The sacred waters and fish: Traditional practices and fish conservation in Indonesian communities

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Abstract

This paper explores the intersection of traditional ecological knowledge (TEK) and fish conservation within the context of sacred waters in Indonesian communities. Sacred waters, revered for their spiritual significance, play a crucial role in conserving native fish species by serving as de facto protected areas. The traditional practices and taboos associated with these waters safeguard them from overfishing, pollution, and habitat destruction, thus preserving biodiversity. The study highlights the importance of integrating TEK with modern conservation efforts to sustainably manage aquatic ecosystems while honoring cultural heritage. Integrating sacred waters into Indonesia's Essential Ecosystem Area (EEA) framework could offer a formal mechanism for recognizing their ecological and cultural value while maintaining local

stewardship. Furthermore, mapping and documenting sacred waters alongside formal protected areas would be a valuable step toward building an inclusive, culturally grounded, and ecologically resilient freshwater conservation network in Indonesia. The findings underscore the interconnectedness of spiritual beliefs and environmental stewardship in Indonesian culture, offering insights into how cultural practices contribute to the conservation of native fish species and their habitats.

Keywords: traditional ecological knowledge, overfishing, pollution, habitat, fish species

Introduction

The link between water and human wellbeing is ingrained in various traditional knowledge systems around the world. Water bodies have long held significant religious connotations, in particular the aspect of the 'river god' and sacred bodies of water have perpetuated history (Niederland, 1957; Cohen et al., 2023). For example, the Nyami-nyami snake-like river god of the Tonga Valley is said to reside in the Zambezi River (Chikozo, Mubaya & Mawere, 2015), Ho Po the god of the Yellow River (Lai, 1990), or the many rivers personified as gods in Ancient Greece (Chiai, 2017). A common theme in each cosmology is that the water, and everything within it, is regarded as a sacred space and conferred protection (Bord & Bord, 1985; Lai, 1990; Chikozo, Mubaya & Mawere, 2015; Chiai, 2017).

Rapid globalisation has coincided with movement away from traditional religious practices. Encapsulated within this is the general *biophobia* experienced by societies who no longer feel kinship with the natural environment that surrounds them (Cohen et al. 2023). This lack of kinship or stewardship of the environment has resulted in a dire state of affairs for freshwater biodiversity and water quality (Sayer et al., 2025). Nonetheless, in spaces where these relationships and traditional ways of knowing still flourish, rights of protection are given to waterbodies considered as sacred natural sites. In these areas, community-based protection systems, such as taboos, seasonal restrictions, and ritual regulations, actively safeguard the ecosystems — offering conservation models that are culturally embedded and self-enforced (Schneider, 2018; Maru, Gebrekirstos & Haile, 2020). Sacred waterbodies have been increasingly addressed due to their conservation potential within national legislation and international conservation frameworks. Notable examples include the legal recognition of rivers with personhood status in New Zealand and Canada (RiverOfLife et al., 2022; Cárdenas & Mestokosho, 2023), as well as the designation of sacred sites as conservation areas by the IUCN (Verschuuren, Wild & Verschoor, 2017). Therefore, the value and potential of sacred natural sites for conservation is high.

The diverse archipelago of Indonesia is a biogeographical and cultural mixing pot where traditional practices often intersect with biodiversity conservation efforts, fostering unique approaches to environmental stewardship (Simbiak et al., 2019; Donkersgoed, 2020). However,

despite its rich aquatic biodiversity, Indonesia's freshwater ecosystems face mounting threats. Indonesia harbors approximately 10% of the world's total freshwater fish diversity, with 1,258 out of 11,952 species (Reid, Contreras Macbeath & Csatádi, 2013; Gustiano, Kurniawan & Haryono, 2021). The urgent need for effective freshwater fish management in the country arises from the overexploitation of aquatic resources, which has led to a growing number of endangered native species (Gustiano, Kurniawan & Haryono, 2021; Budi et al., 2024). Several threats, including habitat degradation, loss of natural ecosystems, the introduction of invasive species, overfishing, water pollution, competition for water resources, and the impacts of climate change, pose significant risks to the survival of wild fish populations (Arthington et al., 2016; Heino et al., 2016). Nonetheless, policies geared towards rapid economic development but with little regard for sustainability further exacerbate these challenges (Wells et al., 1999; Maskun et al., 2021).

Although Indonesia has a wealth of customary law systems such as sasi in Maluku and Lubuk Larangan in Sumatra, which regulate community-based fishery protection through seasonal prohibitions, closed areas, and ritual-based restrictions, these are rarely integrated into formal state-led conservation frameworks (Ferrari, 2002; Badaruddin, Sahusilawane & Anidlah, 2021; Putra et al., 2024). Despite these threats, the relevance of sacred natural sites for fish conservation has been overlooked in Indonesia, even though many customary practices are still being observed. For example, local communities have long regarded certain fish species residing in these waters as sacred and protected, creating de facto protected areas that predate modern conservation strategies (Rebay, 2023). Such cultural reverence has contributed to the preservation of these fish populations and their habitats, sustaining biodiversity in otherwise threatened aquatic ecosystems.

Lack of comprehensive mapping or national registries of Indonesia’s sacred freshwater sites limits effective assessment of the realised potential of sacred sites. Furthermore systematic community-based monitoring remains limited to a few well-documented locations. Thus, despite their cultural importance, there remains a notable research gap regarding the role of sacred waters in biodiversity conservation, particularly concerning specific fishes which inhabit these locations. Understanding the relationship between sacred waters and fish conservation is crucial for elucidating the intersection of traditional knowledge, cultural practices, and contemporary conservation efforts.

This manuscript employs a qualitative, ethnobiological review approach, drawing on published literature, community-based accounts, and case study analyses to explore the cultural dimensions of sacred waters and their role in freshwater fish conservation in Indonesia. The study positions itself within the framework of biocultural conservation, advocating for the integration of Indigenous and local knowledge systems into national conservation strategies. We aim not only to document traditional practices but to critically assess their relevance and potential contributions to modern aquatic conservation, policy, and community resilience building.

The positionality underlying this study is rooted in a combination of academic expertise in aquatic conservation and a deep cultural connection to Indonesian freshwater ecosystems. These dual perspectives inform both the selection of research focus and the interpretation of cultural-ecological relationships presented in this paper. By integrating scholarly analysis with insights drawn from lived cultural contexts, this work seeks to strengthen the recognition and legitimacy of community-based conservation knowledge within broader scientific and policy discussions. While these sacred water sites hold considerable cultural and ecological importance, their position within Indonesia's formal environmental legislation remains undocumented and underrecognized. This study also discusses opportunities for integrating sacred waters into the country's conservation framework, addressing current gaps in policy and protection. Our primary focus is on freshwater ecosystems; however, some marine examples are included in Table 1 to offer a broader perspective.

Overview of sacred waters in Indonesian culture

Sacred waters hold a profound place within Indonesian culture, embodying a spiritual and communal connection that spans centuries (Ariesta, 2022; Putra & Sedana, 2022). Sacred waters such as natural springs are revered as more than sources of water. They are believed to be inhabited by spirits or deities, making them sites of reverence and worship. Throughout Indonesia's diverse religious landscape, from Hindu-Buddhist traditions to Islamic practices, sacred waters play a crucial role in rituals of healing, purification, and spiritual renewal (Aimukhambet, Mirazova & Alimbayev, 2022; Dahlan, Fukamachi & Shibata, 2022). Visiting a sacred water is often a deeply ingrained cultural experience, where individuals seek physical healing or spiritual cleansing (Perriam, 2015). The act of bathing or making offerings at sacred waters is not just a physical ritual but a profound spiritual endeavor, connecting the individual to larger cosmic forces and the collective heritage of their community (Latifundia, 2016; Jonathan & Davis, 2020). The water from sacred waters is believed to possess transformative powers in both physical and metaphysical realms (Aimukhambet, Mirazova & Alimbayev, 2022).

In Indonesian folklore and mythology, sacred waters and fishes are often associated with tales of ancient heroes, mythical creatures, and divine interventions (Cacciafoco, Adzman & Shahirah, 2017; Citraresmana, Wahya & Djajasudarma, 2020). The stories enrich the cultural tapestry of the region, reinforcing the spiritual significance of the natural sites. Local communities maintain the traditions through ceremonies, festivals, and offerings, ensuring that the sacred waters remain integral to their cultural identity (Sudarmadji et al., 2017). Efforts to conserve these sacred sites blend spiritual and environmental concerns, recognizing the interconnectedness of nature and spirituality (Dudley, Higgins-Zogib & Mansourian, 2009). Conservation initiatives often involve collaboration between local communities, religious leaders, and governmental bodies to protect these sites from degradation and preserve their cultural heritage (Ferrari, 2002). In essence, sacred waters in Indonesian culture encapsulate the deep-rooted beliefs and traditions that have

shaped the spiritual landscape of the archipelago. They serve as focal points for spiritual devotion, communal gatherings, and cultural preservation, embodying the enduring relationship between humanity and the natural world.

Traditional ecological knowledge and fish conservation practices

Traditional ecological knowledge (TEK) holds immense value for fish conservation practices, particularly within Indigenous communities where fishing is intertwined with cultural identity and livelihoods (Sinthumule, 2023). Across generations, Indigenous peoples have accumulated deep insights into local ecosystems, including fish habitats, behaviors, and the intricate relationships between species (Legesse et al., 2022; Obiero et al., 2023; Souther, Colombo & Lyndon, 2023). This knowledge, which includes observations of nature, spiritual beliefs, and cultural values, guides their fishing practices to prioritize the well-being of fish populations and not over-exploit them (Yiu, 2022). This knowledge forms the foundation for holistic sustainable resource management approaches that prioritize long-term conservation goals.

Globally, Indigenous fish conservation practices often emphasize ecosystem-based management, where fishing activities are guided by seasonal calendars and natural ecological indicators (Valencia, Miranda & Chaves, 2023). These natural indicators include cues such as; changes in water temperature (Salami et al., 2020), the appearance of certain migratory bird species (Tankersley, 2004), shifts in water clarity (Niinemets et al., 2017), the flowering of specific plants (Niinemets et al., 2017), the phase of the moon (Borie-Mojica et al., 2022), or the behavior of fish themselves (White, Giannico & Li, 2014) — such as schooling or nesting activity — which signal appropriate times for harvesting or restraint. In Eastern Indonesia, the Endenese apply customary laws (known as "Sasi Laut") that prohibit fishing in designated marine and freshwater areas for months or even years, promoting ecosystem recovery (Constanza Ramenzoni, 2023). The Kanikkaran tribal community in the Western Ghats rely on indigenous fish traps that selectively capture mature fish while allowing smaller ones to escape (Velmurugan et al., 2022). Fishermen in Lake Ziway use traditional breeding sanctuaries where fish are protected during spawning seasons to maintain stable population levels. Over generations, Indigenous Peoples around the North Pacific Rim have developed sophisticated management systems rooted in their cultural and spiritual beliefs through their close relationship with salmon (Atlas et al., 2021).

Sacred waters are a significant practice within the TEK of many Indigenous communities in Indonesia. These water bodies are often considered spiritually significant and are protected through cultural practices that have been passed down through generations. The connection between sacred waters and native fish species is a key aspect of this TEK, as these waters often serve as habitats for species that are not only ecologically important but also hold cultural and spiritual significance (Table 1). In sacred waters, traditional beliefs and practices often discourage fishing or other disruptive activities, particularly in the breeding season. This reduces

fishing mortality substantially, supports the persistence of large-bodied species prized for food and ritual purposes, and also limit the introduction of invasive species, helping to stabilize native fish communities.

Dewa (*Neolissochillus soro*), commonly known as Mahseer, is a native fish species found in several sacred waters in Kuningan Regency, West Java Province, such as Cibulan, Cigugur, Darma Loka, Linggarjati, and Pasawahan. These fish are revered by local communities and are protected within these sacred sites, which helps in their conservation (Haryono, 2017; Hasan et al., 2022). The cultural and spiritual meaning of the dewa comes from the local belief that this fish is the guardian of sacred waters and is the incarnation of the warrior Prabu Siliwangi, king of the Pajajaran kingdom from 1482-1521 AD (Maulid & Jati, 2021). Many communities view them as symbols of prosperity and harmony, and harming or capturing them is considered taboo (Haryono, 2017).

In East Java, sacred sites like Rambut Monte in Blitar Regency are home to sengkaring (another Mahseer species) (Figure 1.), and Gua Ngerong in Tuban Regency harbors tawes (*Barbonymus gonionotus*), known as the silver barb. These species are similarly regarded as sacred, with local legends attributing mystical qualities to them. In some cases, they are believed to bring good fortune to those who respect them and misfortune to those who harm them. Sengkaring in Rambut Monte are believed to be the incarnation of Mbah Monte's warriors to guard the Rambut Monte temple (Maulid & Jati, 2021). Meanwhile, the legend in Gua Ngerong concerns a supernatural kingdom that guards the Ngerong River and the animals that live there, so that animals such as tawes/bader bang (*Barbonymus gonionotus*) and arengan (*Labeo chrysophekadion*) are not disturbed (Handayani, 2017; Haryono, 2017). Medang Village is another sacred water site in East Java. According to local beliefs, anyone who eats or sells catfish (*Clarias batrachus*) from this site will experience itching, peeling skin, and, in some cases, white stripes resembling catfish skin (Hasanah, 2013). This deep-rooted cultural reverence plays a crucial role in the long-term protection of these fish populations and their habitats, contributing to biodiversity conservation through TEK (Haryono, 2017).

In Central Java, the sacred spring of Umbul Naga Karanglor in Wonogiri Regency supports the gateng (*Anguilla bicolor* and A. *marmorata*). The conservation of these eel species is closely tied to the spiritual beliefs of the local communities (Oktaviani, Dharmadi & Puspasari, 2017; Octavia & Ismail, 2018). Similarly, in South Sulawesi's Tana Toraja Regency, the sacred waters of Tilanga Village are inhabited by the masapi (*A. marmorata*) or marbled eel , which is also found in Waai Village and Negeri Larike in Maluku Province that called morea. These eels are respected and preserved by local customs, ensuring their continued presence in these regions (Haryono, 2017). In Torajan culture, consuming masapi will bring disaster (Makko' & Rambulangi, 2023). Similarly, in Waai Village, the eels are regarded as sacred, and traditional taboos prohibit their capture, reinforcing their protection. Customary law in the form of caning will be applied to anyone caught catching morea from this place (Nampasnea & Seipalla, 2023)

In the case of Lubuk Larangan, a sacred water site on Sumatera Island, various native fish species, including the ikan garieng (*Tor douronensis*), ikan jurung (*Neolissochilus sumatranus*), and ikan kapiek (*Barbonymus schwanefeldii*), are preserved due to traditional prohibitions against fishing during breeding periods. These prohibitions are rooted in the belief that allowing the fish to reproduce ensures abundance and community well-being. Violating these rules is thought to bring bad luck or even illness, reinforcing community-driven conservation efforts. This practice not only respects spiritual beliefs but also supports the sustainable management of fish populations (Haryono, 2017; Jufrida et al., 2020; Lubis et al., 2021).

Local wisdom is also applied in marine environments, demonstrating that certain sea waters are considered sacred in parts of Indonesia. In Lamatokan Village, Lembata Regency, East Nusa Tenggara Province, the Muro Local Wisdom Sea Zoning system divides the coastal area into three distinct zones: a core zone, a buffer zone, and a utilization zone. This system provides protection for important marine species such as the Napoleon wrasse (*Cheilinus undulatus*), manta ray (*Mobula birostris*), and seahorses (*Hippocampus* spp.) These marine habitats include coral reefs, seagrass meadows, and mangrove-lined coastal lagoons, which are ecologically critical breeding and nursery grounds (Rosari, Paulus & Boikh, 2024). Similarly, in Negeri Hutumuri and Negeri Hukurila, Maluku Province, the traditional practice of Sasi Laut plays a significant role in marine conservation. Sasi Laut enforces restrictions on harvesting specific marine resources within customary sea territories, with species like Kai stingrays (*Urolophus kaianus*) and garopa (*Epinephelus fuscoguttatus*) being protected under this system (Badaruddin, Sahusilawane & Anidlah, 2021).

Figure 1. Rambut Monte pond in Blitar Regency, Indonesia, are home to sengkaring (Photograph by GusJuned. CC BY-SA 3.0; https://web.archive.org/web/20161102051723/http://www.panoramio.com/photo/114045955).

These examples illustrate how sacred waters in Indonesia, deeply rooted in spiritual beliefs, contribute to the conservation of native fish species. The TEK surrounding these waters provides valuable insights into sustainable resource management and highlights the importance of integrating cultural practices with modern conservation efforts. By integrating these traditional practices and beliefs into modern management approaches, there is an opportunity to improve the conservation and sustainable use of fishery resources while honoring indigenous cultures and traditions.

260 **Table 1.** Sacred waters and associated native fish species in Indonesia

No.	Waters cite	Location	Native fish species				References
			Local name	**Common name**	**Scientific name**	**IUCN classification**	
1.	Cibulan, Cigugur, Darma Loka, Linggarjati, Pasawahan	Kuningan Regency, West Java Province	Dewa	Mahseer	*Neolissochillus soro*	Least concern	(Haryono, 2017)
2.	Umbul Naga Karanglor	Kepuhsari Village, Manyaran District, Wonogiri Regency, Central Java Province	Gateng	Marbled eel	*Anguilla marmorata*	Least concern	(Oktaviani, Dharmadi & Puspasari, 2017; Octavia & Ismail, 2018)
3.	Rambut Monte	Blitar Regency, East Java Province	Sengkaring	Mahseer	*Tor tambra*	Data deficient	(Haryono, 2017)
					Tor tambroides	Data deficient	
					Neolissochillus soro	Least concern	
4.	Gua Ngerong	Tuban Regency, East Java	Tawes/Bader bang	Silver barb	*Barbonymus gonionotus*	Least concern	(Handayani, 2017; Haryono, 2017)
			Arengan	Black sharkminnow	*Labeo chrysophekadion*	Least concern	

No.	Waters cite	Location	Native fish species				References
			Local name	Common name	Scientific name	IUCN classification	
5.	Medang Village	Glagah District, Lamongan Regency, East Java Province	Lele	Catfish	*Clarias batrachus*	Least concern	(Hasanah, 2013)
6.	Tilanga Village	Tana Toraja Regency, South Sulawesi Province	Masapi	Marbled eel	*Anguilla marmorata*	Least concern	(Haryono, 2017)
7.	Waai Village	Ambon Regency, Maluku Province	Morea	Marbled eel	*Anguilla marmorata*	Least concern	(Haryono, 2017)
8.	Muro	Lamatokan Village, East Ile Ape District, Lembata Regency, East Nusa Tenggara Province	Napoleon	Humphead wrasse	*Cheilinus undulatus*	Endangered	(Rosari, Paulus & Boikh, 2024)
			Pari manta	Oceanic manta ray	*Mobula birostris*	Endangered	
			Kuda laut	Sea horse	*Hippocampus* sp.	-	
11.	Lubuk Larangan	Sumatera Island	Garieng	Mahseer	*Tor douronensis*	Data deficient	(Pawarti et al., 2012; Yuliaty & Priyatna, 2015; Haryono, 2017; Jufrida, Basuki & Destinanda, 2020; Lubis et al., 2021;
			Jurung	Mahseer	*Neolissochilus sumatranus*	Least concern	
			Salimang	Sumatran rasbora	*Rasbora sumatrana*	Data deficient	
			Garing	-	*Tor tambroides*	Data deficient	

No.	Waters cite	Location	Native fish species				References
			Local name	**Common name**	**Scientific name**	**IUCN classification**	
			Sibahan	Beardless barb	Cycloschilichthys apogon	Least concern	kumparanNews, 2024; Putra et al., 2024)
			Baung	-	*Hemibagrus heovenii*	Least concern	
			Barau	Hampala barb	*Hampala macrolepidota*	Least concern	
			Paweh	Hard-lipped barb	*Osteochilus vittatus*	Least concern	
			Kapiat/lampam	Tinfoil barb	*Barbonymus schwanefeldii*	Least concern	
9.	Sasi laut in Negeri Hutumuri and Negeri Hukurila	South Leitimur District, Ambon City, Maluku Province	Pari	Kai stingaree	*Urolophus kaianus*	Data deficient	(Badaruddin, Sahusilawane & Anidlah, 2021)
			Garopa	Brown-marbled grouper	*Epinephelus fuscoguttatus*	Vulnerable	
10.	Negeri Larike	West Leihitu District, Central Maluku Regency, Maluku Province	Morea	Marbled eel	*Anguilla marmorata*	Least concern	(Nampasnea & Seipalla, 2023)

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Sacred waters as fish spawning refugia

Sacred waters serve as critical refuge habitats for fish spawning and recruitment due to being undisturbed and sheltered from pollution, habitat degradation, and overfishing (Badaruddin et al., 2021; Haryono, 2017; Rosari et al., 2024; Jumani et al., 2023). Furthermore, sedimentation and pollution have degraded the substrates of many Indonesian rivers due to intensive land use and climate change (Noda et al., 2017). However, rheophilic, gravel spawning species such as Mahseer, belonging to the genera *Neolissochilus* and *Tor*, require slow to moderate flow, deep pools, and gravel or sand to spawn in (Taylor et al., 2019; Kondolf et al., 2008; Larashati et al., 2020). Mahseer, are commonly found in sacred waters in Indonesia despite being globally threated (Table 1). The protection of sacred waters means that the clear, oxygen-rich water needed for successful spawning persists in these sites (Larashati et al., 2020).

High and stable water quality in sacred waters is characterized by consistently high dissolved oxygen levels, low turbidity, minimal contamination from pollutants such as heavy metals and agricultural runoff, and a relatively stable physicochemical profile throughout seasonal cycles — conditions that are increasingly rare in disturbed or heavily utilized river systems (Alabaster & Lloyd, 1982; Choque-Quispe et al., 2021). These favorable environmental characteristics are maintained through cultural restrictions that limit disruptive human activities, including deforestation, sand mining, and waste disposal, thereby preserving water clarity, substrate quality, and ecological integrity (Hakim et al., 2023; Jumani et al., 2023). Additionally, because these waters typically maintain ecological stability and are buffered from anthropogenic impacts, they offer ideal environments for the growth of fish larvae and juveniles, which are particularly vulnerable to environmental perturbation (Alabaster & Lloyd, 1982; Nunn, Tewson & Cowx, 2012).

The cultural significance of sacred waters often leads to long-term protection of these habitats, ensuring their stability over time (Hakim et al., 2023). This long-term protection allows fish populations to develop reproductive strategies that are finely tuned to the specific conditions of these waters (Jumani et al., 2023). The cultural practices that maintain the sanctity of these waters act as a form of ecological stewardship, preserving the conditions necessary for successful fish reproduction across generations (Haryono, 2017; Larashati et al., 2020; Badaruddin, Sahusilawane & Anidlah, 2021; Rosari, Paulus & Boikh, 2024).

From an ecological perspective, sacred waters act as a buffer, maintaining the balance of aquatic ecosystems (Hakim et al., 2023). By safeguarding these spawning habitats, indigenous communities not only conserve specific fish species but also contribute to the long-term sustainability of broader aquatic ecosystems. The role of sacred waters as spawning habitats illustrates how traditional cultural practices can directly support environmental conservation and ecological stability.

Policy context and integration of sacred waters in Indonesia

The role of sacred waters in freshwater fish conservation cannot be fully appreciated without understanding how these culturally protected areas relate to Indonesia’s formal environmental

protection framework. Indonesia has an established system of state-managed protected areas governed by Law No. 5/1990 on the Conservation of Living Natural Resources and their Ecosystems and Government Regulation No. 108/2015. These categories include Nature Reserves, Wildlife Reserves, National Parks, Forest Parks, and Nature Tourism Parks. Indonesia currently has at least 54 National Parks (Taman Nasional) and 123 Nature Tourism Parks (Taman Wisata Alam), covering approximately 16 million hectares. In addition to national parks and nature tourism parks, the country also manages 28 Forest Parks (Taman Hutan Raya), 11 Buru Parks (special hunting parks), 219 Nature Reserves (Cagar Alam), 72 Wildlife Sanctuaries (Suaka Margasatwa), and 56 Nature Conservation Areas (Kawasan Suaka Alam/Kawasan Pelestarian Alam) (Agatha, Handayani & Najicha, 2022). Collectively, these areas cover approximately 36.07 million hectares of Indonesia's terrestrial and marine environments (Convention on Biological Diversity, 2020). However, designated freshwater conservation areas within these categories remain limited, often focused on large national parks or forest parks.

In contrast, sacred waters protected by religious, cultural, and customary practices have yet to be formally mapped, inventoried, or incorporated into national conservation databases. Currently, there is no comprehensive estimate of the total number or total area of sacred water sites across Indonesia, though individual sites are well-documented in local contexts — for example in West Java, Central Java, Sumatra, Sulawesi, and Maluku. The actual number of sacred water sites is likely to be significantly higher than what is documented in this study, as many of these areas remain locally managed and undocumented at the national level.

The relative importance of sacred waters versus state-managed reserves remains understudied. However, these cultural sites frequently safeguard highly threatened species, such as *Neolissochilus soro*, *Tor douronensis*, *Anguilla marmorata*, and *Barbonymus gonionotus*, particularly in areas where formal protection is lacking. They act as critical biodiversity refuges complementing formal conservation areas, and in some cases, offering better protection due to strong cultural prohibitions and long-standing communal stewardship.

One potential strategy for elevating the protection status of sacred waters is through Indonesia's Essential Ecosystem Areas (EEA) framework, a non-formal conservation designation introduced under Regulation of the Directorate General of Natural Resources and Ecosystem Conservation Number P.8/KSDAE/BPE2/KSA.4/9/2016 concerning Guidelines for Determining Wildlife Corridors as Essential Ecosystems. The EEA designation allows culturally and ecologically significant areas outside formal reserves to be recognized for their biodiversity value and managed collaboratively by local communities, religious institutions, and government agencies (Sahide et al., 2020). Sacred waters could be proposed as EEAs, granting them legal recognition while maintaining local management systems and cultural values.

Mapping the distribution of sacred water sites across Indonesia would be a crucial first step towards this integration. Such a map could visually overlay sacred waters with government-designated protected areas, revealing potential overlaps, complementary areas, and

conservation gaps. In addition to aiding biodiversity planning, this would acknowledge and legitimize the contributions of Indigenous and local communities in sustaining freshwater ecosystems. This approach could strengthen Indonesia's national conservation framework by bridging customary and scientific conservation models, securing both ecological resilience and cultural continuity in freshwater ecosystems

Conclusions

Traditional ecological knowledge plays a crucial role in fish conservation across Indonesian Indigenous communities, and sacred water conservation is a central pillar guiding this effort. These waters, deeply embedded in cultural and spiritual traditions, are protected through traditional practices that help preserve native fish species and maintain aquatic ecosystem balance. This balance is maintained by regulating human use, protecting spawning refuges, restricting disruptive activities during critical life stages, and preserving clean, high-quality habitats — all of which support the continuity of ecological functions and biodiversity. The reverence for sacred waters has historically created de facto conservation areas, predating modern efforts. Through practices such as taboos and rituals, these waters are safeguarded from human disturbances like fishing and pollution, sustaining fish populations and preventing biodiversity decline.

Despite their cultural importance, formal recognition and protection of sacred waters remain limited. Mapping and documenting these sites could be a vital step in ensuring their long-term conservation. While some community-based monitoring initiatives exist, such as those maintaining "Lubuk Larangan" sites, there is a need for broader institutional support, including legal recognition and conservation programs that integrate traditional wisdom with scientific approaches.

Additionally, sacred waters serve as critical spawning grounds, where their high-water quality and suitable substrates align with fish reproductive behaviors, ensuring the continuation of species. Many native fish species, such as the mahseer (*Neolissochillus soro*) and marbled eel (*Anguilla marmorata*), are believed to be spiritual guardians or divine messengers, reinforcing the community's commitment to their protection. Strengthening conservation efforts requires not only respecting these spiritual beliefs but also fostering collaborative management between local communities and conservation authorities.

The long-term cultural and spiritual protection of sacred waters not only supports biodiversity but also conserves cultural heritage, highlighting the interconnectedness of ecological stewardship and cultural practices. These traditional practices sustain ecological resilience by preserving species diversity, maintaining essential habitat conditions, and ensuring ecosystem functions continue even in the face of environmental change. This resilience strengthens both ecosystems and communities, providing adaptive capacity for responding to future ecological pressures. Strengthening conservation efforts requires not only respecting spiritual beliefs but also fostering collaborative management between local communities and conservation authorities. Integrating sacred waters into Indonesia's EEA framework could offer a formal

mechanism for recognizing their ecological and cultural value while maintaining local stewardship. Furthermore, mapping and documenting sacred waters alongside formal protected areas would be a valuable step toward building an inclusive, culturally grounded, and ecologically resilient freshwater conservation network in Indonesia.

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