



# The Toba Batak tribe's cultural capital in the context of protecting Lake Toba from environmental threats

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## ABSTRACT

**Background:** The Batak Toba tribe predominantly inhabits the Lake Toba area. Lake Toba and the Batak Toba tribe have a strong, unchangeable connection. The historically valued traditions of the Batak Toba tribe have developed over generations due to their interactions with Lake Toba, although they now face the threat of obsolescence and discord. Ecosystem services and tourism attractions are mostly utilized for economic purposes, lacking regard for local wisdom or cultural significance. Consequently, various degradations and environmental damages are inflicted by human activities and company operations in the Lake Toba area. This study aims to explore and provide the distinct cultural values of the Batak Toba tribe to promote the future sustainability of Lake Toba's ecosystem services, including protection against environmental threats and degradation. **Methods:** The employed methodology involved literature research and content analysis, augmented with videos obtained from diverse YouTube channels. **Findings:** The cultural values of the Batak Toba tribe that foster the sustainability of Lake Toba's ecosystem services encompass aek do hangoluan, poda na lima, marsirimpa, mambongoti bagas, and numerous Batak Toba songs pertaining to Lake Toba, including O Tao Toba, Tano Toba, Tao Toba Nauli, HORASI, and Pulo Samosir. The abundance and diversity of these cultural values are expected to provide knowledge, enhance awareness among future generations of the Batak Toba tribe, and motivate a culture-driven environmental restoration initiative focused on restoring and preserving the ecological services of Lake Toba. **Conclusions:** The study provides a significant ecological and cultural connection between the Batak Toba tribe and Lake Toba, dating back to the era of their ancestors. Consequently, it shall remain inseparable. **Novelty/Originality of this article:** The novelty of this research lies in the exploration of Toba Batak cultural values as a local wisdom-based approach to maintaining the sustainability of Lake Toba ecosystem services.

**KEYWORDS:** batak toba tribe; cultural values; ecological services; lake toba

## 1. Introduction

Lake Toba, the largest volcanic-tectonic caldera lake in the world, is located in North Sumatra Province, 100 km in length, 30 km in width, 505 m in depth, 904 meters above sea level, and within the Bukit Barisan mountain range. Lake Toba symbolizes the heritage and affluence of the Batak Toba tribe. Lake Toba has been documented since Dutch colonial period, exemplified by Van der Tuuk's, depiction of Bakkara and Ranfett's depiction of Silindung valley (Utami & Andalucia, 2021). Lake Toba, formed 74,000 years ago by a supervolcano eruption, as detailed by Chesner (2012), provides significant geological, biological, and cultural diversity. Its ecosystem services of Lake Toba provide benefits like agriculture, fisheries, livestock, raw water, hydroelectric power plants, and the aluminum industry. The community's relationship with nature and Lake Toba is reflected in its

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carvings, dances, folklore, and ulos. Lake Toba and the way of life of the Batak Toba tribe have an integrated landscape shaped by their interactions with nature, social relationships, the built environment, arts and culture, and daily existence.



Fig. 1. Batak Toba tribe in Dutch colonial era 1910-1930  
(Utami & Andalucia, 2021)

The Batak Toba tribe views Lake Toba as their life's ideology (*Tao Toba Nauli, aek natio, mual hangoluan*), valuing its beauty, clear water, and life-giving significance (Manik & Astuti, 2019). The reciprocal attitudes and actions of the Batak Toba tribe are associated with the environmental quality of the Lake Toba area, impacting it positively or negatively (Napitu et al., 2022). Ecolinguistic research by Sianturi et al. (2020), Simanjuntak (2019), and Sinaga et al. (2021) proves the language and naming of flora and fauna have strong interactions, interrelations, and interdependencies with the Lake Toba ecology. The cultural values of the Batak Toba tribe can coexist with the environmental preservation and restoration of Lake Toba.

Lake management impacts local communities positively and negatively. The proximity of residential areas and daily activities increases the likelihood of lake conditions deteriorating (Tumuyu et al., 2024). During primary school, when we became weary and thirsty, we would jump into the lake and drink the water. This is due to the pristine and fresh nature of water, which prevented us from contracting any illness (Simatupang et al., 2022). However, the lake's quality has deteriorated, affecting the surrounding community's socioeconomic conditions and leading to dissatisfaction due to deprivation (Simatupang et al., 2022).

The Batak Toba tribe's traditions and culture reflect their deep respect for the environment (Siregar et al., 2023). *Ulini tao toba taruntung tu parange dohot parsaoan ni halak Batak Toba na denggang tu tao toba* (the protection of Lake Toba is predominantly reliant on the conduct and interactions of the Batak Toba community with the lake), which has evolved into the ideological framework for fostering the well-being of the Lake Toba ecosystem (Napitu et al., 2022). The cultural practices of the Batak Toba tribe will direct efforts to conserve the Lake Toba ecosystem (Nababan & Sari, 2022). The Batak Toba tribe's cultural values are expected bolster participation in restoration and alleviate various threats to Lake Toba ecosystem (Manullang, 2019). The amalgamation of cultural values help conserve natural resources and maintain homeostasis (Brownson et al., 2024).

This research integrates the theoretical frameworks of traditional ecological knowledge and cultural ecology. Traditional ecology provides advantages in advocating for sustainable resource management, building community resilience, and promoting biodiversity protection (Berkes et al., 2000). Cultural ecology integrates concepts from ecology and anthropology to provide insights into local adaptations to their environment, as well as the belief systems, behaviors, and sociocultural systems that arise from people's interactions with nature (Brownson et al., 2024). We should not view culture and the environment as separate entities, but rather as mutually influencing each other (Gule & Surbakti, 2021). Cultural ecology shows that cultural norms, attitudes, and social structures are inextricably linked to ecological circumstances (Sewu, 2023), allowing for an investigation of the complex relationships created between humans and nature (Siregar et al., 2023). Globalization, contemporary life, and the development of Christian theology have led to a shift in the meaning of the Batak Toba tribe's traditional ecological knowledge and cultural ecology, causing forgetfulness and disagreement.

The research focuses on the tourism attractions of Lake Toba, the environmental significance of the Batak Toba tribe's cultural heritage, the environmental threats facing Lake Toba, and the acculturation strategies to enhance the sustainability of Lake Toba's ecosystem services. It explores tourism items, traditional ecology, cultural values, and environmental degradation from community and company operations. The findings aim to spark a culture-based environmental restoration movement, raise awareness, and benefit the younger generation of the Batak Toba tribe, both within and outside the Toba area

## 2. Methods

Lake Toba is a national tourism destination (DPN) and a UNESCO Global Geopark, as stated by Presidential Regulation Number 89 of 2024, which specifies the Master Plan for the National Tourism Destination (RIDPN) Lake Toba for the years 2024–2044. The Lake Toba area has been drawn at the exact same coordinates as the watersheds and Catchment Area Treatment (CAT) 2'103000' North Latitude and 98024' East Longitude. Administratively, it consists of eight regencies in North Sumatra Province: Toba, Simalungun, Samosir, North Tapanuli, Humbang Hasundutan, Karo, Dairi, and Pakpak Bharat. To fulfill the study goals, a literature review is used in conjunction with content analytic approaches. The literature employed a combination of numerous sources, including (a) the GARUDA database and several international journal publications; (b) YouTube films on the Batak Toba tribe's cultural riches; and (c) data and information aggregation from several websites.



Fig. 2. Lake Toba area delineation  
(Presidential Regulation Number 89 of 2024)

The selected literature consists of 76 articles, 19 conference papers, and 57 journals. The keywords from each article were then organized into 9 (nine) themes for simpler assessment. The total number of videos utilized is 12 (twelve), as detailed below: 9 (nine) from the Potret YouTube account, 1 (one) from Cultural Preservation Organization for Region I YouTube account, 1 (one) from the National Geographic Indonesia YouTube account, and 1 (one) from the Don Seco account. The websites looked into include the Toba Caldera UNESCO Global Geopark Information Center (<https://calderatobageopark.org>),

Lake Toba Authority Executive Agency (<https://www.bpodt.id>), and the Lake Toba Lovers Foundation (YPDT-<https://danautoba.org>).

Table 1. Number and distribution of articles by year and language

Year	Conference Paper		Journal		Total
	Indonesian	English	Indonesian	English	
2000	-	-	-	1	1
2003	-	-	-	1	1
2012	-	-	-	1	1
2015	-	-	1	-	1
2017	-	1	-	1	2
2018	-	4	1	2	7
2019	2	4	1	1	8
2020	-	2	5	-	7
2021	-	3	6	3	12
2022	-	1	6	5	12
2023	-	1	7	5	13
2024	-	1	3	7	11
Total	2	17	30	27	76

### 3. Results and Discussion

#### 3.1 Tourism attractions in DPN Lake Toba

Lake Toba tourism stakeholders agree in the RIDPN Lake Toba 2024-2024 to encourage holistic development. *Marsipature Hutana*'s vision for tourism development in DPN Lake Toba is to ensure that the growth of tourism contributes to the development of the Batak Toba tribe's home area. Lake Toba, the "Caldera of Kings," symbolizes this area. The image of Lake Toba tourism development also represents the Batak Toba tribe's cultural elements: (a) Samosir Island; (b) the boraspati (gecko), symbolizing adaptability; (c) the gorga art, symbolizing prosperity; and (d) the three bolit, symbolizing colors of the Batak Toba tribe from DEBATA MULA JADI NABOLON.



Fig. 3. Theme of the DPN Lake Toba area  
(Presidential Regulation Number 89 of 2024)

Three bolit represent the Batak Toba tribe's beliefs: white (*banua ginjang*), which represents that one should always do good in order to enter heaven; red (*banua tongah*), which represents blood and existence on earth; and black (*banua toru*), which represents death after life on earth (Siburian, 2022). The DPN Lake Toba is divided into six Key Tourism Areas (KTA). The Key Tourism (KTA) each with natural, cultural, and man-made tourist attractions based on geological, biological, and cultural diversity.

Table 4. Lake Toba KTA delineation

KTA	Sub KTA	District	Regency location
Parapat	Parapat-Ajibata	Girsang Sipangan Bolon	Simalungun
	Sibaganding	Girsang Sipangan Bolon	Simalungun
	Sibisa	Ajibata	Toba
Simanindo	Tuktuk-Tomok-Ambarita	Simanindo	Samosir
	Simanindo	Simanindo	Samosir
	Aek Natonang	Simanindo	Samosir
Pangururan	Pangururan	Pangururan	Samosir
	Parbaba	Pangururan	Samosir
	Huta Namora	Pangururan	Samosir
Balige	Balige	Balige	Toba
	Lumban Pea	Balige	Toba
Muara	Muara	Muara	Tapanuli Utara
	Baktiraja	Baktiraja	Humbang
Merek	Tongging	Merek	Hasundutan
			Karo

(Presidential Regulation Number 89 of 2024)

Table 5. Tourism attractions in DPN Lake Toba

Regency	No	Tourist attraction	Type of tourist attractions			District	KTA
			Nature	Culture	Man-made		
Dairi	1	Kodon Palezoic Basement	√			Silalahi	KTA
	2	Silalahi Volcanic Debris	√			Sabungan	Merek
	3	Silalahi Renun Caldera Wall	√				
	4	Silahisabungan bease	√				
	5	Sigadap stone		√			
	6	Silalahi monument		√			
Humbang Hasundutan	7	Bakara-Doloksanggul, Caldera Sequence	√			Baktiraja	KTA Muara
	8	Bakkara Panoramic View	√				
	9	Bakkara-Tipang, Welded OTT	√				
	10	Janji waterfall	√				
	11	Simamora island	√				
	12	Tombak Sulu-sulu, Limestone		√			
	13	King Sisingamangaraja palace		√			
	14	Tipang tourism village		√			
	15	Tombak Hatuanan		√			
	16	Aek Sipangolu, sacred water well		√			
	17	Hariara Tungkot, archaeological site		√			
	18	Hundul-hundulan stone, sacred site		√			
	19	Sipinsur, Botanical Garden			√	Paranginan	



	20	Sipinsur Information Kiosk		√		
	21	Sipinsur, landform panoramic view	√			
	22	Tao Silosung, sacred pool	√		Lintong Nihuta	
Karo	23	Sipiso-piso Volcanic Cone	√		Merek	KTA Merek
	24	Sipiso-piso waterfall	√			
	25	Tongging village, Paleozoic Basement, caldera wall	√			
	26	Kodon-kodon Caldera Wall	√			
	27	Gajah Bobok mountain	√			
	28	Sapo Juma	√			
	29	Sibuatan hill	√			
	30	Dokkan village, traditional village		√		
	31	Simalem Resort, agrotourism		√		
Pakpak Bharat	32	Mbibulu waterfall	√		Tinada	KTA
	33	Lae Una waterfall	√			Simanindo
	34	Delleng Sindeka	√			
	35	Sisingamangaraja XII fortress		√		
Samosir	36	Hoda Stone beach	√		Simanindo	KTA
	37	Simanindo Terrace Sediment	√			Simanindo
	38	Lava Desit Ambarita	√			
	39	Kubah Dasit Tuktuk	√			
	40	Tomok lake	√			
	41	Aek Natonang lake	√			
	42	Sigarattung waterfall	√			
	43	The Stone Chair of King Siallagan		√		
	44	Sipalaka Siallagan archeological site		√		
	45	Tomb of King Sidabutar		√		
	46	Ambarita village		√		
	47	Tuktuk village		√		
	48	Tomok village		√		
	49	Silimalombu Eco-Lodge		√		
	50	Huta Hotang Desa		√		
	51	Huta Bolon museum			√	
	52	Martoba		√		
	53	Aek Rengat	√		Pangururan	
	54	Sidihoni lake	√			
	55	Hutatinggi Landform Panoramic View	√			
	56	Hutatinggi Debris Flow Deposit	√			
	57	Hutatinggi Lacustrine Deposit Sequence	√			

	58	Hutatinggi Diatomae-Lacustrin Deposit	√			
	59	Air Pangururan	√			
	60	Parbaba beach	√			
	61	Situngkir beach	√			
	62	Tandarabun beach	√			
	63	Lava Dasit Sianjur Mulamula	√		Sianjur Mulamula	
	64	Lava Dasit Batu Parhorasan	√			
	65	Siboro Limestone Volcanic Contact	√			
	66	Naisogop waterfall	√			
	67	Sawan stone	√			
	68	Aek Sipitu Dai, sacred bath	√			
	69	Simpang Limbong Metapebby Mudstone	√			
	70	Traditional Batak House		√		
	71	Hobon stone		√		
	72	Traditional House Sopo Guru Tatea Bulan		√		
	73	Geopark Information Center			√	
	74	Tele View Tower			√	Harian
	75	Simpang Harian Welded Olders Toba Tuff (OTT)	√			
	76	Simanuk Hydrothermally Altered YTT	√			
	77	Efrata waterfall	√			
	78	Holbung hill	√			
	79	Tele Pine Forest	√			
Simalungun	80	Parapat, Non & Semi Welded YTT	√		Girsang Sipangan Bolon	KTA Parapat
	81	Patrajasa, Welded YTT Tilt Blocks	√			
	82	Monkey Forest Sibaganding Limestone	√			
	83	Bung Karno's Exile House		√		
	84	Geopark Information Center (GIC) Parapat			√	
	85	Aek Nauli elephant conservation center			√	
	86	Water Fun Nine, amusement park			√	
	87	Muka Air Parapat Tourism, Free Beach	√			Dolok Pardamean
	88	Tigaras beach	√			
	89	Simalungun palace		√		Purba
	90	Simarjarunjung hill	√			

Tapanuli Utara	91	Tanjung Unta	√		Pematang Sidamanik	
	92	Haranggaol, Welded Middle Toba Tuff (MTT)	√		Haranggao I Horison	
	93	Haranggaol Non Welded YTT	√			
	94	Haranggaol Welded Haranggaol Dacitic Tuff (HDT)	√			
	95	Haranggaol Andesitic Lava	√			
	96	Sigumbagumba beach	√			
	97	Huta Ginjang Plateau- YTT Hydrothermally- alteration, landform panoramic view	√		Muara	KTA Muara
	98	Tapian Nauli, Non- welded YTT Plateau	√			
	99	Tapian Nauli Brecciated Lava	√			
	100	Dolok Martumbur, Mesozoic Meta- sandstones	√			
Toba	101	Sibandang, volcanic cone	√			
	102	Sibandang-Pardepur Post-calderic volcanic formations (Sibandang village)		√		
	103	Ulos village, Muara		√		
	104	Situmurun waterfall	√		Lumban Julu	KTA Parapat
	105	Situmurun Uluan Block	√			
	106	Paleozoic Basement Caldera Wall waterfall	√			
	107	Jangga Dolok village, traditional village		√		
	108	Huta Bagasan, traditional home		√		
	109	Eden 100 botanical garden			√	
	110	Sigapiton village		√		Ajibata
	111	Gibeon hill, 13/5,000 Characters religious tourism		√		
	112	Toba Caldera Resort			√	
	113	Liang Sipege, Limestone Caldera Wall	√		Balige	KTA Balige
	114	Basiha Stone, Prismatic Joints, Andesitic Lava	√			
	115	Lumban Silintong beach	√			
	116	Lumban Bulbul Pantai		√		



117	Onan Balerong traditional market	√		
118	Tomb of King Sisingamangaraja XII	√		
119	T.B. Silalahi museum		√	
120	Huta Tinggi Parmalim, religious tourism	√		Laguboti
121	Tarabunga hill	√		Tampahan
122	Meat village, Paleozoic basement caldera wall	√		
Total		74	36	22

Table 6 features videos showcasing the natural beauty of Lake Toba and the strong social connection between the Batak Toba tribe and its environment. These videos highlight the tribe's livelihoods, cultural traditions, and efforts to ensure the long-term sustainability of Lake Toba ecosystem services. The video Balige City of Memories and Stories from North Tapanuli is an example of the realization of Marsipature Hutanabe. The Megalithic Samosir Film is an example of the origins and remnants of the Batak Toba tribe's geosite. The video Panorama Toba Caldera and Geopark Caldera Toba illustrates the formation process and the natural beauty of Lake Toba. The video "*Mardoton*" illustrates the community's connection to Lake Toba's waters as fishermen.

Table 6. Video of the DPN Lake Toba tourist attraction and cultural values of Batak Toba tribe

No	Video title	Video descriptions	Video resource
1	Panorama Toba Caldera	The Kaldera Toba Nomadic Escape tourism offers breathtaking scenic beauty.	<a href="https://youtu.be/zYlItvRr0i8?si=1ZZNH5XaCxU12AXY">https://youtu.be/zYlItvRr0i8?si=1ZZNH5XaCxU12AXY</a>
2	Geopark Caldera Toba	Nanda Primadana's testimony explores the history of the Toba supervolcano eruption, highlighting its geological, ecological, and cultural legacy for the Batak Toba people.	<a href="https://youtu.be/lyD7pSQo06g?si=EUHmWbVBMqokdRAI">https://youtu.be/lyD7pSQo06g?si=EUHmWbVBMqokdRAI</a>
3	Stories from Batak Land – Bakara	Sisingamangaraja XII, the national hero of Indonesia, belongs to the Batak Toba Sinambela clan. Sinambela Village, Bakkara, has excellent landscapes, making agriculture a viable income source. The community maintains <i>partuturan</i> , and the Datu Unggul Sinambela monument aids in genealogy by helping people remember their origins and ancestors.	<a href="https://youtu.be/4EltfAX31cE?si=4wUq3vPxTmN-CKAP">https://youtu.be/4EltfAX31cE?si=4wUq3vPxTmN-CKAP</a>
4	The tallest statue of Jesus in the world is located at Kilau Permai Hariara Pohan	Hariara Pohan village boasts a 3-century-old sarcophagus, Sampuran Bala, a sacred spring, and a flash flood tragedy, while Siparmahan Village faces challenges in tourism development.	<a href="https://youtu.be/EHHD4reKTYo?si=XmdjHjGS3KOHGLXj">https://youtu.be/EHHD4reKTYo?si=XmdjHjGS3KOHGLXj</a> see to <a href="https://youtu.be/yUtnA4teIVc?si=Ey5iBBQR_omuuG5y">https://youtu.be/yUtnA4teIVc?si=Ey5iBBQR_omuuG5y</a>
5	Explore Samosir Island   Lake Toba	Tomok Village and Tuktuk Village offer tourist attractions, while German citizen Annette Horchmann Sialagan promotes environmental sustainability through ecoenzymes. Widow Tiurma Situmorang cultivates Batak Toba-specific spices, raising	<a href="https://youtu.be/2cF39wzgjdk?si=5jG_1QJGxeXmNFOo">https://youtu.be/2cF39wzgjdk?si=5jG_1QJGxeXmNFOo</a>

		children independently. <i>Panitian</i> dance studio preserves and sustains tribe's dances.	
6	Simalungun Nada Movement	Laura Tyas Avionita Sinaga, founder of Simalungun Home Dancer, has successfully preserved the Simalungun dance. The neglected Bolon Simalungun home requires urgent renovation.	<a href="https://youtu.be/dsdpzho6qnU?si=C7VNAa3cGU_Odt0t">https://youtu.be/dsdpzho6qnU?si=C7VNAa3cGU_Odt0t</a>
7	Balige City of Memories	Balige market ( <i>onan</i> ) is a local market for Lake Toba's ecosystem services. <i>Andaliman</i> pizza is a popular Italian-style Batak dish. <i>Sarung</i> is a popular souvenir in Balige. <i>Gorga</i> woodworking uses naturally perished trees for coffins and Batak houses. <i>Pondok Berata Dapdad</i> , a guesthouse, offers water tourism activities like canoeing and swimming.	<a href="https://youtu.be/eEw7eRd4yLg?si=Khikt0e1nwZgzRiM">https://youtu.be/eEw7eRd4yLg?si=Khikt0e1nwZgzRiM</a>
8	Stories from North Tapanuli	<i>Marsipature Hutana</i> showcases Batak Toba people's dedication to their homeland. Piltik Coffee, Pea Nature, and human-made products like Bonapasogit Sipaholon guitar, <i>Martabe</i> Sipaholon peanuts, and Dame Ulos.	<a href="https://youtu.be/A26ANIZPSWs?si=siirLt6gdlWXlkn4">https://youtu.be/A26ANIZPSWs?si=siirLt6gdlWXlkn4</a>
9	Silalahi Pearl of Lake Toba	Tongging Village in Merek District, Karo Regency, boasts the Sipisopiso waterfall and the Silahisabungan King noble value, <i>Poda sagu-sagu marlangan</i> , promoting harmony, love, and peace among descendants.	<a href="https://youtu.be/PGIWmd_SHQo?si=fRvtAw5gDiWtnMcA">https://youtu.be/PGIWmd_SHQo?si=fRvtAw5gDiWtnMcA</a> see to <a href="https://youtu.be/UELZaOuA6CI?si=8ux7Cofk60BBcx41">https://youtu.be/UELZaOuA6CI?si=8ux7Cofk60BBcx41</a>
10	Embracing Batak in Jabu Sihol	Daniel Ompusunggu founded <i>Jabu Sihol</i> , a resting house that preserves Batak Toba culture by teaching children script, woven cloth, and dances, promotes environmental preservation through waste recycling, enhances mental well-being through training and mentorship, and encourages visitors to share expertise.	<a href="https://youtu.be/nkLf04gdZys?si=emTJG9PnZ0WGDk5z">https://youtu.be/nkLf04gdZys?si=emTJG9PnZ0WGDk5z</a>
11	Stories from the Land of Batak-Ulos	<i>Ulos Huta Dame</i> , a village in Silindung, Tarutung, North Tapanuli Regency, is known for its Batak Toba ulos weaving industry. The Huria Kristen Batak Protestan (HKBP) Dame Church was built by German missionary Ompu IL Nommensen. Dame Ulos gallery helps 50 ulos weavers improve their livelihoods and preserve their cultural heritage.	<a href="https://youtu.be/LCulhwsK8hA?si=0jo6eN3P5ApmU006">https://youtu.be/LCulhwsK8hA?si=0jo6eN3P5ApmU006</a>
12	Megalithic Samosir Film	The megalithic sites on Samosir Island also reveal the origins of the Batak Toba tribe.	<a href="https://youtu.be/5PTYxsrHD3I?si=d_K7A1hs03BS_G20">https://youtu.be/5PTYxsrHD3I?si=d_K7A1hs03BS_G20</a>
13	<i>Mardoton</i> , Cultural Wisdom of Lake Toba	<i>Mardoton</i> , a traditional fishing method in Lake Toba, is thriving in Tuktuk Siadong, Samosir Regency, despite water contaminants causing its decline.	<a href="https://youtu.be/_g7Pd0oTsE?si=ewu8bDUFl7MJgmhv">https://youtu.be/_g7Pd0oTsE?si=ewu8bDUFl7MJgmhv</a>

14	Heart of Toba Official Movie	The video features a kayaker exploring Lake Toba, searching for the Batak Toba paddle artifact ( <i>solu</i> ), and visiting cultural and historical sites along its shores. Viewers who watch this video can experience the beauty of Lake Toba via the waterway.	<a href="https://youtu.be/EWInoVB70WE?si=nnmy7kTTPcPgUXwG">https://youtu.be/EWInoVB70WE?si=nnmy7kTTPcPgUXwG</a>
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### 3.2 Cultural heritages of the Batak Toba tribe demonstrate environmental value

The Batak Toba tribe is renowned for its rich culture, rituals, and kinship. The Batak Toba tribe focusing on Marga (clans), *dongan sabutuha* (born from the same womb), and partuturan (genealogy between clans). Their culture promotes social interactions, respect, and harmony in managing natural resources in Lake Toba, contributing to the sustainability of community life and environmental benefits (Napitu et al., 2022).

First, *Aek do Hangoluan* emphasizes the importance of protecting Lake Toba's water, as it is considered a life-source and destroying it is punishable by the "lake's lord" (Simatupang et al., 2022). The interconnected nature of land (*tano*), plants (*suan-suanan*), and water (*aek*) symbolizes the Batak Toba community's relationship with the lake and their wise treatment of nature (Napitu et al., 2022). The trait of *mongkus* (greed) will lead to disaster.

Second, *Poda na lima* (five cleanliness maxims) is a local wisdom passed down through centuries, guiding individuals to live a clean, healthy physical, and spiritual life (Sibarani et al., 2021). It benefits personal health and the environment. In Batak Toba culture, *Poda* (mandate and advise) represents interactions between humans and God, one another, and the environment. It emphasizes wise use of the planet and its resources wisely and prudently (Nababan & Sari, 2022). *Poda na lima* examples as follow (Sibarani et al., 2021; Napitu et al., 2022): (a) *Paias roham* refers to cleansing the soul, mind, feelings, and heart. For instance, the phrase "*marbahul bahul nabolon, jala marlambok ni roha*" refers to being generous and always patient. (b) *Paias pamatangmu* involves maintaining physical fitness by washing hands and clothes. Example: *usa tanganmu* (wash your hands, clean your hands). (c) *Paias paheanmu* means clean your clothes. Example: *paias abitmu* (washing your clothes). (d) *Paias bagasmu parabitanmu* involves cleaning the house and environment. Example: *sapu jabum* (sweep the yard; sweep your house). (e) *Paias alamananmu* involves cleaning the environment. For instance, *papungu angka plastic dohot harotas na di jolo jabum* (gather all the plastic and paper from your yard) or *baen parapian asa gabe tarutaru angka sampah* (make a compost pile to reduce waste). *Poda na lima* is a guideline for Batak Toba community to maintain their physical and non-physical environment, promoting active participation in activities and environmental preservation (Napitu, et al., 2022). *Poda na lima* deal with personal health, ensuring that everyone is clean and healthy physically, behaviorally, and intellectually. *Poda na lima* may be practiced more broadly because it is relevant and simple to use.

Third, *Marsirimpa* a Batak Toba tribe cultural treasure, symbolizes unity, synchronization, and togetherness. It promotes social cooperation through solidarity and harmony, similar to other cooperative practices like *masiurupan*, *rampak mangula*, *marsisolisoli*, and *masitungkol-tungkolan*. Implementation of *marsirimpa* involves working in turns and promoting mutual support, as per Sibarani (2018): (a) *marsiadapari* or *marsialapari* refers to the practice of working together in the agricultural fields alternately; (b) *marhobas* means working together in traditional ceremonies; (c) *marjule-jule* refers to giving assistance, such as money or rice, to a village resident during a traditional ceremony; (d) *mangindahani* refers to the practice of providing cooked rice to village residents who participate in a traditional ceremony; (e) *manumpahi* is the act of voluntarily giving money to the person who invites you to attend a traditional ceremony; (f) *mangulosi* refers to the act of giving traditional ulos cloth in the Batak Toba tradition; (g) *mamboan sipir ni tondi* is known as giving rice to help finance a traditional ceremony; (h) *margugu* means raising funds for community needs; (i) *mangalelang* refers to the process of raising funds for the purpose of building public facilities for residents, such as places of worship; (j) means

helping residents in need; (k) *marsipature hutana* refers to the process *masiurupan* of returning migrants to their hometown; (l) *pauli dalan*, *pauli mual*, and *pauli bondar* mean together improving public facilities. We can use *Marsirimpa* as a cohesive, simultaneous, and collective community service activity to restore, maintain, and preserve the environmental sustainability of Lake Toba. Therefore, it is beneficial to jointly protect Lake Toba from environmental threats and degradation, as well as to help improve the economy and welfare of the Batak Toba community.

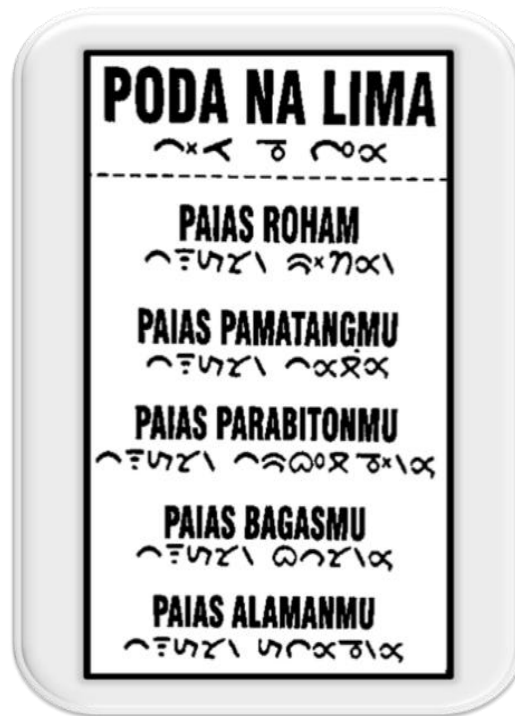


Fig. 5. *Poda na lima* with Batak Toba script

Fourth, *Martutu aek* is a traditional ritual in Batak Toba that emphasizes the connection between humans and nature, particularly water. It highlights the importance of water as a purification element and a symbol of life. *Martutu aek* highlights the Batak Toba community's deep appreciation for nature as a part of God's creation (Manalu, 2024). *Martutu aek* teaches about the importance of the source of human life—that everything on earth is water (Nababan & Sari, 2022). Fifth, *Mambongoti Bagas* is a traditional practice in Pematang Siantar, involving special ceremonies and rituals. It embodies values of mutual cooperation, respect for ancestors, and reverence for nature, serving as a symbol of unity between humans and nature, guiding daily life (Sitompul & Dora, 2024).

Sixth, *Manggotil eme* is an indigenous practice in Sigapiton Village, Ajibata District, Toba Samosir Regency, involving rice harvesting. It emphasizes mutual cooperation, diligent effort, commitment, and gratitude for blessings from God, highlighting the importance of avoiding errors in human actions for positive outcomes (Limbong et al., 2021). Seventh, local wisdom *bohi ni huta-dalan*, *bohi ni jabu-alaman* means how important it is to maintain cleanliness for the Batak Toba community, both environmental cleanliness and the cleanliness of the house itself (Siagian et al., 2018). Eight, *Mangallang babi ambat* and *Mangelek habonaran* are ceremonies for preventing natural disasters and providing relief after calamities. *Solu Bolon* sends young people across Lake Toba for education or employment, accompanied by gondang music, showcasing the interaction between humanity and the Lake Toba ecosystem (Pardosi et al., 2024).

Ninth, the legend of the *Sulu-Sulu* spear may be found at Bakkara Valley, Marbun Tonga Marbun Dolok Village, Baktiraja District, and Humbang Hasundutan Regency. This hamlet is thought to be the birthplace of King Sisingamangaraja I. The Legend of *Sulu-Sulu* spear has ecological ideals, such as (a) respecting nature; (b) living in harmony with nature; (c)

carefully exploiting natural resources; (e) designating places as an identity and interaction of culture, nature, and environment; and (f) nature as a spiritual channel. Nature is more than simply an item or physical surroundings; it is an entity with spiritual and moral force (Latifah et al., 2022).

Tenth, the legend of the *Sulu-Sulu* spear, located in Bakkara Valley, Marbun Tonga Marbun Dolok Village, Baktiraja District, and Humbang Hasundutan Regency, is believed to be the birthplace of King Sisingamangaraja I. It promotes ecological ideals, such as (a) respecting nature; (b) living in harmony with nature; (c) carefully exploiting natural resources; (e) designating places as an identity and interaction of culture, nature, and environment; and (f) nature as a spiritual channel. Nature is more than simply an item or physical surroundings; it is an entity with spiritual and moral force (Latifah et al., 2022).

Eleventh, *The Jabi-jabi* folktale communicates a lesson to decrease tree-cutting operations since trees are tools for human and environmental peace. *The Harbangan* message is that trees, water, and humanity are interdependent and must be conserved. *Aek sitapangi* communicates the notion that water is a vital resource for people and other biota. *Aek baringin* conveys the concept of conserving water as a source of life. *Mual sitonggi-tonggi* conveys the idea that water is a vital resource that must be protected for future generations. The Batak Toba folktale helps to maintain the Lake Toba ecosystems.

Twelfth, *The Bolon house*, a traditional Batak Toba dwelling, promotes sustainability and environmental stewardship through architectural principles like respect for people and site, low impact, high family contact, and comfort (Ongkojoyo & Santoso, 2023). It also holds symbolic significance based on Batak tribe beliefs: *banua ginjang*, *banua tengah*, and *banua toru*. Thirteenth, song lyrics are a form of written communication that express the creator's thoughts and emotions. *Nahum Situmorang's* song, *O Tao Toba*, celebrates Lake Toba's beauty. In 2022, MAXIMA and Michael Hutagaol rewrote and performed the song, creating an immersive experience.

<i>Angka dolok na timbo</i>	every high hill
<i>do manghaliangi ho</i>	surrounds you
<i>o tao toba na uli</i>	oh beautiful Lake Toba
<i>tapiamu na tio i tongtong</i>	your clear waters
<i>di bahen ho dalam lao tu pulomi</i>	you always make as a way to invite people
<i>O tao toba</i>	O Lake Toba
<i>raja ni sude na tao</i>	King of all lakes
<i>tao na samurung na lumobi ulimi</i>	You are so beautiful, your beauty surpasses all
<i>molo huida rupami sian na dao</i>	others
<i>tudos tu intan do denggan jala uli</i>	When I see your face from afar
<i>barita ni hinaulim di tano on</i>	Like a beautiful diamond
<i>umpama ni hinajogim di portibi on</i>	The news of your beauty in this place
<i>mambahen masihol saluhut ni nasa bangso</i>	Has been heard in all corners of the world
<i>mamereng ho o ta... o toba na uli..</i>	Making all nations always long
	To see you, oh beautiful Lake Toba

S. Dis Sitompul's 1990 song *Tano Toba*, rearranged by Adventis Dear, was sung by Tabita Sipahutar in 2024, highlighting the abundance of rice in Lake Toba.

<i>tano toba tano namartua</i>	Toba land, the fortunate land
<i>tarbarita tarbarita tu bariba</i>	Famous, renowned across the sea
<i>tano toba tano namartua eme gok</i>	Toba land, the fortunate land, rice is abundant
<i>sahali pe mangula dainang</i>	Only once did mother plow
<i>martaon marbulan butong mangan da amang</i>	For years, for months, your father ate well

Lake Toba is praised in various songs, including *Tao Toba Nauli* (2018) by Wervin Panggabean, *Pulo Samosir* (1950) by Nahum Situmorang, *Memori Tao Toba* by Jonar Situmorang, *HORAS!* (2023) by Dorman Manik, and *Bagas Pei Danau Toba* (2022) by Ranto

Purba. The song *Danau Toba* (2022), popularized by Tongam Sirait and Friends, expresses a sad lament (*andung-andung*) about the lake's condition, with lyrics describing the disappearance of birds, mountains, trees, and the lake's water, which has now become murky. Tongam Sirait composed *Tapature Ma Hutanta* to encourage the Batak Toba community worldwide to rebuild their hometown while simultaneously addressing the environmental damage to Lake Toba.

We should instill in the Batak Toba community the importance of living peacefully and caring for Lake Toba. There is an inextricable link between the Batak people and Lake Toba. *Dang tarsirang halak Batak dohot Tao Toba* (Lake Toba cannot exist without the Batak people). The Batak Toba tribe will always rely on, interact with, and integrate Lake Toba into their generational social and cultural structure.

### *3.3 Destruction of the environment endangers Lake Toba*

Since the Bali Agreement of 2009, efforts to protect Lake Toba from pollution and environmental damage have been undertaken, while the impact of these restoration efforts has not yet shown significance (Simatupang et al., 2022). The Bali Agreement was followed by 12 integrated action plans for Lake Toba management, signed by the Governor and 7 mayors from the Lake Toba region in 2016. However, the importance of the Batak Toba tribe's cultural acculturation for environmental restoration and lake protection is ignored. Actions and policies are largely top-down and government-centric.

Lake Toba, a popular destination for tourism and economic activities, has been harmed by pollution from domestic activities like company operations, livestock farming, agriculture, fisheries, forestry management, and waste from homes (Napitu et al., 2022), and has even been criticized as the world's giant landfill for trash and waste. Lake Toba is no longer valued; instead, it is viewed only as a resource for the local community and company operations (Pasaribu et al., 2022). The following environmental degradation poses a threat to Lake Toba:

First, eutrophication due to fish pellet disposal. Eutrophication, caused by pellet dumping from floating net cage (KJA) operations, leads to high nitrogen and phosphorus levels, reducing phytoplankton diversity in Lake Toba (Hutajulu & Harahap, 2023). Organic waste and feces from pellet consumption will accumulate at the bottom of the lake. The community is now struggling to obtain clean water for daily needs due to water pollution from eutrophication.

Second, the water quality is declining and does not meet the quality standards. Research on water pollution by Silaen (2022) found that Lake Toba's water quality is poor and moderately contaminated. The closer you get to the fish cages, the more the water changes color, smells and tastes like fish, and has a fishy stench. Numerous additional studies, such as those by Damayanti et al. (2022), Lukman et al. (2019), Harianja et al. (2019), Silaban & Silalahi (2021), and Fukushima et al. (2023), conclude Lake Toba's water quality is polluted, which is undeniable. The water quality of Lake Toba in Toba Samosir Regency is not suitable for raw water and water tourism (Garno et al., 2020).

Third, floating Net Cages (KJA) for freshwater aquaculture. KJA has been present in Lake Toba since around 1986; in Haranggaol Village, Simalungun Regency, it is overseen by 335 farmers, whereas in Silima Lumbu Village, Samosir Regency, it encompasses approximately one hectare. Statistics from the Livestock Feed Corporations Association for 2020 indicate that the community manages 30 hectares of KJA, while companies maintain 16.5 hectares of KJA (Pardosi, 2024). KJA is typically produced from cobalt drums or repurposed barrels, which contaminate the lake water (Hutajulu & Harahap, 2023).

KJA is causing a decline in Lake Toba's water quality (Manik & Astuti, 2019; Ardiani et al., 2023), affecting fish species that are nearing extinction, such as the Batak fish (*ihan batak* and *pora-pora*) (Hutajulu & Harahap, 2023). Water hyacinth proliferation in lake ecosystems also contributes to water pollution, affecting raw water sources (Ardiani et al., 2023; Hutajulu & Harahap, 2023). The water becomes murky, taking on a hue of algae and filth, jeopardizing the source of raw water for residential areas (Gultom, 2023). KJA leads to

abiotic depletion and toxicity due to farmers utilizing rusty drums, discarded oil containers, and nets containing carbon components (Fatimah et al., 2023). The government's repeated promises to achieve a zero KJA The restoration of Lake Toba's clarity has not yielded any tangible results thus far. Despite numerous conversations about rescue, no action has taken place. Implementing current programs is adequate. The community has long desired comprehensive lake management, particularly as coastal inhabitants continue to rely on lake water for drinking and other everyday requirements (statement from Renward Sianturi, a resident on the shores of Lake Toba, Untemungkur Village, Muara District in Simatupang et al., 2022).

Fourth, forest fire, walhi North Sumatra reports yearly forest fires near Lake Toba. There were forest fires reported in 2023. Fires broke out in 2024 in the protected forest of Siarabung, Dolok Sijonaha, Sipitu Dai Village, Sianjur Mulamula District, Samosir Regency, causing biodiversity loss, habitat devastation, and land degradation (Walhi North Sumatera, 2024). Fifth, the activity of C company involves cutting down trees to produce pulp and paper. Company C, which changed its name to Company D, is causing damage by deforesting the area around Lake Toba. The Ministry of Forestry granted a business license to Company C in 1984 to exploit 86 thousand hectares of pine forest, which then increased to 150 thousand hectares in 1986. The impact on the people of Porsea includes the inhalation of a foul smell, damage to agriculture due to water, air pollution, and skin itching. The company's waste is dumped along the flow of the Asahan River, making it difficult for the community to obtain a source of raw water for daily needs. The trees that have been cut down are replaced with eucalyptus, which is water-hungry. Rainfall has become infrequent; the catchment area has diminished and deteriorated, causing the lake's water level to decrease. The risk of landslides and flash floods at any time when heavy rain falls has become a fear for the local residents because the upstream forest has been damaged (YPDTa, 2021; YPDTb, 2021). Unsustainable corporate business practices and capitalism have resulted in the exploitation of natural resources and environmental harm, destroying the Tapanuli forest and ecosystem (Pasaribu et al., 2022).

The village of Bulu Silape, located in the Pardomuan, Silaen District, Toba Regency, was become a "ghost village" after its residents abandoned it following torrential rain on the night of November 25, 1989. This deluge triggered a sudden landslide on Dolok Tampean hill, leading to 13 fatalities, the demise of pigs and buffalo, and extensive damage to 55 hectares of rice fields (YPDTc, 2021). Company D's presence was undermining social relations within the village, to the point where no longer feel united as brothers (*dang mardomu akka na marhaha maranggi di huta alani D on*). The residents have petitioned the Tapanuli Utara Regional People's Representative Council and the Tapanuli Utara Regent for the closure of Company D but have not received a satisfactory response. One of the residents, Nai Togu (Mrs. T), delivered a hopeful speech in front of the Tapanuli Utara Regent's office.

*"Mandok mauiate do hami tu Mr NN, ala boi hami ro tuson. Di dok amang, asa hu catat hami nomor ni amang asa boi hita muse pajumpang manghatai di rumah dinas. Alai amang, piga hali huhubungi hami nomor na dilehon ni staf ni amang tu hami, dang hea diangkat amang. Ingkon di aksi on ma hape hita pajumpang amang. Turun ma amang, bege amang hami di son, lehon amang ma rekomendasi asa ditutup D dohot dipaulak tano nami"*

*(we are very thankful to Mr. NN, who has been our leader. We should take note of your number so that we may meet and talk at the official house. But, Sir, we have frequently called the number provided to us by your personnel, but it has never been answered. If the action is taken, we shall meet, Sir. Get down, Sir. We are here, hear us. Please give instruction that D company must be closed therefore we can return to our home land (YPDTd, 2021).*

Sixth, over consumption of water by E company for processing aluminum. Company E's aluminum processing activities have led to a decrease in Lake Toba's water depth, with a



decrease of 5 meters from 1984 to 1996 and another 2-3 meters from 2015-2018 (Napitu, et al., 2022). Seventh, pig farming waste. Company F, operating in 1995, manages a pig farm in Purba District, Simalungun Regency, discharging roughly 1,200 tons of pig manure daily into Lake Toba via the Silali River (Napitu et al., 2022). Eighth, red devil fish invasion (*Amphilophus citrinellus*). Native to Nicaragua and Costa Rica, Indonesia has bred the red devil fish, also known as oscar fish, red flowerhorn, and nonong. It is a predator, greedy, and disruptive, causing ecological problems in inland waters since the 1990s (Umar et al., 2015), not only in Lake Toba but also in Jatiluhur Reservoir, Cirata, Saguling, Darma, Wadas Lintang, Kedung Ombo, Sermo, Lake Batur, and Sentani. The red devil fish is suspected of having been released carelessly by the local community. The released red devil fish have preyed on endemic fish in Lake Toba (Lumbanraja & Nasution, 2024). The catch is no longer abundant; the red devil fish eats the eggs of fish that are native to Lake Toba, such as tilapia and pora-pora fish. The red devil fish, when caught, has no market value. If not addressed immediately, Lake Toba will gradually be inhabited by this predatory fish. The Indonesian Fishermen's Association of Lake Toba hopes that the local government and the North Sumatra Provincial Government will monitor the fish stocking in the lake. So far, there have been no regulations or oversight, allowing anyone to freely release fish.



Fig. 6. Red devil fish  
 ((a) <https://www.radiodelfm.co.id>; (b) <https://www.rri.co.id>)

### 3.4 The strategies of acculturation and internalization of Batak Toba cultural heritages contribute to the sustainability of Lake Toba ecosystem services

The Batak Toba community's cultural values significantly impact the sustainability of Lake Toba's ecosystem services. Traditional ecological wisdom and cultural ecology are seen as viable paths for community survival and will influence the community to preserve the Lake Toba area (Nababan & Sari, 2022). The achievement of the Batak Toba tribe's ancestors in maintaining the natural ecosystem of Lake Toba, which produced descendants known as pomparan, should guide future life. Revitalizing cultural values in the contemporary context that align with environmental preservation will help the future young generation understand and participate.

The theological cultural approach will aim to encourage understanding and foster the Batak Toba tribe's responsibilities towards nature, based in Christian religious doctrine. Huria Kristen Batak Protestan (HKBP), the largest congregation of the Batak Toba ethnic community in the Lake Toba region and Indonesia, is promoting environmental awareness and eco-friendly practices. The ecological spirituality promoted by the church can foster a collective effort within the congregation to adopt environmentally sustainable practices (Simangunsong et al., 2024). The Batak Toba community's solidarity with nature is significant and valuable. The Batak Toba community's eco-theocentric ethics encompass living harmoniously with nature, managing it fairly, and exercising self-control to prevent irresponsible exploitation (Gule & Surbakti, 2021).

The Batak Toba tribal community's kinship is extremely strong, manifesting itself through clan connections (parsadaan or punguan). Every clan of the Batak Toba tribe, no matter where they are, will undoubtedly be coordinated under a parsadaan or punguan,

complete with a legal document and bylaws. The members' engagement and activities in the *parsadaan* or *punguan* are often positive, as seen by mutual support during crises or misfortunes, births, weddings, or deaths. Although somebody in a clan occupies an honorary position, the concepts of equality and unity must be strictly followed. Strong and positive social and cultural relationships may be realized by imparting compassion and affection for the environment and Lake Toba's future, including restoring present environmental degradation.

#### 4. Conclusions

The study provides a significant ecological and cultural connection between the Batak Toba tribe and Lake Toba, tracing back to their ancestral lineage. Their connection is thus unbreakable. The Batak Toba tribe's initiatives to protect Lake Toba's ecological services will significantly influence their existence, historical narrative, present condition, and future prospects. Failing to avert detrimental actions against Lake Toba, particularly in shielding it from destructive corporate practices, may exacerbate the risk of catastrophic occurrences and jeopardize the preservation of the Batak Toba community. The restoration of the Batak Toba tribe's cultural heritage in contemporary contexts will advantage the younger generation, enabling them to engage in protecting their culture while simultaneously sustaining Lake Toba's ecological services.

The limitation of this research lies in accurately assessing the younger Batak Toba generation's understanding of protecting and preserving Lake Toba. Additional research is necessary to better understand their sentiments, motivations, and levels of knowledge. The Batak Toba community, various synods, and clans (*marga*) should consider eco-theocentric ethics as a step forward in their acculturation process. For this eco-theocentric approach to be effective, comprehensive communication is essential. *Parsadaan* or *punguan* might align their spiritual beliefs with the preservation of the environment by embracing eco-theocentric principles.

This research should not neglect or debate the rich cultural values of the Batak Toba tribe, passed down from predecessors, which are critical to the sustainable future of the Tano Toba (land of Toba) and Tao Toba (Lake Toba). In keeping with the guiding principles of equality and solidarity, the very strong social and kinship bonds that prevail today have transformed into a social capital that can expand not only through mutual help, but also by recovering environmental damage and developing Toba land in line with the values of Marsipature Hutanabe and Marsirimpa. *Tao Toba, tao na uli, mansai arga do i, ingkon jagaon ta do i. Asa rap ma hitta paiashon tao toba i. Tao toba, tao na uli on mamboan hahipason dohot si parngoluon tu hita* (We must preserve Lake Toba, a magnificent and valuable lake. Let us collaborate to restore and safeguard Lake Toba. Lake Toba grants blessings and life to all of us).

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#### Author Contribution

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