# Lubuk Larangan: Indigenous knowledge and fish weirs for sustainable river fisheries management in Central Sumatra

*Akbar* Ario Digdo[1,*2], *Agustinus* Wijayanto[2,3], *Topan* Cahyono[2], *Anggun* Yurna Nudesia[2], and *Heri* Siswanto[2]

[1]Center for Transdisciplinary and Sustainable Sciences (CTSS), IPB University, Bogor, Indonesia
[2]YAPEKA, Bogor, West Java, Indonesia
[3]Doctoral Candidate of Forestry Faculty, Gadjah Mada University, Yogyakarta, Indonesia

**Abstract.** Bukit Rimbang Bukit Baling Wildlife Reserve (BRBB WR), or in short, Rimbang Baling, Central Sumatra, is known as a long-term priority Sumatran tiger (*Panthera tigris sumatrae*) landscape globally. At the same time, the local and traditional communities have been inhabiting the area for hundreds of years. Subayang and Batang Bio rivers are the economic lifelines of the villages inside BRBB WR. People there have local wisdom "*Lubuk Larangan*", using fish weirs "*Ladak*" and temporary closure to manage rivers and fish resources. The research on *lubuk larangan* was conducted on August 3, 2024, in Tanjung Beringin Village using a social-ecological system framework. The analysis results on *lubuk larangan* indicated that 13 species of fishery commodities were caught, mostly *Barbonymus schwanenfeldii (Kapiek*-local name). Fish harvests were partially consumed and partially for *andel* and auctioned. The proceeds of the *andel* and auction were IDR 4,520,000 and used for social support. After opening the *lubuk larangan*, the customary leader and village government agreed to close it and will reopen it based on the customary decision. The *lubuk larangan* system shown that conservation schemes by local communities provide long-term benefits not only to fulfill food security but also to social aspects.

## 1 Background

Rimbang Baling landscape is a critical part of the Sumatran tiger conservation area in Central Sumatra, covering approximately 500,000 hectares. Bukit Rimbang Bukit Baling Wildlife Reserve has an area of 141,226.25 hectares, located within the Kampar and Kuantan Singingi Districts, and has been designated as a wildlife reserve through decree No. SK.3977/Menhut-VII/KUH/2014 issued by the Ministry of Environment and Forestry. Despite its status as a wildlife reserve, this landscape (hereinafter referred to as Rimbang Baling) is unique in that it encompasses twenty-five villages with a long-standing, harmonious relationship with the

* Corresponding author**:** adigdo@apps.ipb.ac.id, akbar@yapeka.or.id

landscape. Seven of these villages are located deep within the reserve, while eighteen lie within the buffer zone. The presence of indigenous communities in these villages has been recorded in various historical documents, including the Pamalayu Expedition of Majapahit (1275–1286 C) and the 1684 account of Thomas Diaz, who visited Pagaruyung and passed through Rimbang Baling [1]. Strongly influenced by Minangkabau and Malay customs, each village operates under a *kenagarian* governance system (customary government) led by a *Ninik Mamak* and bound by traditional customs.

To this day, villages located deep within the forest have limited access to electricity, communication infrastructure, and transportation. Having lived in these remote areas for centuries, the communities are highly dependent on the natural environment, particularly the forest and rivers, to meet their daily needs. The Subayang and Batang Bio Rivers are the two main waterways that flow through the Rimbang Baling landscape. In addition to serving as the only access route to the villages within the reserve, navigable by wooden boats, these rivers play a crucial role in the communities' livelihoods. The rivers provide clean water, serve as areas for bathing and washing, generate hydropower, and supply food resources for daily sustenance.

The community in Rimbang Baling has developed a community-based fisheries management model known as *Lubuk Larangan*, which involves temporarily closing (TC) designated fishing areas in inland waters, particularly river sections, for specific periods. This practice is actively implemented by the eleven villages in Rimbang Baling, with each village managing two to three *Lubuk Larangan* sites. The primary purpose of *Lubuk Larangan* is to generate funds for village needs, such as religious, social, cultural, and youth activities [2]. Ownership of these fishing areas and the resources within them is communal (common property rights), ensuring that they are used solely for collective benefit and community welfare. This local wisdom carries economic value, particularly in providing protein and enhancing food security, while integrating ecological and conservation principles into the local culture. This study aims to provide a comprehensive overview of the *Lubuk Larangan* system, describing and examining the knowledge and practices behind this temporary closure model in freshwater areas through the lens of local wisdom.

## 2 Situational contexts

The presence of indigenous communities in Rimbang Baling has been documented in various records since the 1200s. These communities, heavily influenced by Minangkabau and Malay cultures, apply a *Kenagarian* governance system in each village. Typically, each village is home to three to five clans, each led by an adat leader known as the *Ninik Mamak*. The *Ninik Mamak* is supported by the *Mamak Kampung,* responsible for clan governance, the *Dubalang*: who manages security and safety, as well as the *Alim Ulama,* overseeing religious and spiritual matters at both the clan and village levels. The *Ninik Mamak* holds a key role in village governance, particularly in shaping the village head's decisions. Furthermore, the *Ninik Mamak* represents the Gunung Sahilan Kingdom, a remnant of the Pagaruyung Kingdom, which continues to exist under the leadership of King H.T.M. Nizar (King-XII). The kingdom's symbolic jurisdiction extends to the Rimbang Baling area through its traditional *adat* governance system. On the other hand, Rimbang Baling as a conservation area is managed by the government (Ministry of Environment and Forestry) as a wildlife reserve, and the villages are located inside and around the reserve (Figure 1).

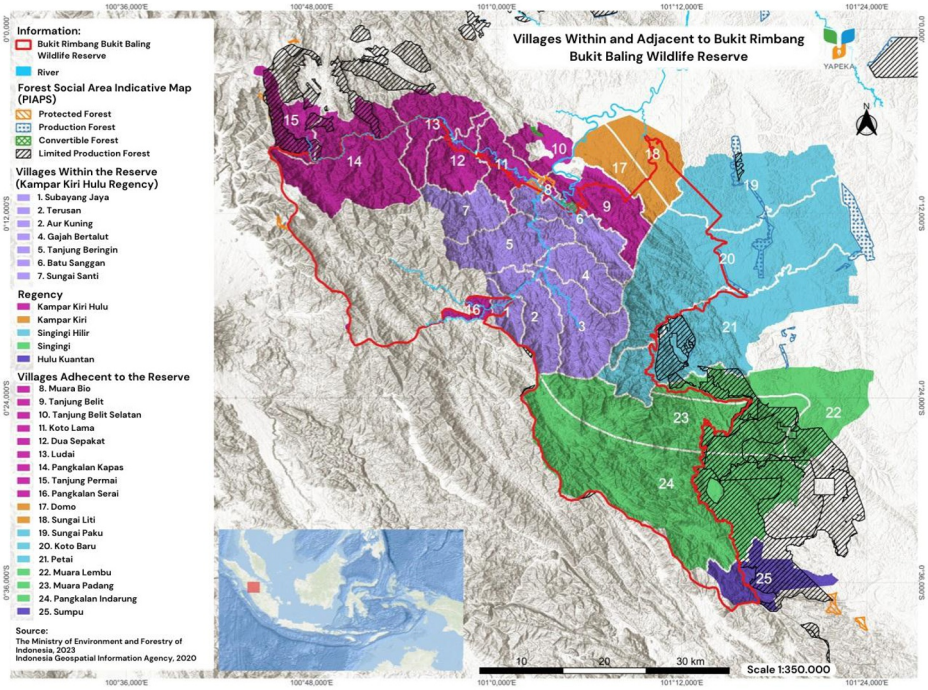


**Fig. 1**. Map of Bukit Rimbang Bukit Baling Wildlife Reserve with surrounding villages. (Source: YAPEKA, 2024)

Traditional communities are highly dependent on the natural environment for their livelihoods, both forest and river. These relatively homogeneous communities have well-structured and documented social systems. Their deep connection with nature has led to the development of extensive knowledge of animals, plants, and ecosystems, particularly those crucial for meeting their daily needs [2]. At least 94% of the population in six villages with limited access (Muara Bio, Batu Sanggan, Tanjung Beringin, Gajah Bertalut, Aur Kuning, and Terusan) primarily engage in rubber farming. In addition, the communities harvest various non-timber forest products (NTFPs) to supplement their income. To meet their daily food needs, they frequently gather forest plants such as stinky beans (a source of plant-based protein), forest fruits, and fish in the rivers [1]. One significant example of the indigenous knowledge possessed by the communities of Rimbang Baling is the application of local wisdom in managing the natural environment, which also serves as a form of cultural heritage. This includes the practice of maintaining *hutan larangan adat* (customary forbidden forests), which are left untouched in their natural state and are considered sacred—believed to be the dwelling places of ancestral spirits, sites of supernatural power, or closely connected to local religious beliefs. Another example is the implementation of the *Lubuk Larangan* (temporary fishing closure or TC) in the Subayang and Batang Bio Rivers, a practice deeply intertwined with religious rituals and customary traditions.

*Lubuk Larangan* originates from the word *lubuk*, meaning a deep part of a river, and *larangan*, meaning forbidden. In addition to being deeper than other sections of the river, *lubuk* areas often have relatively calm water flow, making them ideal habitats for fish breeding and growth. *Lubuk Larangan* represents a community-based fisheries management model in inland waters, particularly in river systems, through a temporary closure scheme. This closure allows fish and other aquatic resources within the Lubuk to grow to maturity and reproduce naturally. Outside of the *Lubuk Larangan*, fishing, and resource use are

permitted, while harvesting from within the *Lubuk* is only allowed when it is opened, which typically occurs 1-2 times per year [3,4]. This practice, recognized as part of Sumatra's local wisdom, is implemented in four provinces: West Sumatra, North Sumatra, Riau, and Jambi. In West Sumatra alone, *Lubuk Larangan* is applied across almost all *kenagarian* with at least 867 documented sites despite the details of implementation were relatively lacking [3].

TC practices are common in marine environments, such as *Sasi Laut* in Maluku of Indonesia, *Tambu* in Papua New Guinea, *Tabu* (also pronounced as tambu) in Fiji, *Ra'ui* in Cook Islands, and *Tokoro* in western Solomon Islands [5]. In marine areas, TC is typically initiated to support ecological resilience by preserving critical habitats, such as coral reefs, fish diversity, seagrass beds, and mangrove ecosystems. TC in coastal or small island environments is often more stable and contributes to long-term marine sustainability by protecting key species and habitats. In contrast, TC in inland waters focuses on freshwater ecosystems, where resource use is closely linked to seasonal variations and requires adaptive management by local communities. Unlike the other TC practices, which usually use the natural characteristics of their ecosystems, Lubuk Larangan also uses man-made structures in the river to manipulate fish movement and assist the fish extraction process, typically using stones and/or wood poles. Use of fish weirs can be found across Asia Pacific islands, from Japan, Australia, to Pacific Islands like Vanuatu and Fiji, usually at seagrass beds and/or coral reef flats [6] although there were a small number of examples from rivers in Australia [7]. Fish weirs are considered to be part of the cultural identities of island people and need to be preserved [8].

The *Lubuk Larangan* practice in Rimbang Baling was first implemented in the circa 1930s by Tanjung Belit Village, followed by Aur Kuning Village, which adopted the practice in 1989. The most recent village to establish the TC was Pangkalan Serai in 1999 [2]. Tanjung Belit, located in the buffer zone of the Reserve, has three *Lubuk Larangan*, each managed by different groups: the village youth, the *kenagarian,* and the village government. Moving outward from Tanjung Belit, in order into the reserve along the banks of the Subayang River—Muara Bio village, Batu Sanggan village, Tanjung Beringin village, Gajah Bertalut village, Aur Kuning village, Terusan village, Pangkalan Serai village, and Subayang Jaya village each have two *Lubuk Larangan*, owned and managed by youth groups and the *kenagarian* of each village. Meanwhile, villages located along the Batang Bio River, Kota Lama, and Ludai, each have one *Lubuk Larangan* owned by the *kenagarian*. Although the practice was only introduced in the 20th century, the TC has now become a vital element of cultural heritage due to its significant value. The continuity of this practice serves not only as an identity marker for the indigenous communities but also supports conservation efforts, provides economic benefits, and contributes to food security. Its potential warrants deeper exploration, particularly in a unique ecosystem influenced by seasonal dynamics.

## 3 Material and method

This research utilized direct observation and key informant interviews to document the knowledge and practices associated with *Lubuk Larangan*. Resource person interviews were made to collect information from key persons such as cultural elders (*Ninik Mamak* and *datuk*), specifically for the ritual's progressions and its cultural and spiritual contexts (for example, historical backgrounds, intentions, and experiences in implementing the TC practices). Focus group discussions with youth, women, and village government officials were made to gather information related to operational aspects of the TC governance and its apparatus. Thus, the documentation process encompassed fish weirs/fish trap structures, fishing gears, activity sequences, rituals, agreements, fish catch diversity and amount, as well as benefit-sharing mechanisms. A drone was used to take aerial view of the structure and

photographs were taken to capture details of the practices. Additionally, reflective literature reviews were conducted to provide context and substantiate the findings. Field observations were carried out at the *Lubuk Larangan* managed by the youth of Tanjung Beringin Village, situated within the Bukit Rimbang Bukit Baling Wildlife Reserve, on August 3, 2024, coinciding with the opening of the *Lubuk Larangan* in the village. Specific observations were made to identify specific functions of the fishing gears and methods, particularly the fish weir structure, development process, and spatial interaction within the study areas, and interactions with external factors, for example, the adjacent villages and other river users such as transportation. Fish catch numbers were noted at the fish landing site using a tally sheet according to the species, which was identified using available literatures [2]. This investigation employed a Social-Ecological Systems (SES) approach to facilitate a comprehensive, dynamic understanding of the practice. The SES approach is implemented by direct observation (capturing knowledge and practice of TC as part of social-ecological interaction) and reflective literature reviews as theoretical frameworks and comparisons of relevant practice.

## 4 Result and discussion

The development of *Lubuk Larangan* in Rimbang Baling was fundamentally driven by community concerns regarding the fulfillment of village needs beyond food security itself, particularly to answer the limitations in funding for socio-cultural problems, including the renovation of religious facilities. It also addressed the construction of village public infrastructure, such as roads, cultural and artistic festivals, social initiatives like the distribution of assistance to orphans, and youth programs along with village sports facilities. Rivers, as providers of natural resources, are an alternative for such fulfillment that is very close to a community's daily lives.

The closest village to the upstream of the Subayang River is Subayang Jaya, which is situated deep within the wildlife reserve, where the water is generally clear and flows gently. In contrast, downstream lies Tanjung Belit Village, located in the buffer area, characterized by turbid water with moderate flow, although it is relatively deep. Tanjung Beringin Village, positioned in the middle of the reserve, experiences moderate water flow with a steady discharge [9]. In selecting a location for *Lubuk Larangan*, the site must be easily accessible to the community for monitoring and management purposes. The chosen area should have a deep riverbed, an abundant fish population, and a relatively calm water flow and should not be a site routinely used for daily fishing. The length of the river stretch designated as *Lubuk Larangan* typically ranges from 300 to 1,500 meters, often located after a sharp bend in the river where the channel is significantly wider.

Once the *Ninik Mamak* agrees upon the location, it is marked with boundaries using materials such as ropes, ribbons, colored cloth, or signboards along the riverbank. As illustrated in Figure 1, the boundaries of the youth-managed *Lubuk Larangan* of Tanjung Beringin are defined at points 3 (0°13'58.87"S 101° 2'59.19" E) and 4 (0°13'58.71"S 101° 3'0.77" E) as the upstream, and point 1 (0°13'53.43"S 101° 2'59.91" E) and 2 (0°13'53.78"S 101° 3'1.38" E) as the downstream, covering a length of 170 meters and reaching depths of up to 3 meters. This boundary marking is accompanied by a prayer and the recitation of *Surah Yasin*, led by the *Imam*, who serves as a religious leader and signifies the formal closure of the *Lubuk*. To reinforce the authority and existence of the *Lubuk Larangan*, the local village government also issues a decree that formalizes the establishment of the TC [2,6]. Our observation also indicated that *Ninik Mamak* played important roles in coordinating with neighboring villages to ensure mutual compliance as well as boat traffic management, especially regarding TC opening days.


**Fig. 2**. The boundaries of the youth-managed *Lubuk Larangan* of Tanjung Beringin Village. (Source: YAPEKA, 2024)

The practice was started by building a fish weir called *Ladak*, a v-shaped trap (Figure 3) with pointing ends orientated parallel to the direction of the river current, located downstream of TC area/*Lubuk* between point 1 and point 2 as shown in Figure 2. *Ladak* location is usually fixed and reusable, with the main construction being a mix of wooden poles reinforced with river pebbles at the base. In the more recent era, the weir/walls were also equipped with continuous nets, called *Salur*. The pebble bases were usually more permanent, while the wooden poles were typically temporary, swept away by the current. The Ladak was gradually renovated as early as a week before the harvesting time, while the net was installed at the pointing end of *Ladak* just before the opening ritual, enclosing the 0.5-1 m gap to enable fish extraction. The size of Ladak can be relatively extensive, up to 60 m long and 20 m wide, accommodating the deepest area of the river. A specific team of men was posted around the net to extract trapped fish and prevent fish overflow. The fish weir did not enclose the whole river width, reserving a rather small passage for boat traffic.

Observations indicated that at least 96 community members participated in the preparation and the harvesting day process, using only traditionally acknowledged, environmentally friendly fishing gear as a must. The methods employed included fish weir preparation as a fixed trap setting known as *Ladak* (42 individuals) and *Salur* type fixed net (22 individuals). Besides passive methods, selections of active methods were also employed, including cast nets (4 individuals), traditional spearguns or *Jubi* (12 individuals), and manual hand-catching techniques (16 individuals). Active methods that were being implemented would also agitate the fish and direct the fish schools to the *Ladak* areas as the final harvesting location.

The practice of reciting prayers serves as a bonding of religious principles and cultural traditions, aiming to protect the TC from resource theft during its closure due to its sacred and mystical significance. Furthermore, community members are prohibited from damaging the river and forest ecosystems and from disposing of waste along the designated area. This practice is rooted in the deep-seated metaphysical beliefs of the Indigenous community, where individuals who violate these boundaries are thought to face calamities, such as illness or even death. This belief system emerged as a response to the ineffectiveness of physical penalties initially imposed during the early development of *Lubuk Larangan*, where community members did not feel deterred by fines, such as 1-2 sacks of cement or 1 bundle of roofing sheets for village construction if caught violating rules or stealing fish. This approach demonstrates that local wisdom in resource management is often framed within

taboos that reflect religious and magical connotations, as well as prohibitions in the form of customary laws. Although these regulations are not documented in writing, they are well understood within the Indigenous community [2].

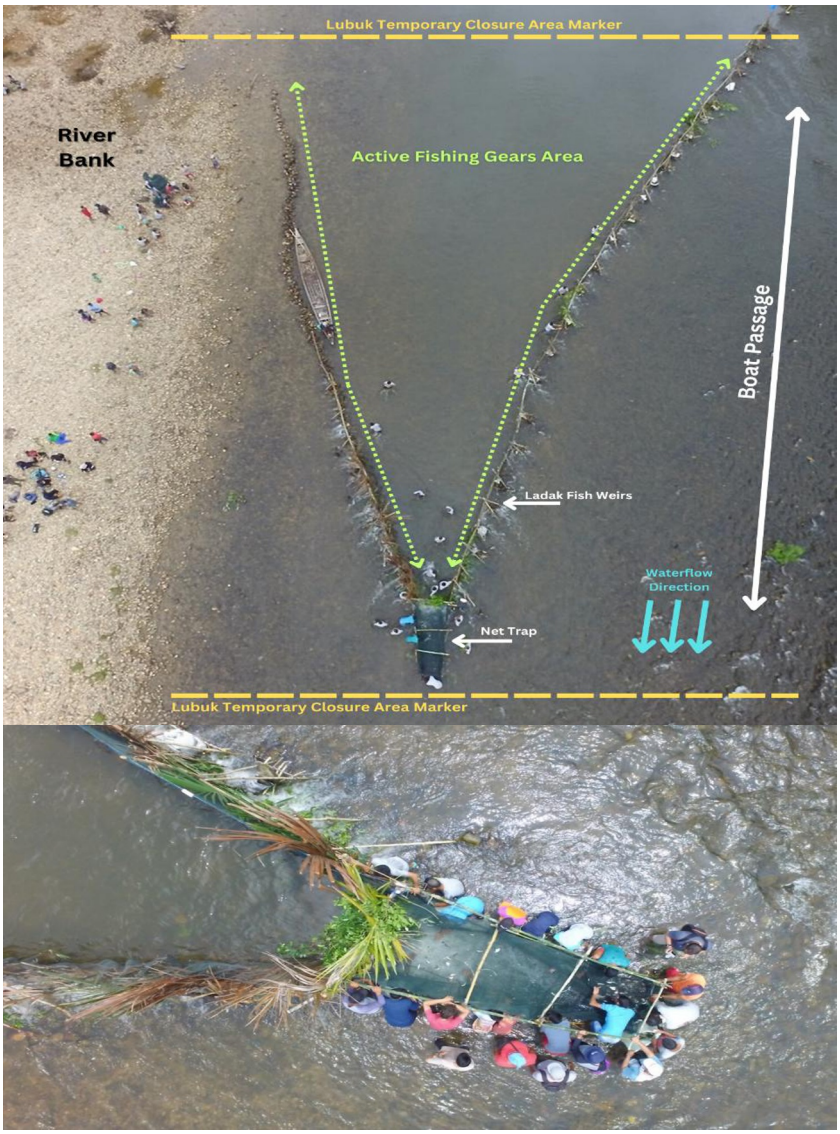


**Fig. 3**. The fixed trap setting known as *Ladak,* placed between points 1 and 2, looking from above, indicates a v-shaped fish weir structure, using stones, wooden poles, and nets at the pointing end of the weir. (Source: YAPEKA, 2024)

*Lubuk Larangan* is typically opened 1-2 times a year, with the timing varying based on local agreements and cultural practices. For instance, in Sialang, West Sumatra, the *Lubuk Larangan* is opened before the month of Ramadan, after the Islamic holiday of Eid Al-Fitr, or following the harvest of crops such as *gambir*, rubber, cocoa, and palm oil [4]. In Rimbang Baling, *Lubuk Larangan* is generally open during the dry season or before the onset of the rainy season, when river water levels are stable and low. Interviews and field observations

indicate that scheduled openings of the TC, planned months in advance, may be canceled if heavy rainfall occurs before the opening, resulting in river water levels rising 2-4 meters above the daily average for the dry season [9].


**Fig 4**. Community contribution during the *Lubuk Larangan* is opened. (a) The fish weir setting (*Ladak*), (b) *Salur* type fixed net at Ladak's tip, (c) Cast net, (d) Traditional Speargun (*Jubi).* (Source: YAPEKA, 2024).

The timing for the 'opening of *Lubuk Larangan'*, also known as *Mencokau*, is determined after careful consideration of several factors by the *Ninik Mamak*, village heads, and community members. In addition to ensuring that the river water level is at its lowest, *Mencokau* takes into account whether the village is experiencing a surge in population, such as when residents return from migration, as well as the maturity of the fish population [2]. Similar to the closure ceremony, *Mencokau* begins with a joint prayer led by the *Imam*. This ritual is followed by two *Ninik Mamak*, *Datuk Pucuk* and *Datuk Sinaro*, who board a boat and head to the center of the river. Datuk Sinaro casts the first net into the Lubuk, repeating the process until a fish is caught. The fish is then cut into two parts on the boat— the head is thrown back to the land, while the tail is cast into the water. This act symbolizes the connection between life on land and in the water. *Datuk Pucuk*, the leader of the Domo Bukik clan, is considered the ruler of the land (*Kenagarian*), while Datuk Sinaro, the leader of the Domo Bawuah clan, is the ruler of the river. Once the opening ritual is completed, community members are permitted to begin fishing in the designated area. Unlike *Lubuk Larangan* in West Sumatra or TC in coastal areas, which can last for up to two weeks, the *Lubuk Larangan* in Rimbang Baling is typically open for just one day. In this instance, the *Lubuk Larangan* in Tanjung Beringin was open from 10:00 AM to 12:00 PM. Additionally, the community has set up a communal kitchen by the river, enabling the immediate cooking and shared consumption of the catch as a demonstration of community solidarity.

Beyond the designated times, the *Lubuk Larangan* in Tanjung Beringin also occasionally opens for night fishing. During these nighttime openings, the youth group establishes a base

price that participants are required to pay. This fee is evenly split among all registered participants, with the total catch also distributed equally. Night fishing participants, often from Tanjung Beringin and neighboring villages, tend to be enthusiasts of traditional speargun fishing known as *Jubi*, as fish are easier to catch with this tool at night. Participants are permitted to fish with *Jubi* throughout the night; however, most conclude their activities by 1 a.m., followed by gathering to grill and share their catch. The participants also tend to take some home if the catch is abundant.

Two systems for selling the 'morning' catch of *Lubuk Larangan* are implemented: The Auction system and the *Andel* system. Fish weighing over 1 kg and of larger size are sold through an auction open to all interested parties. The *Andel* system distinguishes between buyers based on whether they are from the village community or external to it. Villagers purchase the catch at significantly lower prices (almost halved) compared to outside buyers. During the data collection for this study, the price set for local villagers (known as *Andel Dalam)* was Rp 30,000 per pack, while the price for non-villagers (also known as *Andel Luar*) was Rp 50,000 per pack, which at this time consisted of 800 - 1000 gram. The price for *Andel* was determined during a customary meeting to set the opening of *Lubuk Larangan*. However, the exact quantity and weight of the fish included in each *Andel* pack are only decided after the closure of *Lubuk Larangan*. Parties wishing to purchase *Andel* must register in advance beforehand. The total catch is then divided among the registered buyers. Additionally, villagers are only eligible to purchase *Andel Dalam* if they have contributed to the construction of the fish weirs (*Ladak)*, such as by collecting the stones and providing wood for stakes (Figure 4). Those who do not contribute may face social exclusion within the community. Interviews with *Ninik Mamak* and youth members stated that the profits collected during the sale of *Andel* was distributed for social purposes, for example, helping the disadvantaged community members and other greater social purposes.

**Table 1**. The diversity and quantity of catch during the opening of youth-managed *Lubuk Larangan* in Tanjung Beringin Village

| No. | Species | Name | Local Name | Number of Fish Catch |
|---|---|---|---|---|
| 1 | *Barbonymus schwanenfeldii* | Tinfoil barb | Kapiek | 500 - 600 |
| 2 | *Hemibagrus nemurus* | Yellow Catfish | Baung | 9 |
| 3 | *Barbichthys laevis* | Sucker barb | Pitulu | 7 |
| 4 | *Aplocheilichthys pleurotaenia* | Striped Panchax | Mapaik/lelan | 5 |
| 5 | *Tor Tambroides* | Thai mahseer | Garing/Gariang | 3 |
| 6 | *Lobocheilos falcifer* | Barbus falcifer | Kulari | 3 |
| 7 | *Hemibagrus macrolepidota* | Giant catfish | Barau | 2 |
| 8 | *Cyclocheilichthys Apogon* | Apogon barb | Siban | 2 |
| 9 | *Labiobarbus fasciatus* | Kisut | Luwang | 4 |
| 10 | *Labiobarbus sp* | Kisut | Luwang bonca | 1 |
| 11 | *Labiobarbus leptocheilus* | Thin-lipped barb | Luwang bidiang | 1 |
| 12 | *Lobocheilos sp* | Barbus | Kulari lubuk | 1 |
| 13 | *Macrobrachium rosenbergii* | Giant freshwater prawn | Udang galah | 1 |

(Source: YAPEKA, 2024)

Based on a compilation of previous research, at least 72 fish species have been identified in the Subayang River, which have been preserved through local wisdom practices [9]. However, during this opening of *Lubuk Larangan*, only 13 species were successfully caught, with *Barbonymus schwanenfeldii,* or Tinfoil barb, being the most frequently captured species. The fish with bigger sizes were caught with lengths between 15 to 52 cm. The

quantity and size of the catches in *Lubuk Larangan* are influenced by the dimensions of the *Lubuk*, with larger *Lubuk* supporting the growth of larger and more fish.

**Table 2**. The revenue from the opening of the youth-managed *Lubuk Larangan* in Tanjung Beringin Village

| No. | Selling System | Piece or pack | Total (IDR) |
|---|---|---|---|
| 1 | Auction | 6 | 1,000,000 |
| 2 | *Andel dalam* | 69 | 2,070,000 |
| 3 | *Andel luar* | 29 | 1,450,000 |
| **Total** | | | 4,520,000 |

(Source: YAPEKA, 2024)

As shown in Table 2, a total of six fish were sold through an auction, while 98 packs were sold using the *Andel* mechanism. The total revenue amounted to 4,520,000 IDR, which will be allocated to support youth activities, including sports and the commemoration of Indonesia's 79th Independence Day. This income is relatively modest compared to the earnings from the previous opening of the *Lubuk* owned by the youth group in Tanjung Belit, which was approximately 30,000,000 IDR, and the *Lubuk* owned by *Kenagarian*, which yielded around 26,000,000 IDR in 2018. In the same year, the village of Aur Kuning, located closer to the river upstream than Tanjung Beringin, achieved revenue of 7,000,000 IDR from the opening of a larger Lubuk, and 3,000,000 IDR from a smaller one. In addition to the size of the *Lubuk Larangan*, the strategic location and accessibility of the village to the outside community may also play a significant role in determining the profitability of the fishery.

According to data collected in August 2015 [9], the annual productivity value of natural freshwater fishery resources in the *Lubuk Larangan* along the Subayang River is estimated at 525,000,000 IDR. This ilustration contrasts sharply with the productivity of captured fish which averages only 12,220 IDR per day after accounting for the average costs incurred during a single fishing trip, including expenses for fishing gear, profit-sharing, taxes, and transportation fuel. Despite its significant economic potential, the *Lubuk Larangan* in Rimbang Baling remains centered on cultural values and is perceived as a traditional festival.

Currently, most buyers at the TC auction are local, as there has not yet been a widespread dissemination of information that could foster the development of the ecotourism and cultural tourism sectors. One example of a commercialized temporary closure is the *Lubuk Larangan* in Ludai Village, located in the Kampar Kiri Hulu Regency, which is traversed by the Batang Bio River and lies within the buffer zone to Rimbang Baling Wildlife Reserve. Following a similar concept to the nighttime opening of the Lubuk Larangan in Tanjung Beringin, visitors can participate in fishing during the opening of the TC from morning until evening for a fee. Our observation indicated that while the development of *Lubuk Larangan* into an ecotourism and cultural tourism attraction holds promise, it must be approached cautiously to avoid undermining its conservation values. From a conservation perspective, the implementation of *Lubuk Larangan*, which does not solely emphasize productivity, highlights that environmental sustainability is a value whose benefits cannot be easily quantified.

The principle of conservation encompasses the conscious efforts made by communities to preserve their natural resources, ensuring their sustainability amidst evolving economic, political, religious, social, and technological contexts [4]. This condition is a reflection of the dynamic interplay between natural and human factors that if not managed can lead to practical loss. As mentioned in the SES approach, social and ecological systems are interrelated. The SES framework is not simply an ecological system augmented by a social system, but a cohesive and integrated system characterized by the two that determine the dynamics and sustainability of the system as a whole [10,11], included in *Lubuk Larangan.*

The presence of *Lubuk Larangan*, which incorporates conservation principles rooted in local knowledge, demonstrates that indigenous communities possess the capacity to utilize natural resources effectively, drawing on the needs and experiences passed down from their ancestors. Traditional laws serve not only as a means of preserving institutional customs but also of maintaining the ecological functions of rivers. By comparing with similar practices in coastal areas, we might argue that *Lubuk Larangan* as a TC and the use of traditional, environmentally friendly fishing gear, could potentially support local fish species sustainability by creating fish breeding grounds. Consistent implementation and effective management measures will ensure a steady supply of protein for food security and help maintain positive environmental quality [12].

However, local knowledge is often overlooked by scientific knowledge and social institutions in policy-making processes, as it is perceived as traditional and potentially irrelevant in the face of changes in resources, whether physical, social, religious, cultural, or political [2,4]. An example of potential future changes is the diminishing effectiveness of prohibition methods that rely on religious-magical approaches linked to metaphysical powers. Individual perspectives may shift as communities become more exposed to technology and scientific knowledge that promote logical reasoning. This shift can also amplify the desire among modern society to exploit natural resources extensively, significantly change the social-ecological dynamics, and consequently affect its resilience [13,14]. The fish weirs, *Ladak*, are a social-ecological phenomenon that is often less explored, particularly in Indonesia. Many other studies focus on this type of practice from an anthropological or even archeological point of view, despite its dynamic, inseparable social-ecological interaction shaping the unique social-ecological landscape of Rimbang Baling [8]. Fish weir design and use reflect a deep knowledge of the local community, understanding their social-ecological characteristics and how to utilize the existing resources. Other studies in the Pacific and Oceania indicated that social-ecological changes may lead to the fading out of fish weirs and TC practices [7].

The Rimbang Baling ecosystem is subject to various threats arising from both external and internal factors, with particular emphasis on water quality concerns in the Subayang River, as demonstrated by findings from a study conducted in 2015. Sampling conducted at three distinct locations—Aur Kuning (upstream), Tanjung Beringin (midstream), and Tanjung Belit (downstream)—indicated that the levels of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), ammonia, sulfide, and total coliform frequently surpassed the regulatory thresholds established in Government Regulation No. 82 of 2001 pertaining to Water Quality Management [15]. For example, biochemical oxygen demand (BOD) levels varied from 1,610 mg/L in the upstream locations to 3,725 mg/L in the downstream areas, exceeding the established threshold of 2,000 mg/L. Concurrently, chemical oxygen demand (COD) levels at all sampling sites were observed to be near or above the critical limit of 10,000 mg/L. Ammonia concentrations were observed to range from 0.808 to 1.220 mg/L, while sulfide levels remained below 0.010 mg/L [15]. These findings indicate that sulfide may compromise drinking water quality, whereas elevated ammonia levels present potential risks to aquatic organisms. The observed coliform counts ranged from 11,000 to 17,000 per 100 ml, significantly surpassing the established threshold of 1,000 per 100 ml [9]. This finding suggests the presence of water contamination attributed to organic waste, parasites, and pathogenic microorganisms, thereby deeming the water inappropriate for consumption and detrimental to aquatic life development. The identified issues can be primarily ascribed to community practices such as the disposal of organic waste and the prevalence of open defecation [15]. However, recent observations conducted between 2023 and 2024 by the research team indicate a notable transition towards the utilization of indoor water closets, which has contributed to a reduction in direct contamination of river systems. Notwithstanding the advancements made, the issue of inadequate waste

management in conservation villages persists as a significant concern. Households frequently resort to the incineration of non-organic waste and the disposal of organic waste into river systems, attributable to the lack of structured waste disposal facilities. Up-to-date evaluations of water quality and advancements in waste management systems are essential for effectively addressing these challenges and ensuring the conservation of the ecosystem.

Destructive activities that impact the water quality and ecosystem of the Subayang River can lead to significant future losses, including a decrease in fish populations and potential health risks for communities consuming contaminated fish. The decline in fish availability will negatively affect both economic value and food security [15]. Freshwater fisheries in the Subayang River serve as a primary source of affordable and accessible animal protein for local communities, in contrast to other protein sources like chicken and eggs, which must be transported from outside the landscape. Moreover, the effects of ecosystem imbalances resulting from global climate change have emerged and could further exacerbate existing challenges. Deterioration of the river ecosystem, combined with increasing economic demands, may drive communities to engage in other destructive behaviors within the area, such as illegal logging and poaching [16,17]. While the community shows awareness of preserving the river ecosystem through practices like *Lubuk Larangan*, there are additional threats that necessitate cooperation and collective action among various stakeholders to ensure sustainable environmental conservation.

The formal recognition of *Lubuk Larangan* as a local wisdom by policymakers can significantly contribute to its preservation. This acknowledgment not only fosters a sense of ownership among Indigenous communities over their land and natural resources but also serves as a promotion for global initiatives aimed at combating climate change through Ecosystem-based Adaptation (EbA) [18]. Furthermore, it has the potential to expand the area of terrestrial and freshwater conservation in Indonesia by incorporating traditional conservation areas without the need to designate new regions. Previously, Indonesia struggled to achieve the Aichi Biodiversity Targets, which aimed to increase the area of terrestrial and freshwater conservation to 17%—equivalent to 32.48 million hectares—by 2020. According to the reports of the Ministry of Environment and Forestry in the same year, there was still a shortfall of approximately 10 million hectares [19]. Legal recognition of *Lubuk Larangan* as a conservation area is feasible, as demonstrated by one in Muara Bio, which has collaborated with the Fisheries Agency of Kampar Regency and the Food and Agriculture Organization of The United Nations (FAO) since 2023 under an agreement to remain permanently closed and focused on conservation efforts. In West Sumatra, *Lubuk Larangan* has already received recognition at the village and district levels through the regional Fisheries Agency, although it has yet to achieve provincial-level acknowledgment. Additionally, *Lubuk Larangan* contributes to achieving several Sustainable Development Goals (SDGs), particularly Goal 2 (Zero Hunger), Goal 13 (Climate Action), and Goal 15 (Life on Land), and has the potential to be classified as a Category VI protected area, as defined by the IUCN, which promotes the sustainable use of natural resources [3].

*Lubuk Larangan*, which generally exists in a natural state without physical development, has the potential to be classified under Category VI of the IUCN protected areas, specifically as "Protected Areas with Sustainable Use of Natural Resources." This category is currently absent in Indonesia and encompasses areas that protect ecosystems and habitats while maintaining cultural values and traditional natural resource management systems. These areas are typically large, primarily in natural conditions, with a focus on sustainable natural resource management. They permit low-level, non-industrial use of natural resources, which is compatible with conservation goals. The management of such regions emphasizes the sustainable utilization of environmental products and services, including hunting, grazing, and natural resource management [20]. These efforts require recognition and guidance from all stakeholders, especially at the national level through relevant ministries.

## 5 Conclusion

The practice of *Lubuk Larangan* reflects a unique inland practice compared to traditional coastal closures, by integrating the use of traditional fish weirs, traditional conservation methods, and cultural rituals aimed at protecting freshwater resources. It's a complex adaptive social-ecological system that intertwines ecological sustainability and cultural values, utilizing local wisdom to manage and preserve the river ecosystem. Techniques like the use of traditional fishing gears, fish weirs, restricted fishing periods, and rituals involving *Ninik Mamak* as the local leaders demonstrate deep knowledge and profound commitment to both spiritual beliefs and ecological conservation developed organically as responses to environmental needs. *Lubuk Larangan* also proves that conservation schemes by local communities provide long-term benefits not only to fulfill food security but also to social aspects. Economically, *Lubuk Larangan* contributes to local livelihoods, though its financial benefits are often secondary to its cultural and ecological significance. Yet, modern challenges like water pollution from organic waste the risk of deforestation, and illegal activities threaten the health of the Subayang River's ecosystem and could be detrimental to *Lubuk Larangan* as part of local culture on the long-term scale.

Moreover, *Lubuk Larangan* faces the tension between preserving local conservation practices and adapting to economic pressures. As modern influences—scientific knowledge, technology, climate change, and external threats—affect the community, traditional religious-magical prohibitions lose their influence, potentially weakening the control mechanisms over resource use. The long-term viability of *Lubuk Larangan* requires formal recognition from policymakers and alignment with broader conservation goals. By formally integrating *Lubuk Larangan* into the national conservation framework, it could serve as a model for Nature-based Solutions (NbS) and even Ecosystem-based Adaptation (EbA) that preserve traditional ecosystems without disrupting local customs. While *Lubuk Larangan* has proven effective in balancing cultural values, conservation, and the local economy, its sustainability will depend on formal recognition, consistent environmental management measures across governance scales, and the ability to integrate both local wisdom and modern conservation practices to address emerging threats to the ecosystem.

## References

1. Kerabat Consortium, Socioeconomic Assessment in Rimbang Baling "Advancing Human and Tiger Harmony in Rimbang Baling Wildlife Reserve, Central Sumatra Tiger Landscape" (2023). https://yapeka.or.id/wp-content/uploads/2024/07/ITHCP3-Yapeka-Socioeconomic-Assessment-Report_2023.docx.pdf
2. Imbau Consortium, Studi Keanekaragaman Ikan Air Tawar pada Lubuk Larangan Sungai Subayang, Kabupaten Kampar, Provinsi Riau (2019)
3. F.M. Mangunjaya, Aadrean, Yarni, and G. Praharawati, Policy Brief: Pengakuan dan Penguatan Lubuk Larangan Sebagai Kawasan Konservasi Tradisional (2022). https://ppi.unas.ac.id/pengakuan-dan-penguatan-lubuk-larangan-sebagai-kawasan-konservasi-tradisional/
4. C. Yuliaty and F. N. Priyatna, Lubuk Larangan: Dinamika Pengetahuan Lokal Masyarakat dalam Pengelolaan Sumber Daya Perikanan Perairan Sungai di Kabupaten Lima Puluh Kota. Jurnal Sosial Ekonomi Kelautan dan Perikanan, **9**, 1 (2014). http://dx.doi.org/10.15578/jsekp.v9i1.1189
5. G. Gnanalingam and C. Hepburn, Flexibility in temporary fisheries closure legislation is required to maximise success. Marine Policy, **61**, 39-45 (2015). https://doi.org/10.1016/j.marpol.2015.06.033

6. B. Jeffrey, Reviving Community Spirit: Furthering the Sustainable, Historical and Economic Role of Fish Weirs and Traps. J Mari Arch, **8**, 29–57 (2013). https://doi.org/10.1007/s11457-013-9106-4
7. S. Marin, H. Chanson, B. Bates, D. Keenan-Jones, and M.C. Westaway, Indigenous fish traps and fish weirs on the Darling (Baaka) River, south-eastern Australia, and their influence on the ecology and morphology of the river and floodplains. Archaeology in Oceania, **58**, 91-114 (2022). https://doi.org/10.1002/arco.5279
8. B. Jeffrey, 'Tidal Stone-Walled Fish Weirs across Asia-Pacific: An Austronesian Cultural Identity and Its Relevance in Marine Ecology Conservation', in Scott M. Fitzpatrick, Jon M. Erlandson, and Kristina M. Gill (eds), Sustainability in Ancient Island Societies: An Archaeology of Human Resilience, 174-197 (2024). https://doi.org/10.5744/florida/9780813069975.003.0007
9. Lembaga Penelitian dan Pengabdian Kepada Masyarakat (LPPM) Universitas Riau and WWF Indonesia, Pengembangan Program Laboratorium Air Tawar Rimbang Baling (2015).
10. C. Folke, S.R. Carpenter, B. Walker, M. Scheffer, T. Chapin, and J. Rockstorm, Resilience Thinking: Integrating Resilience, Adaptability, and Transformability. Ecology and Society, **15,** 4, 20 (2010). https://edepot.wur.nl/174936
11. R. Biggs, M. Schluter, and M.L Schoon, An Introduction to The Resilience Approach and Principles to Sustain Ecosystem Services in Social-ecological Systems (Cambridge University Press, Cambridge, 2015).
12. R. Kenchington, M.J. Kaiser, and K. Boerder, MPAs, Fishery Closures, and Stock Rebuilding, in Rebuilding of Marine Fisheries - Part 2: Case Studies, 182-205 (2018). https://ro.uow.edu.au/lhapapers/3748
13. B.M. Oliveira, R. Boumans, B.D Fath, and J. Harari, How social-ecological systems resilience unfolds from distinct worldviews. Frontiers in Sustainable Resource Management, **3** (2024). https://doi.org/10.3389/fsrma.2024.1352707
14. S. Villasante, I. Gianelli, M. Castrejón, L. Nahuelhual, L. Ortega, U.R. Sumaila, and O. Defeo, Social-ecological Shifts, Traps and Collapses in Small-scale Fisheries: Envisioning a Way Forward to Transformative Changes. Marine Policy, **136** (2022). https://doi.org/10.1016/j.marpol.2021.104933.
15. V. Pramaningsih, R. Yuliawati, S. Sukisman, H. Hansen, R. Suhelmi, and A. Daramusseng. Indeks Kualitas Air dan Dampak terhadap Kesehatan Masyarakat Sekitar Sungai Karang Mumus, Samarinda. Jurnal Kesehatan Lingkungan Indonesia, **22**, 3, 313-319 (2023). https://doi.org/10.14710/jkli.22.3.313-319
16. Reswita, G. Mulyasari, and Reflis, Hubungan Degradasi Lingkungan dengan Kemiskinan. Jurnal Inovasi Penelitian, **2**, 5, 1579-1583 (2021). https://doi.org/10.47492/jip.v2i5.936
17. S. Noakes and J. Carlsen, Ecotourism as a Potential Tool for Poverty Eradication and Wild Tiger Conservation, in Sustainable Tourism & The Millennium Development Goals: Effecting Positive Change ( Jones & Bartlett Learning, Massachusetts, 2013)
18. GIZ, UNEP-WCMC, and FEBA, Guidebook for Monitoring and Evaluating Ecosystem-based Adaptation Interventions (2020).
19. Indonesia. Ministry of Environment and Forestry, Statistik Direktorat Jenderal Konservasi Sumber Daya Alam dan Ekosistem Tahun 2020 (2020). https://ksdae.menlhk.go.id/assets/publikasi/STATISTIK%202020.pdf
20. Indonesia. Ministry of Environment and Forestry, Laporan Penilaian Efektivitas Pengelolaan KK di Indonesia Tahun 2016 (2016). https://ksdae.menlhk.go.id/assets/publikasi/Laporan%20Penilaian%20Efektivitas%20Pengelolaan%20KK%20di%20Indonesia%20Tahun%202016.pdf