive, with open-field assessments documenting tens of thousands of damaged homes and public facilities. The spatial coincidence of the highest casualty figures with areas of documented ecological degradation underscores the systemic risks created by upstream deforestation, land-use change, and watershed destabilization, and highlights the urgent need for integrated socio-ecological governance to mitigate future disasters (Sources: Detik.com).

These empirical findings are further reinforced by field observations and in-depth interviews with key informants. A BPBD volunteer in Central Tapanuli noted that "the water from the upstream came down like a massive wave, no longer like a normal river flow, because the upper catchment is almost entirely deforested" (Interview, Informant A, 2025). This statement confirms the theory of ecological reciprocity, which posits that upstream degradation particularly deforestation, severe sedimentation, and large-scale land-use conversion intensifies extreme hydrological responses even when rainfall levels are not exceptionally high (J. Fan et al., 2021).

The study also recorded that many affected settlements were located in red zones on official disaster-risk maps, including active riverbanks and slopes with gradients exceeding 30 degrees. A village officer in Angkola Barat explained that residents "are forced to build houses near the river because flat land is no longer available; everything has become plantations" (Interview, Informant B, 2025). These findings are aligned with UNEP (2022) and Hidayat et al. (2023), who argue that deviations from environmentally grounded spatial planning accelerate and intensify the impacts of hydrometeorological disasters.

From a socio-cultural perspective, the study found that most affected communities continue to perceive nature primarily as an object of economic utility rather than as a relational entity possessing ecological rights. This is reflected in interviews with a local religious leader who remarked that "nature is provided to benefit humans, as long as humans do not take excessively" (Interview, Informant C, 2025). Such views reflect an anthropocentric paradigm that stands in contrast to the ethic of reciprocity embodied in *mubādalah*, which situates humans and nature within a balanced, mutual relationship (Abdullah, 2021).

However, the research also identified local wisdom that may serve as an integrative bridge, such as the Mandailing customary principle of "*protect the upstream, protect the downstream*," expressed by an adat leader (Interview, Informant D, 2025). This indigenous principle is substantially consistent with the ecological reciprocity embedded in *mubādalah* and may serve as a socio-cultural foundation for developing a more just ecological model.

Taken together, these findings demonstrate that the ecological disasters in Sumatra cannot be understood merely as natural phenomena but rather as the accumulated outcome of failed reciprocal relations between humans and the natural environment. The loss of upstream vegetation, uncontrolled land-use conversion, violations of spatial planning, anthropocentric ecological perceptions, and weak disaster-risk management have collectively produced conditions in which socio ecological systems are highly vulnerable to collapse.

This disaster serves as empirical evidence that development practices disregarding ecological reciprocity not only degrade the environment but also threaten the survival of human communities. These findings reaffirm the urgency of adopting an ecological *mubādalah* framework as an ethical and policy-based approach for establishing more just, sustainable, and resilient environmental governance.

**Table 1.** Quantitative Data on the Impact of the Sumatra Flood Landslide Disaster (Nov–Dec 2025)

| Impact Category | Quantitative Data (Latest Update) | Source |
|---|---|---|
| Fatalities | 1,053 deaths (confirmed) | *BNPB*, 17 Dec 2025 |
| Missing persons | 200 persons still missing | *BNPB*, 17 Dec 2025 |
| Injured | Thousands injured (ongoing update) | *BNPB*, 17 Dec 2025 |
| Total affected population | > 3.3 million people affected | *BNPB*, 17 Dec 2025 |
| Displaced persons | Nearly 1 million displaced | *BNPB*, 17 Dec 2025 |
| Damaged houses (light–severe) | ~147,000 homes damaged | *INP Polri*, 2025 |
| Damaged bridges | Hundreds of bridges collapsed | *INP Polri*, 2025 |
| Damaged public facilities (incl. schools) | Tens of thousands damaged | *INP Polri*, 2025 |

The data presented in Table 1 demonstrate that the flood and landslide disaster in Sumatra constitutes a large-scale ecological catastrophe with multidimensional impacts on human safety, infrastructure, and social systems. The updated casualty figures 1,053 confirmed deaths and 200 still missing reflect a significantly higher mortality rate than earlier media estimates, underscoring the evolving nature of the crisis and the challenges of identification and reporting in inaccessible areas (Sources: *Databoks Katadata*, 2025).

The sheer number of displaced persons (nearly one million) and the broad distribution of injured individuals indicate widespread social disruption beyond immediate mortality. The catastrophic scale of physical destruction evidenced by the damage to approximately 147,000 homes, hundreds of collapsed bridges, and tens of thousands of public facilities including schools confirms that structural collapse has been pervasive and severe (*INP Polri*, 2025). This extensive material damage carries implications not only for emergency response but also for long-term recovery and resilience building. Collectively, these updated data illustrate an extremely high level of ecological and social vulnerability, reinforcing the strong correlation between upstream ecological degradation and the intensifying severity of hydrometeorological disasters across Sumatra.

**Table 2.** Research Locations and Levels of Disaster Impact
Sources: Kompas.com (2025); Detik.com (2025); Field Observation (2025); BNPB (2023)

| Regency/City | Affected Subdistricts/Villages | Type of Disaster | Impact Level | Data Sources |
|---|---|---|---|---|
| Tapanuli Tengah | Barus, Manduamas, Sorkam Village, Sorkam Kanan Village | Flash flood | Very severe | Kompas (2025); Detik (2025) |
| Tapanuli Selatan | Angkola Barat, Saipar Dolok Hole | Landslides & riverbank flooding | Severe | BNPB (2023) |
| Sibolga City | Aek Manis Subdistrict, Aek Parombunan | Flash flood | Severe–Very severe | Detik (2025) |
| Mandailing Natal | Ulu Pungkut, Pahae Jae | Major landslides; transportation cut off | Moderate–Severe | Field observation (2025) |

| | | | | |
|---|---|---|---|---|
| Tapanuli Utara | Pahae Julu, Pahae Jae | Landslides & flooding | Moderate | BNPB (2023) |

Table 2 provides a comprehensive overview of the spatial distribution of affected areas and the corresponding levels of disaster severity, demonstrating that the greatest impacts were concentrated in regions situated along runoff pathways and river channels originating from upstream zones that have undergone extensive ecological degradation. Subdistricts such as Barus, Manduamas, Angkola Barat, and Saipar Dolok Hole are geomorphologically vulnerable due to their steep slopes and riverbank locations, where soil structure has been altered by prolonged deforestation and land-use conversion. Sibolga City, characterized by its coastal morphology and dense settlements, experienced severe flash flooding exacerbated by land-use incompatibilities within its urban spatial planning. Meanwhile, areas such as Ulu Pungkut and Pahae Jae illustrate infrastructural vulnerability in mountainous regions, where landslides triggered total isolation due to disrupted transportation networks. The geographic distribution of impacts makes clear that the disaster did not occur randomly; rather, it followed a spatial pattern aligned with ecological degradation and maladaptive land-use practices.

**Table 3.** Upstream Watershed Ecological Degradation and Its Relationship to Disaster Impacts
Sources: Field Observation (2025); BNPB (2023)

| Upstream Location | Type of Ecological Degradation | Field Indications | Hydrological Consequences |
|---|---|---|---|
| Upper Watershed of Tapanuli Tengah | Deforestation over the past 5–10 years | Loss of tree cover, heavy sedimentation | Extreme flash floods |
| Upper Mandailing Natal | Land-use conversion to plantations | Exposed soil, slope fissures | Sequential landslides |
| Upper Sibolga–Tapanuli Tengah | Loss of protective vegetation | Thinning riparian vegetation | Rapid flood surges |
| Upper Angkola Raya | Slope vegetation clearing | Bare slopes, erosion | Muddy flooding |

Table 3 illustrates the causal relationship between upstream ecological degradation and the increasing disaster risks, confirming that deforestation, severe sedimentation, and the loss of protective vegetation have direct impacts on hydrological dynamics. Deforestation occurring over the past 5–10 years in the upstream region of Tapanuli Tengah has intensified surface runoff, which subsequently escalated into destructive flash floods. Similar patterns are evident in Mandailing Natal and Sibolga, where extensive land-use conversion has reduced soil cohesion, triggering large-scale landslides. These findings align with the theory of *ecological reciprocity*, which posits that disturbances in upstream ecosystems produce immediate repercussions for the stability of downstream ecological systems. The table demonstrates that the disasters were not merely the result of high rainfall, but rather the cumulative outcome of ecological degradation that has disrupted the balance between humans and the natural environment.

**Table 4.** Spatial-Planning Incompatibilities and Their Effects on Community Vulnerability Sources: Field Observation (2025); Hidayat et al., 2023; UNEP, 2022

| Type of Spatial-Planning Incompatibility | Location | Field Indications | Impact |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Settlements along riverbanks | Barus, Manduamas | Houses < 5 meters from river edge | Flash floods destroying settlements |
| Settlements on slopes > 30° | Angkola Barat, Saipar Dolok Hole | Slope fissures, minimal vegetation | Major landslides |
| High-density housing in flood zones | Sibolga (Aek Manis) | Adjacent houses without drainage | Widespread structural damage |
| Infrastructure built in hazard zones | Ulu Pungkut | Roads near steep escarpments | Complete access disruption |

Table 4 reveals that spatial-planning incompatibilities play a critical role in exacerbating disaster impacts. Settlements constructed along riverbanks and steep slopes reflect a condition of structural compulsion, where communities are forced to occupy unsafe areas due to limited access to viable land, while large-scale plantation expansion has appropriated the majority of productive space. High-density housing in flood-prone zones such as Sibolga further heightens disaster sensitivity due to the lack of water absorption areas and the absence of adequate drainage systems. Public infrastructure built within hazard-prone zones demonstrates weak disaster-mitigation governance and the insufficient integration of ecological knowledge in spatial planning. Collectively, the table indicates that spatial planning incompatibilities not only intensify community vulnerability but also hinder evacuation processes, impede recovery efforts, and undermine long-term environmental sustainability.

**Table 5.** Community Ecological Perceptions and Their Relevance to *Mubādalah* Ethics

Source: Informant Interviews A–D (2025); Abdullah, 2021

| **Type of Perception** | **Interview Findings** | **Alignment with *Mubādalah*** | **Socio-Ecological Implications** |
|---|---|---|---|
| Nature as an object | "Nature exists for human use." (Informant C) | Not aligned | Increased exploitation |
| Nature as a partner | "If the upstream is damaged, the valley is damaged." (Informant D) | Aligned | Potential integration of local values |
| Nature as a threat | "Water came down like a massive wave." (Informant A) | Partial | Increased risk awareness |
| Nature as a source of life | "We depend on the forest, but the forest keeps disappearing." (Informant B) | Partial | Emerging motivation for conservation |

Table 5 illustrates diverse community perceptions of nature, each of which directly shapes how individuals interact with their environment. The perception of nature as an economic object represents the dominant paradigm and stands in contrast to *mubādalah* ethics, which frame nature as a relational partner within a reciprocal moral relationship. Nevertheless, several interviews reveal the existence of local wisdom that supports ecological reciprocity, such as the Mandailing proverb "protect the upstream, protect the valley," which remains embedded in communal traditions. These differing perceptions influence the levels of awareness, attitudes, and behaviors related to environmental stewardship. The data underscores that the success of the *mubādalah* ecological model depends significantly on how the principle of reciprocity can be integrated with local wisdom and revitalized within social practice.

**Table 6.** Integration of Empirical Findings and Theoretical Frameworks
Sources: Research Analysis (2025); Abdullah (2021); Fan et al. (2020); UNEP (2022)

| Field Findings | Related Theory | Alignment / Misalignment | Description |
|---|---|---|---|
| Upstream degradation → extreme flooding | Ecological Reciprocity Theory | Aligned | Upstream degradation intensifies extreme hydrological responses |
| Settlements in red zones | Ecological Justice | Misaligned | Communities are exposed to high disaster risks |
| Nature as an object | *Mubādalah* Ethics | Misaligned | Anthropocentric paradigms remain dominant |
| Local wisdom "protect the upstream" | *Mubādalah* (Reciprocity) | Aligned | Potential for integrating local values |
| Non-adaptive infrastructure | Climate Vulnerability Theory | Aligned | Infrastructure is not disaster-resilient |

Table 6 presents a synthesized integration between empirical field findings and the theoretical frameworks applied in the study. The direct relationship between upstream degradation and extreme flooding reinforces the ecological reciprocity theory, while spatial-planning incompatibilities affirm the relevance of ecological justice theory. The misalignment between community perceptions and *mubādalah* ethics explains the persistence of natural resource exploitation, whereas the presence of certain indigenous values indicates promising opportunities for applying reciprocal ecological practices. Collectively, the table demonstrates that disasters are not solely physical phenomena but reflections of systemic failures in environmental governance, ecological perception, and development structures. The alignment between empirical findings and theoretical insights strengthens the necessity of formulating the *Mubādalah Ecological Model* as both a normative framework and an operational tool for achieving ecological justice.

## Discussion

### Ecological Imbalance and the Relevance of *Mubādalah*

The floods and landslides that struck Sumatra in late November and early December 2025 represent one of the most destructive ecological disasters in Indonesia's contemporary disaster history. Ecological imbalance refers to a condition in which the functions, structures, and services of an ecosystem are disrupted to the extent that they can no longer provide ecological or social support sustainably (Rogger et al., 2017). Operationally, this imbalance is manifested in upstream deforestation, excessive sedimentation along river channels, large-scale land conversion, soil degradation, and declining biodiversity phenomena that heighten vulnerability to hydrometeorological hazards such as floods and landslides (Bradshaw et al., 2007)

These findings correspond with ecological reciprocity theory, which posits that damage to one component of an ecosystem triggers reactive responses in the environment through hydrological, geomorphological, and biological shifts that may threaten human safety. Such imbalance is not solely biophysical but is also shaped by social structures and policy conditions, including weak spatial planning control, economic pressures on local communities, and production practices driven by short-term profit motives. Understanding ecological imbalance therefore requires a cross-disciplinary approach that links ecological

processes to the institutional, social, economic, and spatial dynamics that underlie them. In the context of Sumatra, ecological imbalance has been exacerbated by inadequate regulatory enforcement, socioeconomic pressure on land use, and expansion strategies that disregard ecological carrying capacity (Y. Fan et al., 2022).

The ecological degradation identified in upstream watershed areas and landslide-prone zones reflects a failure to apply the principles of ecological spatial planning theory. This theoretical framework emphasizes that spatial planning must account for ecological capacity, land sensitivity, and ecosystem service functions as foundational considerations in the organization of space (Ahern, 2013).In practice, however, many upstream regions in Sumatra have been converted into monoculture plantations; settlements have been constructed on steep slopes; and river corridors no longer possess adequate ecological buffer zones. Systematic violations of ecological spatial planning principles diminish the ecosystem's ability to absorb runoff, maintain soil permeability, and control erosion thereby intensifying flood and landslide events. Accordingly, the ecological imbalance observed in the Sumatra disaster is not merely a biophysical phenomenon but also a structural failure in spatial governance that lacks grounding in ecological principles.

Within the normative and ethical domain, the *mubādalah* perspective offers a critical framework for understanding and responding to ecological imbalance. Conceptually, *mubādalah* refers to reciprocal relations between humans and nature that demand justice, protection, and ecological responsibility. In Islamic environmental ethics, humans are obligated to uphold *amānah* (moral stewardship), maintain *mīzān* (ecological balance), and avoid *fasād* (destruction), which is explicitly prohibited in theological sources (Zuhdi, 2015).

Contemporary thought by Faqihuddin Abdul Qadir (2019) emphasizes that *mubādalah* is not merely a moral concept but an operational principle that can be applied to environmental policy such as obligations for ecosystem restoration, equitable distribution of environmental benefits, and the protection of vulnerable communities. In the context of the Sumatra disaster, this perspective underscores that ecological destruction constitutes a "reciprocal response" to a broken relational ethic: when humans extract more from nature than they protect, nature responds through ecological instability.

The integration of *mubādalah*, ecological reciprocity theory, and ecological spatial planning theory provides a robust conceptual foundation for formulating disaster mitigation and adaptation strategies in Indonesia. Practically, the application of *mubādalah* can be translated into upstream watershed restoration policies, strengthened zoning based on ecological carrying capacity, and ecological compensation mechanisms for degraded regions.

At the socio-cultural level, *mubādalah* may be internalized through religion-based environmental education, the revitalization of local ecological wisdom, and the enhancement of community participation. On a technical level, *mubādalah* encourages the adoption of agroforestry systems, riparian zone rehabilitation, and co-management frameworks involving government agencies, Indigenous communities, and the private sector (Syihabuddin et al., 2023). When these reciprocal values are integrated with ecological spatial planning, environmental policies shift from reactive approaches toward preventive strategies that are just, adaptive, and sustainable.

### *Mubādalah* as an Analytical Framework for Human–Nature Relations

The concept of *mubādalah* offers an analytical framework that is highly relevant for understanding and evaluating human–nature relations in an ethical, reciprocal, and justice-oriented manner. Semantically, *mubādalah* refers to the principles of reciprocity, balance, and shared responsibility between two entities. In ecological contexts, this principle underscores that humans and nature do not exist within a hierarchical structure but within reciprocal relations in which each influences and protects the other.

As emphasized by Faqihuddin Abdul Qadir (2019), *mubādalah* requires a reinterpretation of human. environment relations, shifting from dominative exploitative patterns toward cooperative and egalitarian ones. This perspective aligns with ecological ethics that position humans as integral components of the ecosystem, not external actors who merely extract benefits from it (Zuhdi, 2015). Accordingly, *mubādalah* serves as an ethical foundation for interpreting contemporary ecological crises, including the 2025 disaster in Sumatra.

Ecological reciprocity theory strengthens the relevance of *mubādalah* by asserting that every human action toward the environment produces a corresponding response from the ecosystem. When humans repair, care for, and maintain ecological balance, nature responds through hydrological stability, sustained resource availability, and optimal ecosystem functioning. Conversely, when humans exert excessive pressure such as through deforestation, illegal land conversion, and violations of spatial planning nature responds through intensified floods, landslides, erosion, and biodiversity loss (Berkes, 2017).

Empirical findings from the Sumatra disaster which resulted in 631 deaths, 472 missing persons, and millions affected demonstrate a pattern of negative reciprocity: destructive human practices in upstream watersheds generated extreme ecological instability (Sources: Kompas, 2025; Detik.com, 2025). The *mubādalah* framework enables this pattern to be interpreted as a breakdown of reciprocal relations, indicating that solutions must simultaneously encompass ethical, ecological, and social restoration.

Ecological spatial planning theory provides the technical foundation for translating these reciprocal principles into policy and spatial governance. The theory emphasizes that spatial organization must account for ecological sensitivity particularly in upstream areas, river corridors, steep slopes, and absorption zones which must be protected through spatial designs grounded in ecological carrying and holding capacity (Ahern, 2013). In the case of Sumatra, spatial planning failures are evident in the conversion of upstream regions into monoculture plantations, the construction of settlements on slopes exceeding 30°, and the loss of riparian vegetation that functions as a natural flood buffer. These mismatches reflect the absence of ecological spatial planning principles in regional policies, resulting in increased surface runoff, erosion, and soil instability (Hidayat et al., 2023). By integrating *mubādalah* into ecological spatial planning theory, spatial governance becomes not only technical and administrative but also infused with the ethical values of reciprocity and ecological justice.

As an analytical framework, *mubādalah* can be employed to reinterpret human–nature relations through three dimensions: (1) reciprocal action, which posits that every human behavior toward the environment directly affects ecological conditions; (2) reciprocal benefit, which requires that environmental management generate ecological advantages for both humans and nature simultaneously; and (3) reciprocal protection, which emphasizes that safeguarding the environment is equivalent to safeguarding the sustainability of human life itself (Arifullah et al., 2024).

These three dimensions provide a more holistic lens for understanding the root causes of ecological disasters. For example, upstream deforestation in Sumatra's watersheds is not merely a technical violation of spatial planning but a violation of ecological reciprocity because it damages hydrological structures that should protect surrounding communities. Thus, *mubādalah* offers an ethical and normative framework for understanding ecological disasters as the logical consequence of humanity's failure to fulfill its reciprocal obligations toward nature.

The integration of *mubādalah*, ecological reciprocity theory, and ecological spatial planning also paves the way for formulating public policies that are more responsive to ecological risks. Within policy frameworks, *mubādalah* may be translated into obligations for ecological restoration, the strengthening of watershed buffer zones, prohibitions on

development in ecologically sensitive areas, and ecological compensation mechanisms for regions suffering environmental degradation.

Moreover, *mubādalah* can serve as a paradigm for promoting co-management arrangements between the state, Indigenous peoples, and local communities that possess valuable ecological knowledge. This approach not only repairs damaged human–nature relations but also enhances the social ecological resilience of disaster-affected communities (Syihabuddin et al., 2023). These insights demonstrate that *mubādalah* can function as an effective bridge between ecological theory and practical policy.

Overall, the application of *mubādalah* as an analytical framework for human–nature relations yields several important implications. First, this study affirms that ecological disasters are not merely technical failures but also ethical and structural failures within human–nature relations. This implication is significant because it encourages a paradigm shift in environmental governance from an exploitative orientation toward ecological reciprocity. Second, the findings of this study could be dangerous if ignored, as they indicate that environmental responses to ecological degradation will become increasingly extreme as ecosystem imbalances intensify.

Third, in contrast to previous studies that largely focused on biophysical factors or spatial planning alone, this research offers a unique novelty through its integration of Islamic ethics of reciprocity (*mubādalah*) with ecological reciprocity theory and ecological spatial planning. This contributes new theoretical insights to Islamic ecotheology and environmental governance scholarship. Fourth, in causal terms, the findings demonstrate that ecological destruction in Sumatra is the consequence of a broken reciprocal relationship between humans and nature; conversely, ecological restoration can only occur if reciprocal principles are reinstated within policies, social behaviors, and spatial design. Accordingly, *mubādalah* is not only normatively relevant but also scientifically and practically significant as an analytical framework for constructing more just and sustainable environmental governance.

## The *Mubādalah* Ecological Model for Sustainable Environmental Governance

The *Mubādalah* Ecological Model is formulated as an integrative framework that synthesizes ethical theological, ecological, spatial, and institutional dimensions to reconstruct a reciprocal human–nature relationship. Conceptually, this model places the principle of *mubādalah* (reciprocity) as the central normative foundation guiding all policies and practices of resource management. The obligations of *amānah* (trusteeship), the maintenance of *mīzān* (balance), and the prohibition of *fasād* (environmental degradation) function as ethical pillars that bind both public and private actions (Qadir, 2019; Harfin Zuhdi, 2024).

Theoretically, the model integrates the principle of ecological reciprocity which highlights the reciprocal relationship between human actions and ecosystem responses with ecological spatial planning that requires land-use arrangements to be aligned with ecological capacity and sensitivity (Berkes, 2017; Ahern, 2013). This integration of religious values and ecological theory allows the model to operate not only at a normative level but also at an operational level, enabling translation into concrete policies, technical programs, and social interventions.

The operational structure of the *Mubādalah* Model rests on three interrelated pillars: (1) the Legal Policy Pillar, which regulates obligations for ecological restoration, watershed carrying-capacity zoning, and ecological compensation mechanisms; (2) the Technical Practices Pillar, which implements upstream rehabilitation, agroforestry, riparian buffers, and soil conservation techniques to reduce run-off and erosion; and (3) the Socio Cultural Pillar, which internalizes the value of reciprocity through religious education, the strengthening of local knowledge systems, and community participation in resource co-management. These pillars are further supported by institutional mechanisms such as cross-sectoral coordination, green financing instruments (e.g., regional green bonds, payment for ecosystem services), and

real-time, spatially informed participatory monitoring systems (Hidayat, Syah, & Erianjoni, 2023; Arifullah et al., 2024). Within this model, the *mubādalah* norm functions as an evaluative criterion: policies and projects are assessed not only in terms of economic efficiency but also in relation to their fulfillment of ecological reciprocity and the equitable distribution of benefits.

The action plan for implementing the *Mubādalah* Ecological Model is structured into integrated short-, medium-, and long-term stages. The short-term actions (0–1 year) include: (a) conducting damage assessments of priority upstream watersheds; (b) imposing a moratorium on land-use conversion permits in ecologically sensitive areas; and (c) launching public campaigns that integrate religious and scientific messages of *mubādalah* through mosques, *pesantren*, customary leaders, and local media to enhance public awareness of human–nature reciprocity (Syihabuddin et al., 2023). Medium-term actions (1–3 years) include: (d) drafting regional regulations incorporating mandatory restoration clauses and ecological compensation; (e) initiating agroforestry and riparian-restoration pilot projects with the involvement of farmer groups and NGOs; and (f) establishing local financing schemes for restoration (green bonds / PES) (Habib & Saeed, 2025).

Long-term actions (>3 years) focus on integrating ecological spatial planning into regional land-use plans (RTRW), strengthening co-management systems, and institutionalizing monitoring frameworks based on socio-environmental indicators such as forest cover, erosion rates, peak discharge, and household economic resilience. Each phase is accompanied by SMART indicators (Specific, Measurable, Achievable, Relevant, Time-bound) and participatory evaluation mechanisms.

The implementation of this model requires evidence-based and culturally resonant communication strategies and public campaigns an essential *lesson learned* from disaster-response experiences. Public campaigns must juxtapose *mubādalah* ethical messages with scientific evidence on the benefits of ecological restoration (e.g., reduced flood frequency, enhanced ecosystem services) to ensure broader acceptance across diverse actors, including religious institutions, customary authorities, government agencies, and the private sector. Monitoring and evaluation encompass ecological indicators (such as the percentage of upstream rehabilitation, reductions in sedimentation rates, and improvements in land cover), socio-economic indicators (including the reduction of disaster casualties and increases in household income among communities adopting sustainable practices), and policy indicators (such as the number of regulations containing restoration clauses and the volume of green financing mobilized).

Previous studies on integrating religious norms into environmental governance indicate that moral legitimacy tends to accelerate compliance and community participation. Therefore, the *novelty* of this model lies in its systematic combination of *mubādalah* norms, ecological reciprocity theory, and ecological spatial planning as a foundation for measurable action (Arifullah et al., 2024; Qadir, 2019). Consequently, the *Mubādalah* Ecological Model functions not merely as an academic framework but also as a pragmatic roadmap for reducing disaster risk, restoring ecosystem functions, and constructing just and sustainable environmental governance systems.

**Table 7.** Action Plan of the *Mubādalah* Ecological Model for Sustainable Environmental Governance

| Action Plan | Measurable Indicators | Numerical Targets | Timeframe |
|---|---|---|---|
| Ecological audit of priority upstream watersheds | Number of watersheds audited | ≥ 10 priority watersheds in Sumatra | 0–12 months |

| | | | |
|---|---|---|---|
| Moratorium on land-conversion permits in sensitive zones | Moratorium policy document | 100% suspension of new permits in high-risk zones | 0–12 months |
| *Mubādalah*-based public campaigns (mosques, *pesantren*, customary institutions, local media) | Frequency of activities and number of participants | At least 50 campaigns involving ≥ 10,000 participants | 0–12 months |
| Drafting ecological zoning regulations based on carrying capacity | Issued regional regulations | ≥ 3 regulations in priority provinces/districts | 12–36 months |
| Upstream watershed restoration programs (reforestation, agroforestry, riparian buffers) | Total rehabilitated area | At least 5,000 ha of forest and riparian zones restored | 12–36 months |
| Implementation of co-management (government–customary institutions–local communities) | Number of co-management agreements | ≥ 15 formal agreements at village/urban-village level | 12–36 months |
| Sustainable agroforestry pilot projects | Number of farmer groups involved | ≥ 30 farmer groups | 1–3 years |
| Green financing (green bonds, PES) | Volume of funds mobilized | ≥ IDR 150 billion allocated for restoration | 1–3 years |
| Riparian-zone rehabilitation for flood control | Length of restored river corridors | ≥ 120 km of riparian zones restored | 1–3 years |
| Real-time spatial participatory monitoring system | Active monitoring dashboard | Dashboard accessible to ≥ 5 institutions | > 3 years |
| Integration of ecological spatial planning into regional land-use plans (RTRW) | Revised RTRW documents | ≥ 4 district/city RTRWs aligned with ecological principles | > 3 years |
| Evaluation of ecological and social indicators | Reduction in erosion and increase in land cover | 20% reduction in erosion and 15% increase in land cover | > 3 years |
| Community capacity building (mitigation and adaptation training) | Number of training sessions | ≥ 120 training sessions in 3 years | 0–36 months |
| Ecological compensation mechanisms (for watershed-affected villages) | Number of beneficiary villages | ≥ 50 villages receiving compensation | > 3 years |
| Law enforcement on violations of ecological spatial planning | Number of cases processed | ≥ 30 cases of illegal logging/conversion prosecuted | > 3 years |

The action plan of the *mubādalah* ecological model, as illustrated in the table, demonstrates a comprehensive and measurable implementation framework for advancing sustainable environmental governance through the synergy of reciprocity based values, ecological approaches, and policy instruments. Each step is articulated through measurable indicators and realistic numerical targets, ranging from ecological audits of upstream watersheds, moratoriums on permits in sensitive zones, and *mubādalah*-based public campaigns to the formulation of regional regulations on ecological zoning and the implementation of restoration programs in critical areas.

The model also encourages the adoption of co-management arrangements involving government agencies, customary communities, and local stakeholders, while providing green-financing mechanisms to ensure the long-term sustainability of restoration initiatives. Moreover, the integration of ecological spatial planning into revised regional land-use plans (RT-RW) and the strengthening of spatial data driven monitoring systems render this model not merely normative but operational and evidence-based. Accordingly, the action plan serves as a strategic roadmap to address ecological degradation, reduce disaster risks, and institutionalize reciprocal humannature relations within environmental governance practices.

## Conclusion

This study asserts that the imbalance in human–nature relations in Indonesia particularly in Sumatra constitutes a structural condition shaped by a combination of upstream ecological degradation, dysfunctional spatial planning, and development paradigms that position nature as an object of exploitation rather than a relational partner. An analysis grounded in ecological reciprocity theory indicates that the floods and landslides occurring in late 2025 should not be viewed merely as extreme hydrometeorological events; instead, they represent the cumulative manifestation of disrupted ecological reciprocity mechanisms that have long regulated the balance between human activities and the regenerative capacity of ecosystems. Through the lens of *mubādalah*, the study concludes that human–nature relations require a normative reconstruction anchored in the ethics of reciprocity a paradigm that positions humans as guardians of *mīzān* (balance), bearers of ecological *amānah* (trusteeship), and moral agents responsible for preventing *fasād* (destruction). This approach offers a theological operational dimension absent in technocratic ecological models, thereby providing a novel contribution to the fields of religious studies, social sciences, and cultural studies by integrating ecological spirituality with evidence-based environmental governance. Furthermore, the study introduces the *Mubādalah* Ecological Model as both a conceptual and practical contribution that can be applied to sustainable environmental governance in Indonesia. The model brings together the principle of reciprocity inherent in *mubādalah*, ecological spatial-planning theory, and the scientific management of watersheds, thus offering a multidimensional approach to ecosystem restoration planning and disaster-risk mitigation. The novelty of this research lies in the systematic, operational, and measurable integration of Islamic ethical values into modern ecological frameworks an advancement that surpasses earlier studies which largely remained at descriptive or ethical levels. Through theoretical synthesis and empirical findings, this study demonstrates that governance models guided by *mubādalah* principles may elucidate the causal dynamics of ecological disasters more comprehensively and offer an alternative development paradigm that is ecologically just, socially equitable, and spiritually grounded.

Based on the above conclusions, this study recommends the formal integration of *mubādalah* principles into environmental policy, particularly in the formulation of regional spatial plans (RT-RW), watershed management, and disaster-prevention instruments. It is advised that both local and national governments adopt the *Mubādalah* Ecological Model as a planning reference, especially by strengthening ecological zoning regulations, imposing

moratoria on land-use conversion in critical areas, and expanding green-financing schemes to support environmental restoration efforts. The study also recommends enhancing public education through eco-theological campaigns involving religious institutions, customary authorities, and local communities so that the ethics of reciprocity may function as a form of collective consciousness. At the academic level, further research is needed to examine the model's effectiveness across different eco-regional contexts and to deepen the integration of Islamic epistemology with ecological science as a basis for developing a transformative and climate-responsive scientific framework. Accordingly, this study contributes not only to theoretical advancement but also provides practical guidance for transforming environmental governance toward greater sustainability and justice in Indonesia.

## References

Abdul Kodir, F. (2019). *Mubadalah: Tafsir Relasi Gender dalam Islam*. IRCiSoD. https://ircisod.com/product/qiraah-mubadalah/

Ahern, J. (2013). Urban landscape Sustainability and Resilience: the Promise and Challenges of Integrating Ecology With Urban Planning and Design. *Landscape Ecology*, *28*(6), 1203–1212. https://doi.org/10.1007/s10980-012-9799-z

Alcántara-Ayala, I. (2025). Landslides In A Changing World: Global Change Drivers and Socio-Natural Hazard Risk. *Landslides*, *22*(9), 2851–2865. https://doi.org/10.1007/s10346-024-02451-1

Almutairi, A., Mourshed, M., & Ameen, R. F. M. (2020). Coastal Community Resilience Frameworks for Disaster Risk Management. *Natural Hazards*, *101*(2), 595–630. https://doi.org/10.1007/s11069-020-03875-3

Arifullah, M., Ulum, B., Firdaus, A., & Jannah, S. (2024). Reconstructing Human-Environmental Relations on the Basis of Islamic Eco-Ethical Spiritual. *Proceedings of the 7th International Colloquium on Interdisciplinary Islamic Studies (ICIIS) in Conjunction with the 6th Annual Postgraduate Conference on Muslim Society (APCoMS), ICIIS and APCoMS 2024, 17–18 June 2024, Banjarmasin, Indonesia*. http://dx.doi.org/10.4108/eai.17-6-2024.2349107

Arnall, A. (2023). Encountering the Anthropocene: Reconfiguring Human-Nature Relations on the North Norfolk Coast, UK. *Geoforum*, *143*, 103768. https://doi.org/https://doi.org/10.1016/j.geoforum.2023.103768

Bradshaw, C. J. A., Sodhi, N. S., PEH, K. S., & Brook, B. W. (2007). Global Evidence that Deforestation Amplifies Flood Risk and Severity in the Developing World. *Global Change Biology*, *13*(11), 2379–2395. https://doi.org/10.1111/j.1365-2486.2007.01446.x

Cantoni, R., Llavero-Pasquina, M., Apostolopoulou, E., Gerber, J.-F., Bond, P., & Martinez-Alier, J. (2025). From Françafrique to Chinafrica? Ecologically Unequal Exchange, Neocolonialism, and Environmental Conflicts in Africa. *World Development*, *193*, 107015. https://doi.org/https://doi.org/10.1016/j.worlddev.2025.107015

Duc, M. D., Duy, L. T., Thi Thanh, T. N., & Le Minh, T. (2025). Human–nature relations in the Anthropocene: Responsible hiking and ecological balance in Thiềng Liềng. *Journal of Outdoor Recreation and Tourism*, *51*, 100926. https://doi.org/https://doi.org/10.1016/j.jort.2025.100926

Estrada, M., Young, G., Flores, L., Hernandez, P. R., Hosoda, K. K., & DeerInWater, K. (2022). Culture and Quality Matter in Building Effective Mentorship Relationships with Native STEM Scholars. *BioScience*, *72*(10), 999–1006. https://doi.org/10.1093/biosci/biac064

Fan, J., Meng, J., Ludescher, J., Chen, X., Ashkenazy, Y., Kurths, J., Havlin, S., & Schellnhuber, H. J. (2021). Statistical Physics Approaches to the Complex Earth System. *Physics Reports*, *896*, 1–84. https://doi.org/10.1016/j.physrep.2020.09.005

Fan, Y., Shi, X., Li, X., & Feng, X. (2022). Livelihood resilience of vulnerable groups in the face of climate change: A systematic review and meta-analysis. *Environmental Development*, *44*(November), 100777. https://doi.org/10.1016/j.envdev.2022.100777

Gade, A. M. (2015). Islamic Law and the Environment in Indonesia: Fatwa and Daʿwa. *Worldviews: Global Religions, Culture, and Ecology*, *19*(2), 161–183. https://doi.org/https://doi.org/10.1163/15685357-01902006

Gosal, R. C., Tewu, P. S., & Komaling, O. N. (2025). Ecological Sin and Its Impact on Environmental Crisis: A Case Study of Landslides and Floods in Kali Village, Minahasa. *Santhet (Jurnal Sejarah Pendidikan Dan Humaniora)*, *9*(5), 1712–1722. https://doi.org/10.36526/santhet.v9i5.6136

Ghosh, J. (2025). We Have So Little Time Left: Portrayal of Environmental Catastrophe in Selected Poems from *Reckoning*. In *Imagining Ecocatastrophe* (1st ed., pp. 1–13). *Routledge India*. https://doi.org/10.4324/9781003602750-3

Ha, K.-M. (2015). The Role of Religious Beliefs and Institutions in Disaster Management: A Case Study. *Religions*, *6*(4), 1314–1329. https://doi.org/10.3390/rel6041314

Hermanto, A. (2022). Menjaga Nilai-Nilai Kesalingan Dalam Menjalankan Hak Dan Kewajiban Suami Istri Perspektif Fikih Mubadalah. *Al-Mawarid Jurnal Syariah Dan Hukum (JSYH)*, *4*(1), 43–56. https://doi.org/10.20885/mawarid.vol4.iss1.art3

Hess, G. (2024). Virtue Ethics and the Ecological Self: From Environmental to Ecological Virtues. *Philosophies*, *9*(1), 23. https://doi.org/10.3390/philosophies9010023

Khalid, F. (2010). Islam and the environment–ethics and practice an assessment. *Religion Compass*, *4*(11), 707–716. https://doi.org/10.1111/j.1749-8171.2010.00249.x

Kodir, F. A. (2019). *Qiraah Mubadalah, Tafsir Progressif untuk Keadilan Gender dalam Islam* (Rusdianto, Ed.). IRCiSoD.

Kula, E. (2001). Islam and Environmental Conservation. *Environmental Conservation*, *28*(1), 1–9. https://doi.org/10.1017/S0376892901000017

Liu, J., & Zhuo, J. (2025). Ecological Gaze and Unequal Subjectivity: A Sociological Analysis of Marine Garbage Governance. *Asian Journal of Social Science*, *53*(4), 100225. https://doi.org/https://doi.org/10.1016/j.ajss.2025.100225

McKay, J. E., Mangunjaya, F. M., Dinata, Y., Harrop, S. R., & Khalid, F. (2014). Practise What you Preach: A Faith-Based Approach to Conservation in Indonesia. *Oryx*, *48*(1), 23–29. https://doi.org/DOI: 10.1017/S0030605313001087

Muhasim, M., Muhammad, Z., & Jainurakhma, J. (2024). The Role of Religious Figures in Community Resilience in Disaster-Prone Areas. *LISAN AL-HAL: Jurnal Pengembangan Pemikiran Dan Kebudayaan*, *18*(2), 248–262. https://doi.org/10.35316/lisanalhal.v18i2.248-262

Nazah, F. N., Gustiana, R., Saadah, T., & Suryadi, A. (2025). Gender Justice in Child Custody Disputes: The Maqāṣid al-Sharīʻah Approach in Contemporary Judicial Practice. MILRev: Metro Islamic Law Review, 4(2), 1328–1358. https://doi.org/10.32332/milrev.v4i2.10790

Nazaruddin, M. (2024). Religious Modeling of a Natural Disaster: A Cultural Semiotic Study. *Chinese Semiotic Studies*, *20*(1), 187–209. https://doi.org/10.1515/css-2024-2011

Nazaruddin, M., Marasabessy, F., Quraisy, S., & Basri, A. (2024). Study on the Development and Environmental Adaptation of Mosque Architecture in Disaster-Prone Region of Ternate Island, Indonesia. *International Review for Spatial Planning and Sustainable Development*, *12*(4), 225–252. https://doi.org/10.14246/irspsd.12.4_225

Qadri, B., & Siregar, I. M. (2023). Islamic Renewal in the Field of Family Law: A Historical Analysis of Gender Equality. El-Usrah: Jurnal Hukum Keluarga, 6(2), 444–455. https://doi.org/10.22373/ujhk.v6i2.17128

Qodir, F. A. (2019). Qira'ah Mubadalah: Tafsir Progresif untuk Keadilan Gender dalam Islam. *Yogyakarta: IRCiSoD*, *28*. https://balaiyanpus.jogjaprov.go.id/opac/detail-opac?id=309642

Rambe, T., Sari, S. M., & Rambe, N. (2021). Islam dan Lingkungan Hidup: Menakar Relasi Keduanya. *Abrahamic Religions*, *1*(1), 1–14. https://doi.org/10.22373/arj.v1i1.9476

Rahmawati, S. (2020). Mainstreaming of Gender Equality in Islamic Family Law: Opportunities and Challenges. Samarah: Jurnal Hukum Keluarga dan Hukum Islam, 4(2). https://doi.org/10.22373/sjhk.v4i2.8110

Ran, Y., Zhao, X., Ye, X., Wang, X., Pu, J., Huang, P., Zhou, Y., Tao, J., Wu, B., Dong, W., & Qu, G. (2024). A Framework for Territorial Spatial Ecological Restoration Zoning Integrating "Carbon Neutrality" and "Human–Geology–Ecology": Theory and Application. *Sustainable Cities and Society*, *115*, 105824. https://doi.org/10.1016/j.scs.2024.105824

Rogger, M., Agnoletti, M., Alaoui, A., Bathurst, J. C., Bodner, G., Borga, M., Chaplot, V., Gallart, F., Glatzel, G., & Hall, J. (2017). Land use Change Impacts on Floods at the Catchment Scale: Challenges and Opportunities for Future Research. *Water Resources Research*, *53*(7), 5209–5219. https://doi.org/10.1002/2017WR020723

Rozzi, R. (1999). The Reciprocal Links Between Evolutionary-Ecological Sciences and Environmental Ethics. *BioScience*, *49*(11), 911–921. https://doi.org/10.2307/1313650

Rulke, J., Rieckmann, M., Nzau, J. M., & Teucher, M. (2020). How Ecocentrism and Anthropocentrism Influence Human-Environment Relationships in a Kenyan Biodiversity Hotspot. *Sustainability*, *12*, 8213. https://doi.org/10.3390/su12198213

Saniotis, A. (2012a). Muslims and Ecology: Fostering Islamic Environmental Ethics. *Contemporary Islam*, *6*, 155–177. https://doi.org/10.1007/s11562-011-0173-8

Saniotis, A. (2012b). Muslims and Ecology: Fostering Islamic Environmental Ethics. *Contemporary Islam*, *6*(2), 155–171. https://doi.org/10.1007/s11562-011-0173-8

Sharma, S. K., & Pathak, S. L. (Eds.). (2024). *Urbanization, Population and Environment*. *Springer Singapore*. https://doi.org/10.1007/978-981-97-6020-6

Syihabuddin, M., Mubaraq, Z., & Mustofa, M. L. (2023). Elucidating eco-Religious in Islamic Studies and the Future of Environmental Ethics. *Al'Adalah*, *26*(2), 189–207. https://doi.org/10.35719/aladalah.v26i2.370

Wu, S. (2023). Reinventing Sacred Ground Amidst Natural Disaster: The Holy Islamic Tomb in Seventeenth-Century Quanzhou. *International Journal of Islamic Architecture*, *13*(2). https://doi.org/10.1386/ijia_00143_1

Zuhdi, M. H. (2015). Paradigma Fiqh Al-Bi'ah Berbasis Kecerdasan Naturalis: Tawaran Hukum Islam Terhadap Krisis Ekologi. *Al-'Adalah*, *12*(2), 771–784. https://doi.org/10.24042/adalah.v12i2.213