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Evaluation of the Suitability of the Fishery Reserve (Reservaat) at Teluk Rasau Lake, Ogan Komering Ilir Regency, South Sumatra Province

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Abstract: Teluk Rasau Lake is one of the reserve areas in South Sumatera Province, Indonesia. This research aims to analyze the suitability of the Teluk Rasau Lake fish reserve based on environmental, social, economic, and cultural aspects and provide management recommendations for the fish reserve based on its suitability. The research was implemented from August to September 2023 in 3 (three) locations using the purposive sampling method. The suitability through the approach analysis of the function and effectiveness of the fish reserve area, considering parameters such as water depth, water quality, availability of aquatic plants such as riparian vegetation, protection, water area, spawning, feeding, and nursery grounds for fish, rare/protected species, legality aspects, ease of access, usage conflicts, and the role of the community supervisory groups. Each parameter was scored based on its importance for the fish reserve. The analysis results of the function and effectiveness of the fish reserve show that its feasibility is entirely appropriate, with a score of 26, indicating that the fish sanctuary is moderately functional and fairly effective. It was concluded that these categories showed optimal performance for the conservation goals of protecting rare/endemic fish species and increasing fish stocks in the surrounding waters. However, participation in community supervisory groups the role was still low. Co-management-based fish reserve management is suitable for the Teluk Rasau Lake fish reserve.
Keywords: fisheries reserve, fish stock, protection, Teluk Rasau Lake

1. Introduction

The Teluk Rasau Lake fishery reserve covers an area of approximately 180 hectares, with water depths ranging from 1 to 3.5 meters. It is located at coordinates 03031'46 SL and 1040 51' 21 EL [1]. The fish migration path in this fishery reserve is connected to the Lempuing River, which borders the Aur River downstream and the Sekampung Sea upstream. This area is subject to "Lebak lebung" auctions sold openly to the public [2].

Based on the Governor's Decree Number 398/Kpts/IV/82 dated June 19, 1982, the zoning of the Teluk Rasau fishery reserve is designated as a Core Fishery Reserve (Reservaat), where fishing and activities that can damage the environment are prohibited [3]. The negative impacts of social and economic developments, such as plantation and agricultural activities, as well as the expansion of residential areas around the conservation area, have led to environmental degradation [4]. The Teluk Rasau Lake fishery reserve faces various challenges, including illegal fishing practices, habitat destruction, and pollution threats. These challenges threaten the ecological integrity and fish stock availability in the conservation area [2].

Significant environmental changes have occurred in terms of forest area and carrying capacity, water sedimentation, and the opening of oil palm and rubber plantations by the community, which are not adequately monitored and supervised. as well as the side effects of using chemical fertilizers and pesticides carried by water flow into the fishery reserve. According to the research results [5], the water quality status of the Lubuk Lampam fishery reserve, which experiences light to heavy contamination, contains herbicides such as paraquat and glyphosate. Then, the research [6], which identified the condition of the Lebung Karangan fishery reserve in Ogan Ilir Regency, is identified to contain organochlorine pesticides.

Therefore, it is necessary to evaluate the function and effectiveness of the Teluk Rasau Lake fishery reserve based on studies of the community's environmental, social, economic, and cultural conditions around the area. The research aims to analyze the suitability of Lake Teluk Rasau as a fisheries reserve based on the environmental, social, and economic aspects of the surrounding community and give recommendations for the appropriate management of the Lake Rasau Lake fisheries reserve.

2. Material and Methods

The research was conducted in the Teluk Rasau Lake fishery reserve in Menang Raya Village, Pedamaran Sub-district, Ogan Komering Ilir Regency, South Sumatra Province. Menang Raya Village is

approximately 6 Km from the centre of Ogan Komering Ilir Regency and about 64 Km from Palembang City. Sample collection was carried out from August to September 2023. This research was conducted through observation, calculations, measurements, and direct interviews in the field using the purposive sampling method for environmental parameter sampling at 3 (three) stations (Table 1), then the distribution of questionnaires to the community around the fishery reserve and government officials. Direct interviews with 39 respondents were held around the fisheries reserve, and four people were from government apparatus (villages, sub-districts and provincial and regency marine and fisheries services), so 43 people were interviewed.

Figure 1. Research Location Teluk Rasau Lake

Table 1. Environmental Parameter Research Stations

Station	Locations	Coordinat Point
Station 1	Near inlet	3.52017884S 104.85471595E
Station 2	Central area of the lake	3.52014419S 104.85153313E
Station 3	Near residential areas and community plantations	3.52082156S 104.84947968E

2.1. Analysis of Suitability Data (Function and Effectiveness) of the Fishery Reserve

2.1.1. Water Quality

The water quality data taken was from chemical and physical parameters. The location of water quality sampling is carried out at three stations that have been determined, namely station 1, near the inlet; station 2 is located in the Central area of Lake Teluk Rasau; station 3 is Near residential areas and community plantations, Sample measurements are carried out in situ, ex-situ tests are carried out in the Laboratory. Water quality parameters such as temperature, brightness, and depth are measured in situ. The pH, DO TDS, TSS, BOD, COD, Total N, ammonia and phosphate parameters were measured ex-situ at the Environmental Laboratory of the Environment and Land Office of South Sumatra Province.

The data obtained from water quality measurements are compiled into a table, followed by calculations using the Pollution Index (PI) method to determine the water quality status. The measured water quality parameters are compared with the water quality standards according to Government Regulation No. 22 of 2021 concerning implementing Environmental Protection and Management for Class III water quality standards (Fishery and Agriculture). The formula for the Pollution Index is as follows:

$$PI_j = \sqrt{\frac{(C_i/L_{ij})_M^2 + (C_i/L_{ij})_R^2}{2}}$$

Explanation:

PIj	:	Pollution Index for use j
Lij	:	Concentration of water quality parameters in the designation quality standard water j
Ci	:	Concentration of water quality parameter i
(Ci/Lij)M	:	Maximum value of Ci/Lij
(Ci/Lij)R	:	Average value of Ci/Lij

Pollution Index (IP) Classification:
$0 \leq IP \leq 1$: Meets quality standards (good)
$1 \leq IP \leq 5$: Lightly polluted
$5 \leq IP \leq 10$: Moderately polluted
$IP > 10$: Heavily polluted

2.1.2. Aquatic Plant Diversity

Data on the availability of aquatic plants or vegetation on the shores of Lake Rasau Bay or fishery sanctuaries is carried out by making 2 (two) transect lines at 2 (two) observation stations with a distance of 2 m from each station. The transect is rectangular, using a paralone pipe measuring 1 m x 1 m and placed on a grove of aquatic plants. The positioning of the sample is done by looking at the location conditions, such as the sample plot can be reached by boat and the condition of the plants can be stepped on. Recognition of vegetation types is obtained from residents, for example, local names and based on aquatic plant identification books [7][8]. The analysis of the Aquatic Plant Diversity Index uses the species diversity index formula from Shannon-Wiener (1963) as cited in [9]:

$$H' = -\Sigma\, pi \ln pi$$

Explanation:
H' : Diversity index
pi : ni/N
N : Total number of individuals
ni : Number of individuals of species i
Criteria for species diversity index:
a. $H' > 3$: High species diversity.

b. $1 \leq H' \leq 3$: Moderate species diversity.
c. $H' < 1$: Low species diversity.

2.1.3. Fishery Reserve Areas Protection

The protection of the Teluk Rasau Lake fishery reserve is analyzed through literature studies and direct visual observations in the field.

2.1.4. Fishery Reserve Area Size

The analysis of the fishery reserve area size uses Geographic Information System (GIS) with ArcMap software version 10.5, which is then compared to the area size obtained from literature studies based on the Governor's Decree Number 398/Kpts/IV/82 dated June 19, 1982, concerning the Teluk Rasau Lake Fishery Reserve.

2.1.5. Spawning, Feeding and Nursery Grounds

The analysis of the spawning grounds, feeding grounds, and nursery grounds is conducted through visual observation of the aquatic environment, identification of aquatic plants and the diversity index of aquatic plants present in the Teluk Rasau Lake Fishery Reserve.

2.1.6. Rare/Protected Fish Species

Fish caught with nets at the research stations were identified using existing fish identification guidebooks, including Kottelat and Whitten (1996), www.fishbase.com. The determination of protected or conservation status was based on the Minister of Marine Affairs and Fisheries Regulation Number 1 of 2021 concerning Protected Fish Species and referring to the International Union for Conservation of Nature /IUCN (www.iucn.org) for species globally threatened with extinction.

2.1.7. Fishery Reserve Zoning

The analysis of the fishery reserve zoning suitability was carried out through literature studies referring to the Governor's Decree Number 398/Kpts/IV/82 dated June 19, 1982, the Minister of Marine Affairs and Fisheries Regulation Number 30 of 2010 concerning the Management Plan and Zoning of Aquatic Conservation Areas, the Minister of Marine Affairs and Fisheries Regulation Number 02 of 2009 concerning Procedures for Determining Aquatic Conservation, and the Minister of Marine Affairs and Fisheries Regulation Number 31/PERMEN-KP/2020 concerning Conservation Area Management.

2.1.8. Legal Aspects

The analysis was conducted through literature studies on policy products such as decrees, regional regulations, and existing village/customary regulations, as well as interviews with the community around Teluk Rasau Lake.

2.1.9. Ease of Access

Direct observations in the field and interviews with the community were conducted to determine the level of difficulty in reaching the location, including road access and transportation ease to the fishery reserve. The findings were then analyzed descriptively.

2.1.10. Conflict of Use

Data obtained from direct interviews with the community around Teluk Rasau, local sub-district government, regional government, and provincial government (in this case, The Marine and Fisheries Department) was then analyzed descriptively.

2.1.11. Role of Community Supervisory Group (CSG)

Data from interviews regarding the role of the Community Supervisory Group were analyzed descriptively to determine the extent of community support for the protection, supervision, or management of the fishery reserve as a government partner. This analysis also covered the legal basis for forming CSG, the background of the group's establishment, organizational structure, the government's role in this group, work programs, and activities.

2.1.12. Existence of Fishery Reserve Supports Fish Stock and Local Wisdom

The data obtained from interviews and data regarding the local wisdom of "Lebak lebung" and river auction catch yields from inland waters, and the revenue of Regional Original Income (ROI) from the "Lebak lebung"and river auction objects in the Pedamaran district, are then analyzed descriptively to conclude the extent of the influence of the fish reserve of Teluk Rasau Lake in supporting fish stocks and local wisdom in the Pedamaran District.

2.1.13. Suitability Analysis of the Fishery Reserve

The suitability analysis of the location as a fishery reserve was conducted by comparing the measured parameters with the criteria for fishery reserves according to [10], [4], [11], [12] Each parameter was then given a score (scoring method) based on the order of its importance for the fishery reserve.

Table 2. Analysis of the Functions and Effectiveness of the Teluk Rasau Lake Fishery Reserve

No	Parameter	Score value					
		S1	value	S2	value	S3	value
1.	Depth (meters)	>15-25	3	>2-15	2	< 2	1
2.	Water Quality	good	3	medium	2	bad	1
3.	Availability of Aquatic Plants as Riparian Vegetation	many	3	medium	2	few	1
4.	Protection	bay	3	Open bay	2	Open aquatic	1
5.	Aquatic area (ha)	>200	3	100-200	2	<100	1
6.	Spawning, feeding and nursery grounds for fish	Available	3	Limited	2	Not Available	1
7.	Protected fish spesies	≥2	3	1	2	0	1
8.	Legal aspects (Regulation)	Ministerial	3	Governors/ Region	2	Village/cultural herritage	1
9.	Ease of acces	Easy	3	Moderate	2	Slightly difficult	1
10.	Conflict of use	never	3	ever	2	sometimes	1
11.	Role of the POKMASWAS	High	3	Medium	2	low	1
	Score totally		33		22		11

The suitability categories include:

Highly Suitable : The reserve functions well and is very effective with a score ≥ 33

Moderately Suitable : The reserve functions moderately and is quite effective with a score of 22 to < 33

Low Suitability : The reserve functions poorly with a score ≤ 11

3. Results and Discussion

3.1 Depth of the Water

The water depth in the fish reserve of Teluk Rasau Lake at 3 (three) research points ranges between 2.15 and 4.24 m. One of the criteria for a fish reserve, according to [13], is deep waters, which is between 2 and 4 m to prevent it from drying up during the dry season. During the rainy season, the water depth fluctuations in the fish reserve range from 2 to 5 m. With high rainfall, fish can spread to the surrounding waters following the water flow into the swamp forest for spawning, while during the dry season with low rainfall, the fish will return to the fish reserve.

3.2 Water Quality

The results of the Pollution Index (PI) analysis at each research station are presented in Table 2:

Table 2. Pollution Index (PI) Analysis Results

Station	PI Value	Water Quality Status
I	1.08	Lightly Polluted
II	1.03	Lightly Polluted
III	1.04	Lightly Polluted

Based on the results of the Pollution Index (PI) analysis at each station, it can be seen that the PI values range from $1.0 < Pij \leq 5.0$, which means that the water quality status in the Teluk Rasau Lake fishery reserve is lightly polluted. The sampling location at Station I is at the water inlet that connects the Teluk Rasau Lake fishery reserve with surrounding waters (Babatan River and Lempuing River), where pollutants from these waters are suspected to enter the fishery reserve area. Meanwhile, Stations II and III surround rubber/palm oil plantations and residential areas.

The sources of pollution are likely from fertilization activities carried by rainwater runoff and bathing and washing activities by Teluk Rasau Lake waters residents. Using fertilizers on agricultural land and detergents from residential activities are the causes of pollution in a water area [14]. Various types of waste, such as organic and inorganic waste, entering the water have caused the water quality status of the Teluk Rasau Lake fishery reserve to become lightly polluted. Environmental changes resulting from land conversion into residential areas, office areas, plantations, and mining activities have led to increased environmental pollution, including a reduction in clean water quality and pollution of inland waters [15].

3.3 Aquatic Plant Diversity

Based on the analysis using the Shannon-Wiener diversity index (1963), the aquatic plant diversity in the Teluk Rasau Lake fishery reserve is around 2.013 with $H' \; 1 \leq H' \leq 3$, indicating moderate species diversity, which suggests that the diversity of aquatic plants is quite even, with no dominant species and relatively controlled populations. It indicates that the waters are still suitable to support life processes in the aquatic environment. If the *H*, value approaches 3, it means a good condition of the waters, showing that the environment is well-maintained. Therefore,

aquatic plants in the Teluk Rasau Lake fishery reserve are believed to have good adaptation abilities to the environmental conditions of the waters, anatomically, physiologically, and morphologically [16].

Table 3. Aquatic Plant Species Found in the Teluk Rasau Lake Fishery Reserve

No	Family	Scientific Name	Local Name	Number of Individuals	H'
1	*Salviniaceae*	*Salvinia molesta*	Kiambang	74	0,294
2	*Pontederiaceae*	*Eichhornia crassipes*	Eceng gondok	85	0,312
3	*Araceae*	*Pistia stratiotes*	Kiapu	76	0,298
4	*Hydrocharitaceae*	*Hydrilla verticillata*	Antanan Air	23	0,150
5	*Nymphaeaceae*	*Nymphaeaceae alba* L.	Teratai	34	0,193
6	*Polygonaceae*	*Polygonum barbatun*	Ketanan	60	0,266
7	*Cyperraceae*	*Cyperus platystylis*	Rumput Para	59	0,264
8	*Poaceae*	*Leersia hexandra*	Rumput Grigit	48	0,236
				459	**2,013**

3.4 Fishery Reserve Area Protection

According to literature studies and visual observations, the Teluk Rasau Lake fishery reserve is an oxbow lake with a depth of about 3 meters in the middle during the dry season, with an average water level fluctuation of up to 2.5 meters.

3.5 Area Measurement Results (Hectares)

Using a Geographic Information System (GIS) with ArcMap version 10.5, the total water area of the Teluk Rasau Lake fishery reserve is 106.10977 hectares. According to the Governor's Decree Number 398/Kpts/IV/82, dated June 19, 1982, concerning the Teluk Rasau Lake Fishery Reserve, the area was originally ± 180 hectares. The reduction in the fishery reserve's area by approximately 76 hectares over 42 years (from 1982 to 2023) is suspected to be due to sedimentation.

Solid particles or silt carried by continuous and large volumes of water flow through canals from the surrounding inland waters into Teluk Rasau Lake and settle at the lake's bottom over time, causing rapid sedimentation and shallowing. Continuous sedimentation leads to the formation of new land, thereby reducing the fishery reserve area. Sedimentation occurs when solid particles carried by water settle at the bottom of rivers or lakes, eventually forming new land [17].

3.6 Spawning, Feeding and Nursery Grounds

Visual observations of the aquatic environment of the Teluk Rasau Lake fishery reserve indicate the availability of aquatic plants such as water-bonnet (*Pistia stratiotes*), water hyacinth (*Eichhornia crassipes*), kariba weed (*Salvinia molesta*), hydrilla (*Hydrilla verticillata*), and surrounding tree vegetation. These plants and trees serve as spawning, feeding, and nursery areas for fish. According to [18], aquatic plants serve as a direct food source for herbivorous fish and provide a habitat for various types of periphyton, a primary food source for other fish in the aquatic ecosystem. The presence of aquatic plants, in terms of both species and abundance, can be an indicator of the environmental condition of the water body, one of which is a reproduction site for fish [19].

The presence of aquatic plants, in terms of species diversity and abundance, can indicate the water body's environmental condition, including being a critical habitat for fish reproduction [20]. In lake ecosystems, aquatic plants serve as a vital food source for aquatic organisms. They play an essential role in supporting the ecosystem by providing nutrients and energy to various species that inhabit the water, spawning ground, nursery ground, and shelter ground for fish and other aquatic invertebrates. Additionally, some aquatic plants can absorb heavy metals, thereby helping to reduce pollution in the water. This natural filtration process aids in maintaining a cleaner and healthier aquatic environment [21].

3.7 Rare/Protected/Endemic Fish Species

Based on the catches during the research conducted at Stations I, II, and III, 12 fish species were identified. A further review through the IUCN (International Union for Conservation of Nature) website https://www.iucnredlist.org revealed that 2 (two) of these species are categorized as rare/endangered Belida fish (*Chitala hypselonotus*) and Belida Jawa/Putak (*Notopterus notopterus*) among the species found, there is also one introduced species tilapia (*Oreochromis niloticus*). Based on the feeding habits of the fish living in the Teluk Rasau Lake fishery reserve, there are two types: herbivores and carnivores.

Introducing fish species is important for the sustainability of native fish in the area, as the Nile tilapia (*Oreochromis niloticus*) is invasive and can threaten native fish. Introduced fish species have positive and negative impacts, but based on experiences in various countries, the impact tends to be negative, primarily related to the diversity of fish species [22]. Introduced fish in inland waters are feared to threaten native fish through hybridization with endemic fish, habitat destruction, competition for food and habitat, predation, and the spread of parasites or diseases [23].

Tabel 4. Types of Fish caught in Lake Teluk Rasau (reserve)

No	Family	Scientific Name	Local Name	Red list of Threatned Species
1	Osphronemidae	*Trichopodus pectoralis*	Ikan Sepat siam	Stable
2	Osphronemidae	*Trichopodus trichopterus*	Ikan Sepat rawa	Stable
3	Anabantidae	*Anabas testudineus*	Ikan Betok	Stable
4	Pristolepididae	*Pristolepis grootii*	Ikan Sepatung	Stable
5	Notopteridae	*Chitala hypselonotus*	Ikan Belida*	Critically endangered
6	Notopteridae	*Notopterus notopterus*	Ikan Putak*	Critically endangered
6	Channidae	*Channa striata*	Ikan Gabus	Stable
7	Channidae	*Channa lucius*	Ikan Bujuk	Stable
8	Channidae	*Channa micropeltes*	Ikan Toman	Stable
9	Cyprinidae	*Barbonymus schwanenfeldii*	Ikan Lampam	Stable
10	Cyprinidae	*Hampala macrolepidota*.	Ikan Sebarau*	Least concern
11	Helostomatidae	*Helostoma temminckii*	Ikan Tambakan	Stable
12	Bagridae	*Mystus negricep*	Ikan Berengit	Stable
13	Cyprinidae	*Rasbora argyrotaenia*	Ikan Seluang Batang	Stable
14	Cichlidae	*Oreochromis niloticus*	Ikan Nila	Stable

Noted: (*) IUCN (International Union for Conservation of Nature) and Regulation of the Minister of Marine Affairs and Fisheries No. 1 of 2021 Concerning Protected Fish Species

3.8 Fishery Reserve Zoning

Based on [3], the zoning of the Teluk Rasau Lake fish reserve area has been designated as a core fish reserve, where fishing and activities that can damage the environment are prohibited. Based on the literature analysis, there is no clear zoning division in the Teluk Rasau fish reserve area, and the intensity of fish theft still frequently occurs in this area.

According to [24] about the management and zoning plans for marine conservation areas, the zoning of marine conservation areas is divided into four areas: the core zone, sustainable fishing zones, use/buffer zones, and other zones, which, due to their functions and conditions are designated as specific zones (protection and rehabilitation zones). However, the zoning division was later revised so that the conservation areas were divided into only three areas: the core zone, sustainable fishing zone, and limited use/other zones [25].

3.9 Legal Aspects

Based on interviews with the community around the Teluk Rasau Lake fishery reserve, approximately 83.72% of them are aware of clear legal regulations governing the existence of Teluk Rasau Lake. Furthermore, 86.05% of the respondents know that this area is owned by the government, specifically under the jurisdiction of the Fisheries Department of the Ogan Komering Ilir Regency, as established by the existing regulations.

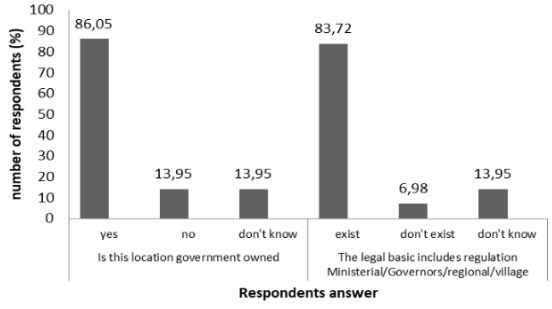

Figure 1. Respondents' Perception Legality of the Fishery Reserve

Legal aspects in fishery reserves play a crucial role in maintaining the sustainability of aquatic resources and habitats. Legal measures help regulate, protect, and ensure that activities threatening the sustainability of the fishery reserve can be anticipated and managed within sustainable limits, including legal actions. Regulations help prevent overfishing and fish theft, which can damage marine ecosystems and threaten the sustainability of fish resources in the reserve[26].

3.10 Ease of Access

Based on the results of the research questionnaire shown in Figure 2, approximately 83.72% of respondents stated that access to the fishery reserve is nearby and easily accessible. The road conditions leading to the Teluk Rasau Lake fishery reserve are excellent and connected to local and national roads.

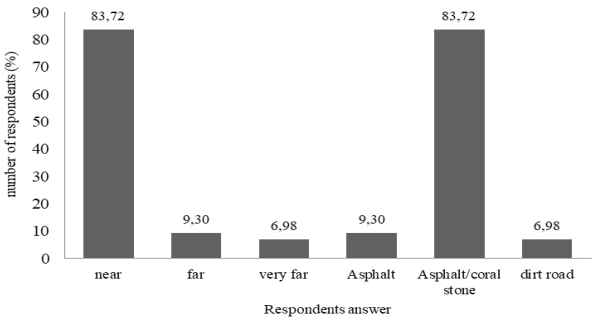

Figure 2. Distance and Road Conditions to the Fishery Reserve

Accessibility consists of two elements: distance and travel time from the object's location to the provincial or regency capital. Accessibility consists of distance and travel time from the object's location to the provincial or regency capital. Accessibility (travel distance, facilities, and safety) is an important supporting factor because it drives the market and encourages visitor potential. Accessibility indicates the ease with which an object can be reached [27].

3.11 Conflict of Uses

Interview results during the research show that 69.77% of the local community around the fishery reserve reported never experiencing usage conflicts. The intensity of usage conflicts around the fishery reserve can be seen in Figure3.

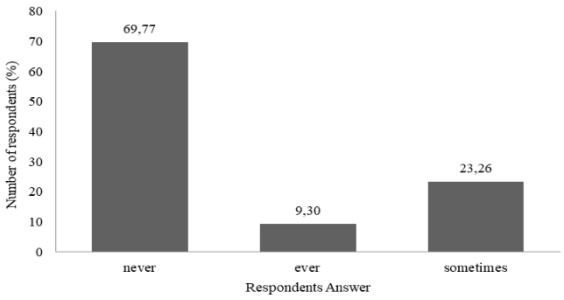

Figure 3. Intensity of Usage Conflicts Around Fishery Resesrve

The causes of land conflicts can vary, including unclear land ownership status and overlapping ownership claims. These land conflicts impact social stability and security. Unclear land status is a primary trigger of conflicts in the community and among other interested parties who have conflicting claims over the same piece of land [28].

However, what needs to be monitored is the conflict between the government and fishermen regarding the exploitation of fishery resources. The government has policies that differ from the needs of the fishermen, such as the prohibition of fishing in the Teluk Rasau Lake fishery reserve, due to the high frequency of fish theft. Good spatial and regional planning policies should be able to direct this. Good spatial and regional planning policies can direct this.

Proper zoning can reduce usage conflicts between the government as the manager and the fisher while protecting environmentally sensitive areas. Spatial policies can protect conservation areas that are important for preserving natural ecosystems, biodiversity, and natural resources, including protected forests, national parks, and nature reserves [29].

3.12 The Role of Community Supervisory Group (CSG)

The survey results from 43 respondents around the Teluk Rasau Lake fishery reserve show that approximately 81.40% of respondents believe that the low level of supervision by the community fishery supervision group (CSG) to report, prevent, or carry out prevention of violations is a significant issue. The role of CSG is closely related to the rate of fish theft in the Teluk Rasau Lake fishery reserve, as illustrated in Figures 4 and 5.

The role of CSG in safeguarding and assisting authorities in monitoring and reporting violations around the fishery reserve is still perceived as low. Fish theft by local and external individuals continues to occur. Interviews with respondents living around the Teluk Rasau Lake fishery reserve show that 79.07% of residents and outsiders still engage in fish theft despite the regulations prohibiting such actions.

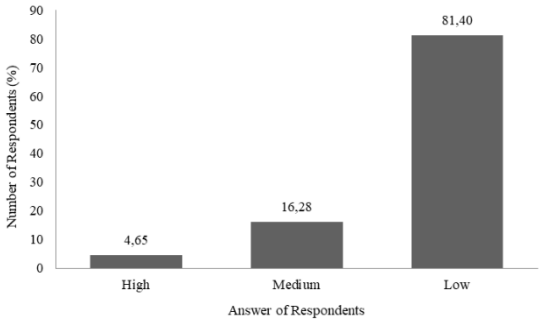

Figure 4. Role of the Community Supervisory Group (POKMASWAS)

The primary role of CSG is to inform authorities about suspected violations in the fisheries and marine sectors, raise local community awareness about regulations and sustainable practices, and assist authorities by monitoring activities in the Teluk Rasau Lake fishery reserve. However, their effectiveness is still perceived as lacking. The community supervisory group (CSG) operates at the field level and comprises community leaders. This group was formed by community members aware of the importance of marine and fishery resource conservation [30].

The Community Supervisory Group (CSG) 's role in safeguarding and assisting authorities in monitoring and reporting violations around the fishery reserve is still perceived as low. Fish theft by local and external individuals continues to occur. Interviews with respondents living around the Teluk Rasau Lake fishery reserve show that 79.07% of residents and outsiders still engage in fish theft despite the regulations prohibiting such actions.

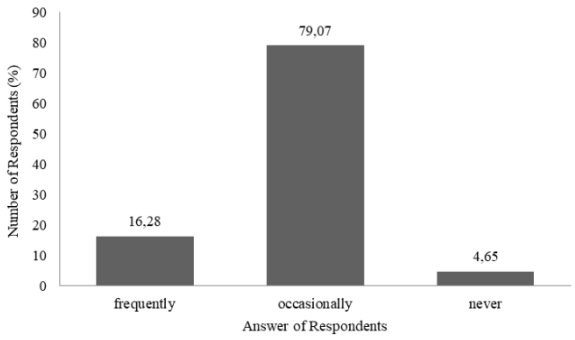

Figure 5. Intensity of illegal fishing in the Fishery Reserve

The limitations of monitoring conducted by community groups such as CSG, the lack of strict sanctions, the lack of awareness and active participation from local communities in supporting supervision and reporting violations, and the vast area

of the fishery reserve are the main reasons for the continued fish theft in the fishery reserve area [31] The management of the Lake Teluk Rasau fisheries reserve is currently still dominated by the fisheries office of Ogan Komering Ilir district, coordination and communication with community supervisory groups (CSG) is still lacking because the management only 2 (two) guards assigned to this fisheries reserve. With a large enough area, they cannot supervise or guard against disturbances of habitat destruction, theft of fish activities, and the threat of pollution from plantations or surrounding settlements. Co-management-based fisheries reserve is a reasonably appropriate approach in the management fishery reserve of Lake Teluk Rasau, where collaboration between the government, local communities, and other stakeholders will be able to optimize the role and function of the Community Supervisory Groups (CSG).

Management of fisheries reserves in Indonesia includes various patterns that are predominantly managed by the government and managed by the community. Each pattern has its advantages and disadvantages. The combination of these 2 (two) methods is called co-management, which involves regulation by utilizing the capabilities and interests of local fishermen or local community groups, coupled with government support in the form of legal tools or other assistance in the management of fisheries reserve. A study in the inland waters of Lake Arang-Arang Jambi shows that 74% of fishing communities that catch fish in inland waters and implement fisheries reserve with a co-management pattern consider the existence of a management working group for fishery resources, including fisheries reserve management. Meanwhile, in the inland waters fishing community that implements a government-dominated fisheries reserve, Only 23% feel they can convey their aspirations verbally and in writing to local governments through working groups. Institutions are provincial marine and fisheries offices, district fisheries offices, community supervisory groups (CSG), district offices, village heads and fishermen groups[32].

3.13 The Existence of Fisheries Reserve Supports Local Wisdom and Fish Stocks

A fish reserve is a designated area that functions as a fish protection zone and helps maintain fish production in the surrounding area. Based on a survey conducted on respondents, it was found that there is a significant increase in fish stocks of 58.14% in the area around the Teluk Rasau Lake fish reserve in the Pedamaran district (Figure 6). Respondents' feedback in the Pedamaran district indicates that the fish reserve has a substantial impact in supporting the local wisdom "lelang lebak, lebung, sungai" (L3S) at 74.42%, fish stocks in surrounding waters at 65.12%, and in preserving rare/endemic fish at 46.51%, as seen in Figure 7.

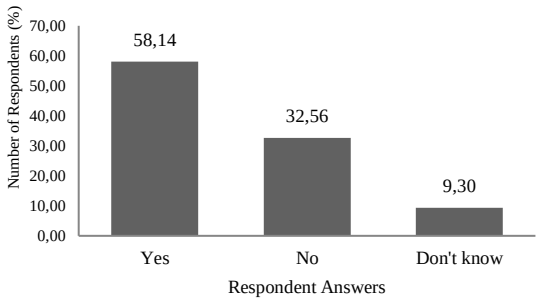

Figure 6. The Influence of increased Fish Populations around Fish Reserve

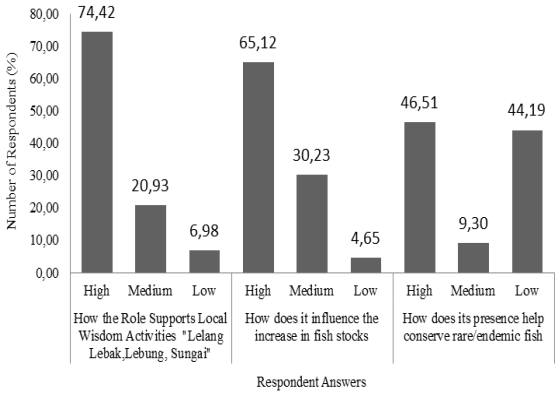

Figure 7. Influence on Local Wisdom, Fish Stocks, and Rare Fish

Based on the statistical data analysis from the Fisheries Department of Ogan Komering Ilir Regency, the number of inland waters capture fisheries production from 2019 to 2023 in the Pedamaran district shows that the annual production figures are stable and tend to experience a significant increase. Besides seasonal factors, this is also due to the influence or impact of the Lake Teluk Rasau fish reserve, which affects the fish stocks spreading in the surrounding waters. The production of inland water fisheries can be seen in Figure 8 as follows.

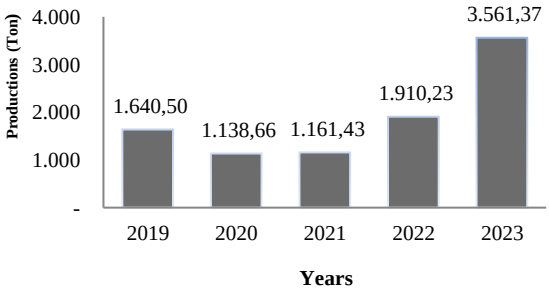

Figure 8. Inland Waters Fisheries Production 2019 to 2023

Original local revenue from local wisdom auction of lowland ponds and rivers Pedamaran district is the third largest contributor, with revenue from 2019 to

2023 amounting to IDR.6,258,120,000 (six billion two hundred fifty-eight million one hundred twenty thousand rupiah) or approximately 15.04%. This result indicates that fish stocks are still abundant in the Pedamaran district, making it an attractive prospect for auction winners who enthusiastically participate in the “auction lowland ponds and rivers” every year, which is influenced directly and indirectly by the presence of the Lake Teluk Rasau fishery reserve, which continues to be maintained.

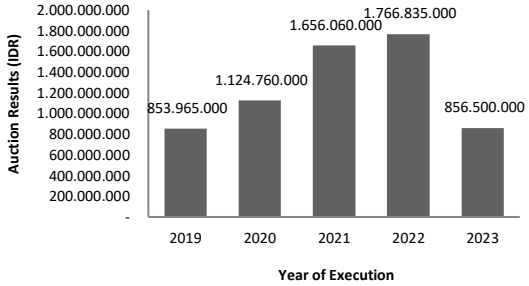

Figure 8. Auction Results of floodplain and Rivers in Pedamaran District 2019 to 2023

The existence of reserve/conservation areas in a particular region/area can maintain the preservation of animal resources [33]. A fish reserve can function both in the short and long term as a buffer for the aquatic ecosystem. The short-term function is how this area can recover nearly extinct fish or maintain fish stock levels [34],[35]. The availability of abundant fish stocks and the diversity of fish species indicate that the ecosystem is functioning healthily, where economically valuable fish are still widely found in the waters of floodplains and rivers [36].

Fishery reserves play an important role in maintaining the income levels of inland water fishers [37]. The presence of juvenile fish is crucial as they replace the fish that fishers have caught. If the development or growth of juveniles is disrupted in the aquatic ecosystem, it can affect fish catch production [38].

Based on the research presented in Figure 7, Teluk Rasau Lake's influence is significantly high, with around 74.42% playing a crucial role in supporting local wisdom. The auction of floodplains and rivers is a form of local wisdom in managing inland water resources in Ogan Komering Ilir Regency. The auction of floodplains and rivers is a local term nationally recognized for namig the management of areas [39].

Management of the inland water ecosystem (Auction of floodplains and rivers) has been implemented since the 17th century during the Palembang Darussalam Sultanate era, and it has been implemented until now, with regional regulation number 14 of 2015 [34]. This management involves designating areas for the Auction of floodplains and rivers in river, lake, and flooded swamp waters, including fish reserves as protected areas and efforts to conserve rare/endemic fish species and enhance fish stocks in the surrounding waters[40]. In 2021, the Auction of floodplain and rivers was designated as an Intangible Cultural Heritage originating from Ogan Komering Ilir Regency by the Ministry of Law and Human Rights of the Republic of Indonesia [41].

According to Keraf (2002) in [42], local wisdom includes beliefs, understandings, customs, knowledge, and ethics that guide human behavior in ecologically-based groups. Local wisdom plays an important role in sustainable fisheries development because it forms the foundation for community self-reliance and initiative, thus enhancing community participation [43].

Fishery reserves or 'lubuk larangan' have three functions: ecological, economic, and socio-cultural. The ecological function is to protect the existence of local fish species, serve as fish spawning grounds, and maintain environmental cleanliness. The economic function includes creating job opportunities, providing recreational facilities, and being an additional source of income and funding for village development, as well as being a source of food security for the community. Socio-culturally, they preserve their ancestors' local wisdom or unique phenomena and maintain traditional institutions [44].

In some cases in Indonesia, local wisdom has not only proven capable of saving resources. It has also changed people's behaviour towards these resources, including a paradigm shift from open access, where resources can be accessed by anyone, to community-owned resources and the consistent enforcement of rules that have been collectively established [45].

3.14. Scoring Results of Function and Effectiveness of Fishery Reserve

Based on various suitability parameters used to determine the fishery reserve areas, which are part of the requirements that need to be assessed in a fishery reserve area to be maintained or further developed in the future. The analysis results of the function and effectiveness of the Teluk Rasau Lake fishery reserve show that it is suitable, with a score of 26, where the fishery reserve has moderate functionality and effectiveness. These criteria indicate that the fishery reserve performs adequately in several aspects, such as conservation goals and management, like increasing fish population (fish stocks) and habitat protection. However, challenges still need to be addressed, including monitoring aspects, law enforcement, and community participation, which must be improved to achieve optimal effectiveness.

The existence of the Teluk Rasau Lake fishery reserve still needs to be maintained as it can increase or maintain fish stocks in the waters around the Pedamaran district, support local wisdom like auctioning of lowland ponds and rivers and serve as a refuge for rare/endemic or endangered fish species. Table 5 shows the results of analysing the functions

and effectiveness of the Teluk Rasau Lake fishery reserve.

Tabel 5. Results of the Analysis of the Functions and Effectiveness of the Teluk Rasau Lake Fishery Reserve

No	Parameter	Score value						Score results
		S1	value	S2	value	S3	value	
1.	Depth (meters)	>15-25	3	>2-15	2	< 2	1	2
2.	Water Quality	good	3	medium	2	bad	1	2
3.	Availability of Aquatic Plants as Riparian Vegetation	many	3	medium	2	few	1	2
4.	Protection	bay	3	Open bay	2	Open aquatic	1	3
5.	Aquatic area (ha)	>200	3	100-200	2	<100	1	2
6.	Spawning, feeding and nursery grounds for fish	Available	3	Limited	2	Not Available	1	3
7.	Protected fish spesies	≥2	3	1	2	0	1	3
8.	Legal aspects (Regulation)	Ministerial	3	Governors/ Region	2	Village/cultural herritage	1	2
9.	Ease of acces	Easy	3	Moderate	2	Slightly difficult	1	3
10.	Conflict of use	never	3	ever	2	sometimes	1	3
11.	Role of the POKMASWAS	High	3	Medium	2	low	1	1
	Score totally		33		22		11	26

Explanation:
S1 : High suitable (Fishery Reserve Functions Well and Is Highly Effective with a Score ≥ 33)
S2 : Moderately suitable (Fishery Reserve Functions Moderately and is Fairly Effective with a Score of 22 - < 33)
S3 : Unsuitable (Fishery Reserve Functions Poorly with a Score ≤ 11)

4. Conclusion

The analysis results on the function and effectiveness of the Fishery reserve at Lake Teluk Rasau show that it is moderately suitable with a score of 26, indicating that the fishery reserve functions at a moderate level and is pretty effective. These criteria suggest that the reserve performs adequately, achieving conservation and management goals such as increasing fish populations (fish stocks) and habitat protection. However, there are still challenges to be addressed. These challenges include monitoring, law enforcement, and community participation, which must be improved to achieve optimal effectiveness.

Co-management is a reasonably suitable approach for managing the Fishery reserve at Lake Teluk Rasau. Collaboration among the government, local communities, and other stakeholders can optimise community supervisory groups (CSG).

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