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CULTURAL HERITAGE AND SUSTAINABLE RIVER MANAGEMENT: INCORPORATING LOCAL WISDOM IN SUBAYANG RIVER, INDONESIA

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Abstract: The Lubuk Larangan is a sustainable water resource management system that consists of a water system and a river. This study aims to explore the potential of cultural heritage and indigenous knowledge in relation to sustainable river management. The study was conducted in the villages of Gema and Tanjung Belit in the Riau Province, Indonesia. The data were collected through in-depth interviews, observation, and a review of the relevant literature. The collected data were analysed using descriptive qualitative analysis, which consisted of three stages: data reduction, data display, and conclusion drawing. The results indicate that the water system's cultural practices have played a significant role in preserving the ecosystem, sustaining natural resources, and preserving water quality in the Subayang River. This study contributes to the growing body of literature. It provides a deeper understanding of the role of local wisdom and cultural heritage in achieving long-term ecological and social sustainability. Several factors, including geographical conditions, livelihood systems, customary law, and leadership patterns, support the ecological behaviour of a community in managing river resources.

Keywords: local wisdom, Lubuk Larangan, sustainability, river management, Subayang river.

Introduction

Rivers have played a significant role in shaping human civilisations throughout history. Along with their banks, they have served as a source of livelihood, transportation, cultural source, and spiritual significance. Nonetheless, as a result of the increasing demands of industrialisation and urbanisation, rivers have been heavily exploited, with several ecological and social consequences (Tickner *et al.*, 2017; Sharma *et al.*, 2020; Wantzen, 2023).

The establishment of aquatic conservation areas as a form of protection and preservation is one of Indonesia's efforts to maintain the sustainability of its fisheries resources (Andriyono, 2018; Zamzami *et al.*, 2019). Additionally, aquatic conservation areas serve as economic drivers (Pantzar *et al.*, 2018). Within these conservation areas, aquatic nature tourism programmes that contribute to the well-being of local communities can be implemented. It is anticipated that the establishment of aquatic conservation areas will protect the quantity and quality of fish stocks, thereby preventing their overexploitation (Edgar *et al.*, 2014; Anshari & Afriansyah, 2022).

Increasing interest has been shown in incorporating indigenous knowledge and cultural heritage into the implementation of sustainable river management strategies in order to mitigate the effects of these impacts. The preservation of water resources is of the utmost importance to indigenous communities because it ensures a continuous supply of clean water for multiple uses, including drinking (Abas *et al.*, 2022)at the same time, indigenous people and their lands are facing immense threats through modernization and globalization. This study aims to systematically review and analyze the local wisdom of the indigenous people in nature conservation. The present study integrated

multiple research designs, and the review was based on the published standard, namely the PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses. Local wisdom refers to the knowledge and practices indigenous and local communities have developed over generations to manage the sustainability of natural resources (Watanabe, 2010; Ojha *et al*., 2016; Elfis *et al*., 2020). The incorporation of local wisdom and cultural heritage into river management can provide a more comprehensive and inclusive strategy for addressing the complex challenges faced by river systems. Such an approach acknowledges the significance of involving local communities in decision-making processes and integrating their expertise with scientific and technological solutions (Braga *et al*., 2017; Comptour *et al*., 2018).

The community residing in the Subayang River basin in the Kampar Kiri Hulu district has a local knowledge system for managing river resources. The name of this management system is Lubuk Larangan. The focus of this management is the conservation of the river's natural resources, including the protection of fish and the surrounding ecosystem. In addition to its ecological function, the community benefits from alternative livelihoods as tourism service providers and strengthens social ties among neighbouring communities (Kurniati *et al*., 2013). The Subayang River is one of the tributaries in the Bukit Rimbang Baling Wildlife Reserve. However, the local community continues to engage in illegal land clearing for agriculture. This needs to be taken into consideration for the river's sustainability. The larger the expansion of agricultural land, the greater the use of fertilisers. Discharged agricultural waste can flow into the river and may affect the increase in phosphate and nitrate concentrations in the river. The high concentration of these substances will promote algae growth, potentially contaminating the river's water quality. Furthermore, this damage can also disrupt the reproduction of various fish species found in the water body (Bhateria & Jain, 2016; Akhtar *et al*., 2021).

This study aims to explore the potential of cultural heritage and local wisdom in relation to sustainable river management. Through a case study approach, we will examine the river management practices of a community or region that has successfully incorporated indigenous knowledge and cultural heritage. This study contributes to the expanding literature on sustainable river management. It provides a deeper understanding of the role of local wisdom and cultural heritage in achieving long-term ecological and social sustainability. By incorporating these approaches, river management can become more culturally sensitive, socially just, and environmentally sustainable.

Materials and Methods

Study Area

The study was performed in January 2022. Figure 1 depicts the location where the study was conducted: Gema Village and Tanjung Belit Village, Kampar Kiri Hulu District, Kampar Regency, Riau Province, Indonesia. A part of the Kampar Kiri Hulu sub-district area is within the protected forest area of the Bukit Rimbang Bukit Baling Wildlife Reserve.

Procedures

Data was collected via in-depth interviews, observation, and literature review (Sairun *et al*., 2019). Interviews with key informants were conducted using the FGD (Focus Group Discussion) method. This method is a process of gathering information on a very specific issue through small group discussions. Interviews with a total of 10 informants, including 4 from the general public (*Ninik Mamak*), 2 from customary leaders, 2 from youth leaders, and 2 from village government officials of Gema and Tanjung Belit, were interviewed. The parameters in this study revolve around the management of water resources carried out by the community of Tanjung Belit and Gema Village. In accordance with Law No. 32 of 2009, Hasibuan *et al*. (2015) revised the management components related to Environmental Protection and Management

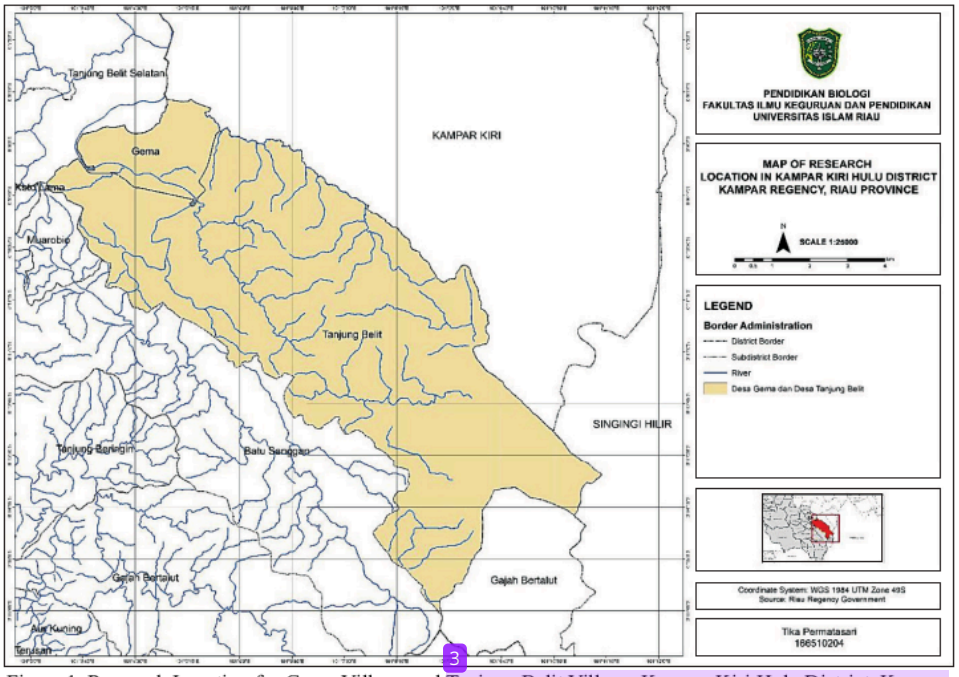

Figure 1: Research Location for Gema Village and Tanjung Belit Village, Kampar Kiri Hulu District, Kampar Regency, Riau Province, Indonesia

to include (a) planning; (b) utilisation; (c) control; (d) maintenance; (e) monitoring; and (f) enforcement of the law. Subsequently, observations were made for the biotic and abiotic environment components surrounding the Lubuk Larangan.

Data Analysis

The collected data were analysed using descriptive qualitative analysis, which consisted of three stages: data reduction, data display, and conclusion drawing. The stage of data reduction involves the process of systematically selecting, focusing on, and simplifying the data collected. The data were then displayed to visually represent the reduced data to facilitate the analysis process and make patterns and themes more apparent. The conclusion-drawing phase involves making sense of the data and developing overarching themes, patterns, and interpretations (Kurniasari *et al*., 2013).

Results and Discussion

Ecological Behavior as A Form of Local Community Wisdom

The conscious actions and attitudes that support sustainable practices, reduce waste and emissions, and promote the conservation and preservation of natural resources are referred to as ecological behaviour. This type of behaviour has become increasingly crucial in addressing global environmental challenges such as climate change, biodiversity loss, and pollution. Extensive research has shown that individual behaviour significantly impacts environmental outcomes and can have a cumulative effect on the environment. Individuals can play significant roles in promoting a more sustainable future by making informed decisions and taking actions that reduce environmental impact and protect the planet for future generations (Mancha & Yoder, 2015; Schlüter *et al*., 2017; Titisari *et al*., 2019).

Lubuk Larangan, a cultural water system on the Subayang River, is utilised by the inhabitants of the Kampar Kiri Hulu District to preserve the river's natural resources. Lubuk Larangan is a portion of the river regarded as a fish spawning ground and managed using a fishery management model based on the community's indigenous knowledge. The management entails the temporary closure of an area of water that serves as a fishing zone for a period of time (Yuliaty & Priyatna, 2014).

Through the application of the Lubuk Larangan concept, the ecological behaviour of the Kampar Kiri Hulu District community has been manifested. There are four aspects that demonstrate the implementation of this ecological behaviour: (1) the ability to divide the management area based on ecological, economic, and social interests, (2) the ability to make collective decisions to reach a common agreement, (3) the ability to establish an effective legal enforcement system to minimise violations and dampen conflicts, and (4) the ability to effectively socialise the local agreement, enabling not only the Kampar Kiri but also the surrounding communities to benefit from it (Kurniasari *et al*., 2013). The successful implementation of the Lubuk Larangan concept can serve as a model for the adoption of ecological behaviour by other communities residing along river basins that face several problems in managing river resources.

The History of Lubuk Larangan

The Lubuk Larangan was established in 1980 and is present in every riverside village along the Subayang River. It was created during a community meeting attended by village elders, youth, and officials. The community sought a solution to the difficulty of meeting the village's numerous development needs with very limited funds. It was hoped that the Lubuk Larangan programme would generate revenue for the village's budget. The revenue generated from the sale of harvested fish would assist the community in meeting its infrastructure and facility development requirements. This program was created to ensure sustainable management of the fish resources in the river.

The Lubuk Larangan program demonstrates how the wisdom and cooperation of a community can address economic challenges and promote sustainable development. The program aims to ensure a sustainable future for the village by relying on local knowledge and the participation of all community segments (Rukiah, 2020). The area of the river designated as Lubuk Larangan is regarded as a fish spawning and breeding ground. The area is also a habitat for large riverbed-dwelling fish. Figure 2 depicts that the zoning of the Lubuk Larangan region has an average horizontal length of over 50 meters and a vertical length of over 20 meters. A rope strung from upstream to downstream of the Lubuk Larangan establishes a boundary within the region. The rope is positioned 4 meters above the river's surface and attached to riverbank trees. The rope is chosen as a boundary because it does not impede river transportation or harm the ecosystem.

In order to preserve and protect the river's fish resources, the Lubuk Larangan programme's

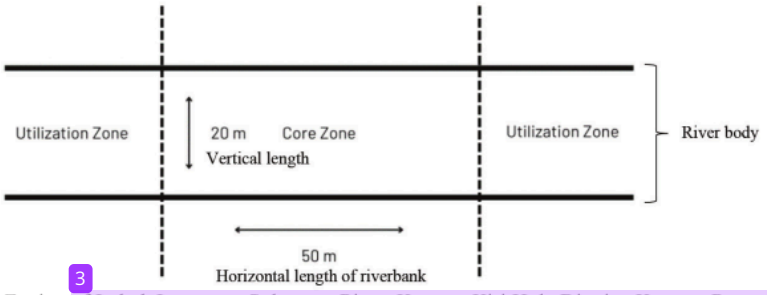

Figure 2: Zoning of Lubuk Larangan, Subayang River, Kampar Kiri Hulu District, Kampar Regency, Riau

zoning and boundary maintenance is essential. The approximate 50-meter length, also known as the core zone, has been designated as an ecological or conservation zone. During the period of Lubuk Larangan's closure, no disturbances are permitted within this core zone, which serves as an essential fish breeding ground (Figure 2). By designing an area for the breeding and protection of large fish, the community can ensure the long-term viability of the river's ecosystem. When necessary, the community is permitted to utilise the utilisation zone as a source of river resources. However, they are expected to adhere to the agreed-upon equipment and procedures for resource extraction. To achieve a sustainable future for the river and its inhabitants, the programme relies on the collective intelligence and cooperation of the community.

The Lubuk Larangan programme serves several crucial functions and objectives. First, limiting activities in the Lubuk Larangan can aid in maintaining the river's environmental cleanliness and serve as a conservation effort to preserve the river's fish resources and ecosystem. Furthermore, when the Lubuk Larangan is opened, the sale of harvested fish becomes an additional source of revenue and funding for village development. As a result of the Lubuk Larangan's opening, the community's food security is bolstered. In addition to its economic benefits, the Lubuk Larangan programme can help preserve local wisdom and traditional institutions passed down from their ancestors.

Lubis *et al*. (2021) found that Lubuk Larangan in Mandailing Natal, North Sumatera, served as an economic asset for the villagers and held significance in terms of social, cultural, ecological, and religious values. Over time, it evolved into a tradition and a symbol of local wisdom for the Mandailingnese people. Norsidi (2016) shows that the Lubuk Larangan area in Lubuk Beringin Village, Bathin III Ulu Sub-district, has collectively agreed on rules prohibiting fish harvesting along the river basin within residential ar[illegible]. This local wisdom of Lubuk Larangan plays a crucial role in supporting the economic, developmental, and environmental aspects. The Lubuk Larangan tradition instils a sense of stewardship for the local natural resources. Consequently, the Lubuk Larangan programme plays a crucial role in preserving nature and promoting community welfare.

Enforcement of Rules, Sanctions, and Prohibitions on Lubuk Larangan

Since the inception of the Lubuk Larangan programme, applicable regulations have been established. The regulations are the result of deliberations and dictate how the community treats its environment, particularly the river, which is their primary source of income. The rules include provisions, management procedures, prohibitions, and penalties for rule infractions.

The following restrictions have been established for the Lubuk Larangan programme:

- It is prohibited to take, fish, or engage in any other activity outside of Lubuk Larangan's permitted hours and methods.
- It is prohibited to poison, uproot, electrocute, or dump waste into the river and its surroundings, which could harm the aquatic biota.
- It is prohibited to speak or behave inappropriately in the Lubuk Larangan region.

According to the rules established by the community, anyone who intentionally or unintentionally violates these rules will be subject to fines and social sanctions. Penalties include one bag of cement, one roof mark, and one goat. The social repercussions include illness, mental illness, and even death. During the establishment of Lubuk Larangan, the community took an oath by reciting Surah Yasin and praying [illegible]t to take fish and to always preserve the area. Surah Yasin is the 36th chapter of the Quran, which is the holy book of Islam. Surah Yasin is often recited for blessings and p[illegible]ction as well as during times of mourning. The purpose of this oath is

to preserve the resilience of Lubuk Larangan so that it can be used responsibly and the river's ecology is maintained.

The community holds a firm belief in the myths that have emerged and become the basis for their river resource utilisation practices. This belief embodies the local wisdom of the community regarding the preservation of a sustainable environment. This practice is consistent with the provisions of Government Regulation, Law No. 32 of 2009 about Environmental Protection and Management, Article 1, Paragraph 31 which states that indigenous communities are groups of people who have traditionally inhabited specific geographic areas due to their ancestral ties, close ties to the environment, and a value system that determines economic, political, social, and legal institutions. Moreover, this management system and conservation efforts are bolstered by government regulations found in Government Regulation, Law No. 17 of 2019 about Water Resources Article 1, Paragraph 8, which defines water resource management as a concerted effort to plan, implement, monitor, and evaluate the conservation, utilisation, and control of water resources. Local wisdom activities, such as the imposition of fishing restrictions, are supervised by designated figures or officials tasked with maintaining the system's proper management during the opening and closing of fishing grounds. This committee is formed as a result of a decision made at a village meeting. Figure 3 and Table 1 illustrate the organisational structure of the prohibited fishing grounds management committee in the Gema village.

The Opening and Closing Rituals of Lubuk Larangan

The act of opening or harvesting fish in the Lubuk Larangan is known as *mancukou*. The annual *mancukou* activity takes place during the dry season, in June, July, or August, and begins with a discussion between the village government and the *Ninik Mamak* (traditional elders) of the area. The falling river levels make it easier to catch fish. The villagers and the committee collaborate to prepare for the fishing ground's traditional opening ceremony. The ritual begins on Friday after the Friday prayers, with the village community reciting the Surah Yasin three times. On Sunday, the opening and fish harvesting are conducted from morning until night. The event begins with the Gendangkong committee's traditional *gondang oguang* music performance while the invited guests are greeted. Each village's head of tradition, *Ninik Mamak* or *Datuk*, is in charge of the *mancukou* tradition. Table 2 represents the arrangement of the traditional elder council or *Ninik Mamak* and their corresponding duties during the execution of the *mancukou* tradition. Three

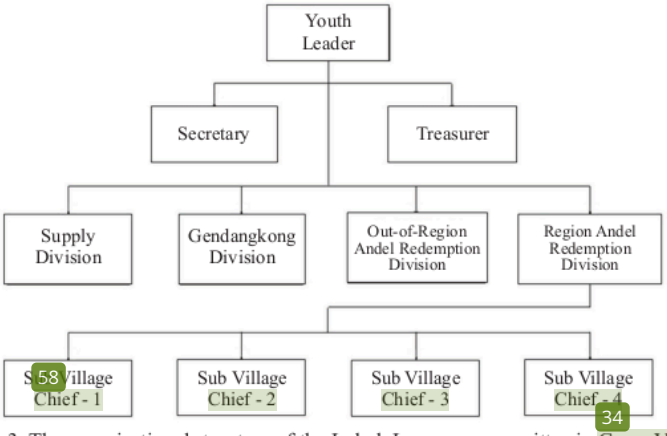

Figure 3: The organisational structure of the Lubuk Larangan committee in Gema Village

Table 1: The duties of the Lubuk Larangan management committee in Gema Village

Position	Duty
Youth Leader	Leading the organisation, nurturing the members, making decisions, and coordinating policies that are fully responsible for the organisation's activities during the prohibited fishing grounds management committee's tenure.
Secretary	Assisting the organisation's leader in coordinating activities and conducting technical and administrative tasks in programme development, such as scheduling and recording group activities.
Treasurer	Managing financial administration, such as preparing budget plans, overseeing the inflow and outflow of funds, and creating financial reports.
Supply Division	Responsible for documenting and planning the equipment and supplies needed during the implementation of activities.
Gendangkong Division	Preparing traditional *Gondang Oguang* musical instruments and performing traditional *Gondang Oguang* music before the opening ceremony.
Out-of-Region Andel Redemption Division	Providing coupons and registering participants from outside the village who are eligible to receive Andel coupons.
Regional Andel Redemption Division	Providing coupons and recording the registration of recipients of Andel coupons from within the village.

Table 2: The arrangement of the caliphate in Gema Village

Ninik Mamak	Title	Caliphate
Ahmad Sidik	Datuk Rajo Malekan	The highest Datuk in Gema Village serves as the apex of adat authority and has the power to make decisions on adat matters.
Khairi Anwar	Datuk Sikoto	This Datuk represents a broad perspective on village affairs.
Zamri	Datuk Marajo Indo	This Datuk serves as a mediator between Rajo Malekan and Datuk Sikoto. His principle is to divide and distribute the village affairs equally.
Bustar	Datuk Rangkayo Bonsu	-
Lukman	Datuk Jalelonan Puti	Chairman of the 4 tribes, namely Domo tribe, Malayu tribe, Malayu Tonga tribe, and Kape tribe.
Jailami	Datuk Singo	This Datuk holds authority over the mainland and serves as the pinnacle of traditional customs (representing the village of Tanjung Belit).
Yusri	Datuk Godang	This Datuk holds power in the river area and is responsible for managing everything related to activities in the river.
Mardanus	Datuk Marajo	Part of Datuk Singo
Elpi	Datuk Rangkayo Mudo Basa	Representative of Pulau Pencong Village.
Saidi Mansur	Datuk Paduko Sindo	This Datuk is in charge of community affairs (representative of Datuk Singo and Datuk Godang).

Ninik Mamak aboard the boat while awaiting the Village Chief's opening of the fishing grounds. The three *Ninik Mamak* are *Datuk Godang*, *Datuk Singo*, and *Datuk Majo*. *Datuk Singo* is responsible for paddling and steering the boat, while *Datuk Majo* is in charge of bailing water from the vessel. *Datuk Godang*, who is in the lead, is responsible for tossing the first fishing net to signify the opening of the fishing grounds. As soon as *Datuk Godang* catches the first fish,

the villagers can begin fish harvesting. The village's tradition of opening the fishing grounds has become a tourist attraction and has been incorporated into the Subayang festival.

Fishing equipment includes cast nets, harpoon guns, and spears. These are simple fishing implements that are inexpensive and do not harm the river's ecosystem. Some people are even able to catch fish with their bare hands due to the shallowness of the river. Following the harvest, the fish are collected and classified by size. Fish weighing more than 2 kg are auctioned off, while those weighing less than 2 kg are sold by the village community using the *Andel* system. *Andel* is a coupon for purchases distributed to registered villagers who pay the required fee. *Andel* coupons are divided into '*Andel Dalam'* and '*Andel Luar.'*

Andel Dalam coupons are distributed to registered village residents for a fee of IDR 20.000, while *Andel Luar* coupons are distributed to non-village residents for a fee of IDR 30.000. The proceeds from the auction and sale of fish are divided and used for the village's needs and growth. 50% of the allocation is distributed to the village youth, 25% to the *ninik mamak*, and 25% to the construction of the mosque. A specially designated individual leads the community in the recitation of the Surah Yasin as the community closes the prohibited fishing area. Once the prohibited fishing area has been closed, the community is not permitted to fish there.

The local wisdom tradition of Lubuk Larangan in the Subayang River region of Upper Kampar Kiri embodies the values of sustainable development, encompassing three main dimensions: social, environmental, and economic sustainability. These dimensions are elaborated upon in Figure 4 by Firdaus & Elfis (2017).

In addition to the values encompassed by the aforementioned three dimensions, the local wisdom of Lubuk Larangan includes nine educational values: 1) Serving as a field laboratory for science education, 2) cultural values, 3) social values, 4) values of love, compassion, and concern for the river

Figure 4: The Dimensions of Sustainable Development in Lubuk Larangan at Subayang River

environment, 5) religious values, 6) values of responsibility, 7) economic values, 8) values of natural resource conservation, and 9) values of environmental education. The fundamental principle of sustainable development is to maintain the quality of life for all human beings while considering the sustainable fulfilment of present and future needs (Langhelle, 1999; Bansal, 2002; Serag El Din *et al*., 2013).

The Diversity of Fish Species Found in Lubuk Larangan

Lubuk Larangan serves an essential role in preserving the diversity of fish species in the Subayang River. The fish species listed in Table 3 can be found in Lubuk Larangan and the Subayang River, and they are an important source of sustenance for the local population.

Table 3 suggests that the dominant fish species in the Subayang River habitat are members of the Cyprinidae family. The Cyprinidae family has a relatively high number of species in freshwater, especially in the rivers of Sumatra (Fitrha & Siregar, 2012). In the Lubuk Larangan region of Subayang, the Belida fish (*Chitala lopis*) is a fully protected species. According to Ministerial Decree No. 1 of 2021 on Marine Affairs and Fisheries, the community

Table 3: The diversity of fish species found in the Subayang River

Ordo	Family	Genus	Species	Name	Local Name
Anabantiformes	*Osphronemidae*	*Trichogaster*	*Trichogaster trichopterus*	Sepat	Sepat
		Oshphronemus	*Oshphronemus gouramy*	Gurami	Gurami
	Channidae	*Channa*	*Channa micropeltes*	Toman	Toman
Cypriniformes	*Cyprinidae*	*Hampala*	*Hampala macrolepidota*	Barau	Barau
		Barbonymus	*Barbonymus schwanenfeldii*	Kapiek	Kapiek/ Tengadak
		Osteochilus	Osteochilus *melanopleura*	Kelabau	Kelabau
		Crossocheilus	*Crossocheilus oblongus*	Selimang Batu	Selimang Batu
		Rasbora	*Rasbora argyrotaenia*	Pantau	Badar
		Cyprinus	*Cyprinus carpio*	Mas	Mas
		Thynnichthys	*Thynnichthys polylepis*	Bawal	Motan
Osteoglossiformes	*Notopteridae*	*Chitala*	*Chitala lopis*	Belida	Balido
Siluriformes	*Siluridae*	*Wallago*	*Wallago attu*	Tapah	Tapah
	Pangasiidae	*Pangasius*	*Pangasius polyuranodon*	Patin	Patin Juaro
	Siluridae	*Belodontichthys*	*Belodontichthys dinema*	Sengarat	Sengkarek
	Bagridae	*Mystus*	*Mystus nemurus*	Baung	Geso
Synbranchiformes	*Mastacembelidae*	*Mastacembelus*	*Mastacembelus erythrotaenia*	Tilan	Tilan

is prohibited from catching and consuming the Belida fish. Through the Lubuk Larangan cultural activity, the Belida fish population can be preserved, which in turn maintains the sustainability of the Subayang River's fisheries ecosystem by limiting fish capture.

The Factors that Affect the Ecological Behaviour of the Community in the Lubuk Larangan System

Depending on how they interact with their environment, each person exhibits unique behaviour. Human behaviour regarding the environment plays a crucial role in determining the sustainability of environmental conditions. The geographical condition of the area in which the community resides is an environmental factor that has an impact. Ecologically conscious individuals view themselves as environmental stewards. Local communities have developed their own techniques for conserving land and natural resources. It is their responsibility to safeguard the region they inhabit and attest to nature's existence. Environmental management aims to meet current needs without compromising or depleting future generations' ability to meet their own. It is considered useful for managing natural resources and protecting river ecosystems from destructive and damaging activities. Traditions, habits, and behaviours evolve based on the proximity of human to their surrounding environment and the challenges they face. Human actions and attitudes towards an object or event that occurs in a specific location are regarded as local wisdom. Local wisdom is the application of values held to be true by a community in the Kampar Kiri Hulu District, which influences the community's way of life (Pinto, 2016; Rahmawati, 2016; Utina, 2012).

The management of river resources has been regulated by Government Regulation No. 37 of 2012 on River Basin Management. This regulation has significant potential to influence human behaviour towards the environment by organising, restricting, and providing incentives to individuals and companies to pay more attention to the environmental impacts of their activities within the river basin areas. These regulations encompass limitations on environmentally damaging activities, stringent permitting, natural resource conservation, environmental monitoring, and raising public awareness about the necessity of preserving river basin ecosystems. Consequently, river basin laws are crucial in promoting more sustainable and environmentally responsive behaviour (Găzăroiu *et al.*, 2020; Pinho & Gomes, 2023) followed by environmental concerns. This article constitutes an opportunity to take (suggested.

The Subayang River flows through the villages of the Kampar Kiri Hulu District, and the inhabitants of the Subayang River basin have a close and intimate relationship with the river. They participate in a variety of activities associated with the river. Direct exploitation of natural resources, such as fishing, farming, mining, and animal husbandry, continues to dominate the local economy. In addition, they utilise forest products such as stink beans, tampui fruit, pulasan fruit, and durian, as well as plantation crops such as rubber and oil palm. Due to the lack of inter-village roads, the community relies heavily on the river for transportation, as it is their only major transportation route. The *Piyau* boat is the primary mode of transportation on the river that winds through the forest's verdant hills. *Piyau* is a small motorised boat. In addition to being the primary mode of transportation that sustains the economy, the river serves as a gathering place for the villagers. Daily activities such as bathing, washing, and water collection serve as opportunities for social interaction within the community. Figure 5 depicts the illustration of the community participating in activities associated with the river. Furthermore, the Subayang River and the Lubuk Larangan opening activities have been transformed into eco-tourism destinations and developed as tourist attractions. Numerous visitors from outside the village visit the river, which contributes to an increase in the village's income. Lubuk Larangan is representative of the river culture that exists in river basin communities of Indonesia.

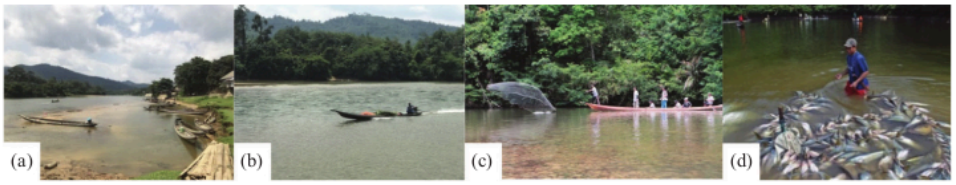

Figure 5: Community activities on the Subayang River: (a) River access, (b) People carrying the forest harvest, (c) Fish net spreading during the opening rituals and (d) The process of collecting the fishes

The ecological behaviour of society is influenced by the traditions and customs of river basin communities. The village community within the district of Kampar Kiri Hulu is an indigenous community. Article 1, paragraph 3 of Ministerial Regulation Number 5 of 1999 defines indigenous communities and provides guidelines for the settlement of indigenous communities' customary land rights issues. The regulation defines an indigenous legal community as a group of individuals bound by their customary legal order as members of a legal association based on a shared place of residence or descent. Full recognition of indigenous communities' customary land ownership has proven effective in halting the accelerating rate of biodiversity loss. Indigenous communities have a system of sage knowledge for dividing areas of natural resource use, such as customary systems for land use, fisheries, and forestry, with rules and ethics to maintain environmental sustainability and ecological balance. Participation in the community's adherence to established regulations. They engage in the rule-making process and have consented to provisions of the rules. This demonstrates the importance of community participation in the development of water resources management regulations. Therefore, those who implement the rules perceive them to be equitable. In the absence of indigenous community roles, excessive exploitation of natural resources can result in environmental degradation, extinction of species, and climate change (Etchart, 2017; Garnett *et al*., 2018; Townsend *et al*., 2020; Baragwanath & Bayi, 2020; Weningtyas & Widuri, 2022).

Support from an informal leader or traditional figure also influences indigenous communities' role in preserving the environment they manage. *Ninik Mamak* is the name of this traditional figure. According to Article 1, Paragraph J of the District Regulation of Kampar Number 12 of 1999 concerning Indigenous Land Rights, the Pemangku/Tokoh Adat (*Ninik Mamak*) is an appointed or elected individual to lead their community or clan. This individual has been confirmed or appointed in accordance with local customary law by their community. As a leader within his community and clan, *Ninik Mamak* must be able to protect his people's traditions and cultures from a variety of threats and foreign cultural influences. Additionally, *Ninik Mamak* contributes to the preservation of peace within the indigenous community. The indigenous community's obedience to *Ninik Mamak* establishes the leader as a central figure who shapes collective behaviour, including the community's ecological behaviour in the utilisation of the river (Mashuri & Putra, 2021; Arrazak *et al*., 2022). Figure 6 depicts the factors that influence the ecological behaviour of the communities residing along the river.

Benefits of Lubuk Larangan from an Ecological Perspective

The cultural practice of Lubuk Larangan has a substantial effect on the viability of the river's fisheries resources. The ecological and environmental aspects of Lubuk Larangan's indigenous knowledge are intended to protect the river from contamination, preserve the ecosystem, and ensure the availability of clean water sources for the daily needs of the local

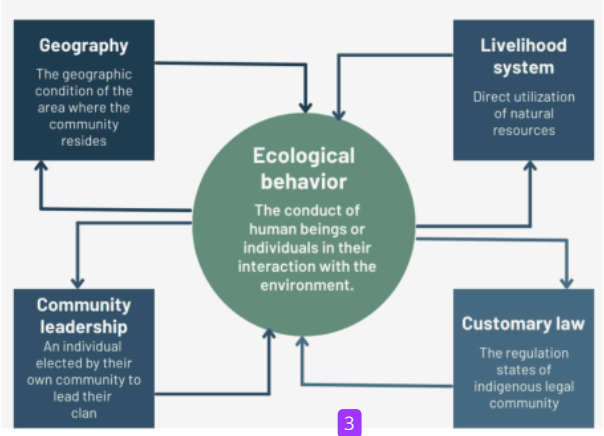

Figure 6: Factors affecting the ecological behaviour of the community in the Lubuk Larangan system

populace. Lubuk Larangan serves as a habitat and breeding ground for fish, thereby conserving the river's fish population. The Lubuk Larangan opening system is founded on a conservative principle. Instead of exploiting the river on a large scale, the local community employs specialised management techniques. The fishing gear utilised by the community does not harm the river's ecosystem. In addition, the community keeps the river environment clean and refrains from engaging in activities that could harm the ecosystem. This endeavour allows the river's natural resources to be utilised for an extended period of time while preserving the river. Since there is no road access, the river serves as the village's primary mode of transportation. Therefore, the indigenous community can manage water resources sustainably by avoiding activities that harm the river ecosystem. The existence of Lubuk Larangan's local regulations aids in the preservation of water resources. By adhering to these regulations, the local community pledges to preserve the river ecosystem and its water catchment areas.

Indigenous communities' implementation of sustainable water resource management has a significant direct effect on river water quality. Alongside the Lubuk Larangan management model, these communities implement a conservative agricultural system, avoiding the excessive use of chemicals in their fields, which aids in the reduction of water pollution caused by these chemicals. The subdistrict of Kampar Kiri Hulu is a protected area, specifically the Bukit Rimbang Bukit Baling Wildlife Reserve Forest. The indigenous community actively contributes to the preservation of the river's surrounding forests, allowing them to serve as natural filters that maintain water purity. All of these factors contribute to the preservation or enhancement of the river's pollution index and water quality. Wulandari *et al*. (2018) conducted a study at observation stations in three villages located in the Subayang River basin: Batu Sanggan, Muarobio, and Tanjung Belit. The pollution index and water quality of the river in these three villages ranged from $1 < IP \geq 5$, indicating that the Subayang River is only slightly polluted and that its water quality is considered to be excellent.

Conclusion

The cultural practices of the Lubuk Larangan water system have significantly contributed to the preservation of the ecosystem, the maintenance of natural resources, and the preservation of water quality in the Subayang River. Lubuk Larangan has become a habitat favourable to the reproduction of the *Chitala lopis* fish species. This species holds a protected status, consequently rendering it impermissible

to engage in the act of capturing and consuming these piscine creatures. Lubuk Larangan's local wisdom tradition in the Subayang River embraces the values of sustainable development across three key dimensions: social, environmental, and economic. The ecological behaviour of the Kampar Kiri Hulu District community in managing river resources is supported by several factors, including geographic conditions, livelihood systems, customary law, and leadership patterns. The implications of these supporting factors have an impact not only on the environment but also on the socio-economic behaviour of the community. The cultural activities of Lubuk Larangan are expected to inspire the government and other communities as one of the solutions to preserving and improving the environmental degradation of rivers in the area.

Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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