Paradigm of Inland Fisheries Resources Management: An Environmental Sociology Review

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Abstract: Inland fishery resources are faced with ecosystem damage due to highly exploitative utilization. This is closely related to the paradigm of natural resource management. The anthropocentric paradigm that has been widely embraced so far places the environment only as a tool to meet human needs. In the last 30 years, inland fishery resources have been damaged due to various human activities. The purpose of the research is to analyze the paradigm of inland fishery resource management and the impact of aquatic environmental damage caused. The research method uses literature studies. The data were analyzed using articles obtained from reputable national and international journals, and related to research problems. Data analysis is carried out through the stages of recording important and relevant parts, compiling, then analyzing, and drawing conclusions. The results of the study show that the management of inland fishery resources in Indonesia is very anthropocentric. Natural resource management is generally focused on the production aspect and ignores the sustainability aspect. The causes of the damage are continuous large-scale fishing, water pollution due to inland acriviability, conversion of inland water areas, suboptimal governance and synergy of stakeholders. As a result, the decline in fish populations due to uncontrolled fishing, the extinction of some endemic fish, and water pollution are a serious threat. Damage to inland water areas not only threatens the environment, but also poses a threat to the social and cultural life of the surrounding communities.

1 INTRODUCTION

One of Indonesia's natural resources is inland fisheries. Although it does not provide the large sustainable production potential of the marine sector. Inland fisheries contribute to food security and provide employment for communities. Inland waters have their own uniqueness compared to marine areas, such as the potential for endemic varieties. From an emic perspective, the presence of endemic fish is part of the life of the local community. Furthermore, inland waters also contribute to improving the welfare of local communities with the potential of fish resources. Indonesia's inland waters have a high diversity of fish species, making it recorded as a *mega biodiversity* in the world (Kartamihardja et al., 2009) which is inhabited by approximately 100 species of fish(*Kottelat, M et T Whitten 1996 Freshwater Biodiversity in Asia With Special Reference to Fish, Volumes 23-343.Pdf*, n.d.). In addition to the fisheries sector, inland water areas also function as raw water providers for consumption, agriculture, industry and tourist attractions.

The management of inland waters is faced with various problems and challenges. Increasing challenges due to climate change and socio-cultural-economic factors further add to the burden of sustainable management of inland water areas. Beyond the impacts of climate change, disparities in power dynamics, limited access, socio-cultural and socio-economic disparities.

Inland fisheries resource issues are not only related to fishing activities. A variety of problems exist that are complex and interconnected. For

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example, pollution, poor governance, threats to endemic species, changes in water areas, movement of diseases and pathogens, and social conflicts. Uncontrolled fishing; pollution due to inland activities; declining endemic fish populations; damage to inland areas; suboptimal policies and governance; and Fishermen's poverty are problems that must be resolved immediately.

Fisheries resources are*renewable* or recoverable resources. Although *renewable*, fisheries resources are very vulnerable to damage and threatened with sustainability. Sustainability and preservation of fisheries resources are highly dependent on management patterns. Several strategies have been implemented to prevent and overcome the problems faced by fisheries resources. Introductions and restocking are done to maintain fish stocks. However, these measures are not effective in preventing the extinction of biodiversity. Introductions actually cause new problems, especially the existence of endemic species. Fish introduction is done to increase the economic function of inland fisheries by introducing iken with a short growth period and large size. In this activity there is an anthropocene trajectory, the achievement of increased production ignores the sustainability of the ecosystem. These activities are very likely to accelerate extinction (Wahyudewantoro & Rachmatika, 2016). In addition to restocking and induction, other strategies include limiting human activities such as regulating fishing gear, closing fishing periods, closing water areas, and establishing conservation areas.

Efforts to encourage sustainable management of fisheries resources are often faced with economic interests, resulting in ecological aspects being neglected. A case in point is the utilization of inland water areas for cage culture fisheries. This practice has resulted in changes in the composition of endemic fish species and biochemical contamination of water areas. (Hutajulu & Harahap, 2023; Yuniarti et al., 2023).

This paper will examine the management of inland fisheries resources in Indonesia. The analysis is conducted through a review of journals, research reports, and other documents related to the management of inland water areas. The analysis is carried out by examining management, problems and impacts on the environment and society. Analysis of the management of inland water areas is focused on the perspective of political ecology as an alternative paradigm in natural resource management. The perspective of political ecology can be said to be the antithesis of the *developmentalism* and neoliberalism paradigms that have been established in practice.

2 METHOD

This article uses the literature study method. We conducted a search for scientific articles that examine fisheries resource management in various aspects. The search for articles focused on national articles and articles from reputable international journals. Some articles did not fall into these categories, but we still used them because they presented field facts in accordance with the needs of this article. Data analysis is carried out through the stages of recording important and relevant parts, compiling, then analyzing, and drawing conclusions. The facts found were analyzed using a sociological approach and political ecology. the results are presented in descriptive form.

3 RESULT AND DISCUSSION

3.1 Overview of Inland Fisheries Resources in Indonesia

Fisheries resources are*renewable* or recoverable resources. Although *renewable*, fisheries resources are very vulnerable to damage and threatened with sustainability. The sustainability and preservation of fisheries resources is highly dependent on management patterns. The basic principle in management that needs to be understood is that its utilization must pay attention to the *carrying capacity of* the resource. We can ask a simple question that will also be a trigger in proposing a management model, namely how to manage fisheries resources that can provide ecological benefits (sustainability and sustainability) and provide economic benefits for the people who use them. There are two things that need to be harmonized in this question, namely the sustainability of fisheries resources and economic benefits for the community.

The ideal management model should be able to accommodate both sustainability and economic interests. To accommodate these interests, it is formulated in three objectives, namely the sustainability of fish resources, habitat sustainability, and business sustainability. Sustainability of fisheries resources can be implemented by preserving biota including native/endemic fish species and inland water areas. There are four main ecosystem compartments (Rahardjo, 2012), namely the biological compartment, the non-biological compartment characterized by the topography of the water bottom type and water quality, the fishing and

harvesting process compartment with technological characteristics, and the institutional compartment which is intertwined with the regulations and organizations needed in fisheries governance. These compartments interact with and are influenced by non-capture activities, climate change, neighboring ecosystems that exchange materials and information, the socioeconomic environment reflecting markets, relevant policies, and social values.

The utilization of inland water resources in Indonesia is increasing along with the increasing rate of population growth. Its utilization is not only in the aspect of fisheries, but also used for water consumption needs, industrial raw water sources, transportation facilities, energy, irrigation, and for tourism purposes. However, the utilization of inland water areas is less controlled, causing considerable pressure on the carrying capacity of the environment. The government has designated 15 National Priority Lakes that must be saved immediately, because the existence of these lakes has a considerable impact on society. Various interests are present in the management of inland water resources which include lakes, rivers, swamps, artificial water areas. Fisheries resources are faced with at least four problems, namely increasing fishing intensity and controlled levels, extinction of endemic species, pollution, modification of the aquatic environment / land use change, not optimal governance, and inequality of access.

3.1.1 Overfishing in Indonesia

Continued fishing correlates with increased public fish consumption. This has led to a decline in fish stocks and populations. Uncontrolled fishing can be seen in the behavior of catching broodstock and fry. Initially, inland waters were multi-species, generally dominated by large fish, with some medium and small fish. As fishing activities increased compared to conservation efforts, large and medium-sized fish decreased, replaced by small fish. This phenomenon is termed *fish down the foodweb* (Rahardjo, 2012).

As a form of control over fishing activities can be done by dividing zoning, regulating fishing time, regulating the type and size of fish that can be caught, and regulating the use of fishing gear. One of the zoning divisions is by establishing fish conservation areas and fishing areas. Furthermore, the regulation of fishing time aims to provide time for fish resources to carry out the process of reproduction and fish growth. Type and size regulations are implemented to ensure that the fish caught are not protected fish species, not broodstock or fry, and the size of the fish is fish that is suitable for consumption. Supervision of the type and size of fish that can be caught and traded can be carried out at fish landing sites, fish auction sites, and fish markets / traditional markets. The use of fishing gear is important to monitor. The government can socialize the types of fishing gear that are prohibited and explain the impacts. The government has established several fishing gears that are allowed to be used and prohibited to be used.

The extinction of endemic species is correlated with uncontrolled fishing activities. The next cause is the emergence of invasive fish or other fish species that interfere with the existence of endemic fish. The increase in the distribution of new fish species can occur through the process of fish introduction, intentional or unintentional release by the community. The worst impact is the extinction of endemic fish.

3.1.2 Degradation of Endemic Fish Species

Freshwater fish have always been a major source of food for humans. It is in a very vulnerable situation as its habitat is being degraded. Agricultural activities, damming, canalization, deforestation, wetland reclamation, urbanization, water extraction and transfer, and waste disposal are significantly altering freshwater ecosystems. (Arlinghaus et al., 2002).

One of the causes of degradation and extinction threats to endemic species is fish introduction activities that do not pay attention to the sustainability aspects of inland aquatic ecosystems. Fish introduction is the activity of introducing new species of fish into waters where previously the fish to be introduced did not exist in the waters. Fish introductions in Indonesia have been carried out since the 18th century, namely 16 species and until now officially recorded as many as 24 species (Wahyudewantoro & Rachmatika, 2016).

The original purpose of fish introduction was to cultivate superior fish, increase the productivity of fisheries in a water body, control pests or weeds and fishing game. Other records mention that fish introductions were carried out with the aim of diversifying farmed fish, and controlling disease vectors (Muchlisin, 2011). Fish introduction with the aim of saving endemic fish populations has been carried out by saving the bilih population from its habitat in Lake Singkarak, West Sumatra to Lake Toba, North Sumatra, the results are quite good, namely the size which was originally only 9 cm in its natural habitat grew longer in Lake Toba reaching 18.5 cm (Umar & Sulaiman, 2013).

Unsupervised fish introductions have damaged aquatic ecosystems. Introduced fish species are generally invasive, have high adaptability, and fast breeding ability. Another characteristic of introduced fish is that they are able to live with the type of food that is around them, and become top predators for other fish. In addition, introduced fish can become a dominant species because introduced fish have high fecundity, mature gonads and rapid growth (Webinar Series Road to ISARM 2022 IPB). Introduced foreign fish will take up the spawning space of endemic fish.

Table 1: Introduced fish species in Indonesia and their distribution.

No	Indonesia Name	Scientific Name	Year of introduction	Origin	Introduction Objective
1	Mas	*Cyprinus carpio*	Before 1900	China	Indonesia
2	Nilem	*Osteochilus hasseltii*	1937	Unknown	Irian Jaya
3	Koan	*Ctenopharyngodon idella*	1964	Malaysia, Singapore, Thailand dan Jepang	Indonesia
4	Mola	*Hypophthalmichthys molitrix*	1969	Jepang dan Taiwan	Indonesia
5	Karp Lumpur Cina	*Cirrhinus chinensis*	1969	Taiwan	Indonesia
6	Karper Cina	*Hypophthalmichthys nobilis*	-	Jepang	Indonesia
7	Karper Cina	*Hypophthalmichthys nobilis*	1969	Taiwan	Indonesia
8	Tawes	*Puntius gonionotus*	1963	Unknown	Irian Jaya
9	Tawes derbang	*Puntius orphoides*	1963	Unknown	Irian Jaya
10	Carp lumpur	*Cirrhinus molitorella*	-	Jepang	Indonesia
11	Rainbow trout	*Oncorhynchus mykiss*	1929	Belanda	Indonesia
12	Rainbow trout	*Oncorhynchus mykiss*	1983	Unknown	Irian Jaya
13	Bintik putih/panchax biru	*Aplocheilus panchax*	Unknown	Indonesia (disebelah barat garis wallacea)	Indonesia
14	Gurame	*Osphronemus goramy*	1937	Unknown	Irian Jaya
15	Sepat siam	*Trichogaster pectoralis*	1937	Unknown	Irian Jaya
16	Sepat siam	*Trichogaster pectoralis*	1930	Malaysia	Indonesia
17	Tambakan	*Helostoma temminckii*	1937	Unknown	Irian Jaya
18	Tambakan	*Helostoma temminckii*	-	Indonesia (Pulau Jawa)	Bali
19	Tambakan	*Helostoma temminckii*	-	Indonesia (Pulau Kalimantan)	Sulawesi
20	Betok	*Anabas testudineus*	Unknown	Unknown	Irian Jaya
21	Mujahir	*Oreochromis mossambicus*	1939	Barat Africa	Indonesia
22	Mujahir	*Oreochromis mossambicus*	-	Philipina	Indonesia
23	Nila	*Oreochromis niloticus*	1971	Unknown	Irian Jaya
24	Nila	*Oreochromis spp*	1980	Philipina	Indonesia
25	Nila	*Oreochromis niloticus*	After 1980	Taiwan	Indonesia
26	Nila	*Oreochromis niloticus*	-	Philipina	Indonesia
27	Sidat	*Anguilla anguilla*	1992	Inggris, Prancis, Denmark	Indonesia
28	Koki	*Carassius auratus*	Unknown	China	Indonesia
29	Gabus	*Channa striata*	-	South China	Indonesia
30	Lele Dumbo	*Clarias gariepinus*	Mid-1980	Belanda	Indonesia
31	Lele Lokal	*Clarias batrachus*	1939	Indonesia (Pulau Jawa)	Sulawesi
32	Lele Dumbo	*Clarias gariepinus*	1985	South Afrika	Indonesia
33	Lele Amerika	*Ictalurus punctatus*	1986	Amerika	Indonesia
34	Sejenis Bawal	*Colossoma macropomum*	1986	Taiwan	Indonesia
35	Ikan Nyamuk	*Gambusia affinis*	1929	Italy	Indonesia
36	Bintik Mutiara	*Etroplus suratensis*	1979	Malaysia	Indonesia
37	Gupi	*Poecilia reticulata*	1920	Unknown	Indonesia
38	Salmon	*Salmo salar*	1929	Belanda	Indonesia
39	Salmon	*Salmo trutta fario*	1929	Belanda	Indonesia

No	Indonesia Name	Scientific Name	Year of introduction	Origin	Introduction Objective
40	Tench Hijau	*Tinca tinca*	1927	Belanda	Indonesia
41	Pacu	*Piaractus brachypomus*	1985	Taiwan	Indonesia
42	Patin Siam	*Pangasius hypophthalmus*	-	Thailand	Indonesia

Source: Jurnal Kebijakan Perikanan Indonesia (Umar dan Sulaiman, 2013).

Research conducted by Kottelat, in Western Indonesia and Sulawesi has found as many as 900 species of freshwater fish. (Wahyudewantoro & Rachmatika, 2016). FAO notes that (Umar & Sulaiman, 2013) The first fish introduction was carried out in 1939 but did not specifically mention the purpose of the fish, the first fish introduced on the island of Sulawesi was the local catfish curl (*Clarias batrachus*) from Java. Whitten's notes state that tilapia was introduced to Indonesia in 1939 and then in 1951 it was introduced to lakes in Sulawesi, subsequently becoming an invasive fish and a threat to local fish. In the last 10 years, several new fish species have been found in several inland water areas in Indonesia, such as red devil fish, cichlid fish, sapu-sapu fish, Amphilophus spp (Lumbanraja & Nasution, 2024; Ohee et al., 2020; Suryandari et al., 2021; Umar et al., 2015). The appearance of these fish is thought to be due to human behavior that intentionally or unintentionally releases them in inland water areas in Indonesia.

Recorded on May 31, 1996, there are 1032 species of freshwater fish in Indonesia (Kottelat & Whitten, 1996b), while other records mention 1300 species of fish and 90 species of crabs (Kottelat & Whitten, 1996a). The number and scientific names keep changing because they have to be adjusted with new discoveries. Some endemic fishes are under threat of extinction, in Sumatra 14 endangered freshwater fish species were identified, an estimated 8% of the 1300 endangered freshwater fishes. The number and scientific names keep changing because they have to be adjusted with new discoveries. Some endemic fishes are under threat of extinction, in Sumatra 14 endangered freshwater fish species were identified, an estimated 8% of the 1300 endangered freshwater fishes (Kartamihardja, 2014; Syafei, 2017). Data released by the International Union for Conservation (IUCN) in 1990 fish species in Sulawesi consisted of 27 taxa from 5 tribes, and all of them urgently need to be protected because they are in endangered status.

Table 2: Endangered Indonesian Freshwater Fish Species Listed on the IUCN Red List Of Threatened Animals (IUCN-The World Conservation Union, 1990). (Scarcity category abbreviation: Ex = Extinct; E = Endangered; V = Vulnerable; R = Rare; I = Indeterminate; K = Insufficiently Known; T = Threatened; CT = Commercially Threatened).

Nation, Tribe, and Type Name	English Name (Common Name)	Category of Scarcity	Geographic Distribution
Ordo Osteoglossiformes Fam. Osteoglossidae *Sclerophages formous*	Asian Bonytongue	K	Southeast Asia
Ordo Belaniformes			
Fam. Adrinichthyidae			
Adrianichthyes kruyti	Duck-bellied Buntingi	E	Sulawesi
Xenopoecilus cophorus	Egg-carrying Buntingi	E	Sulawesi
Xenopoecilus poptae	Poptas's Buntingi	E	Sulawesi
Xenipoecilus sarasinorum	-	E	Sulawesi
Fam. Orzyiidae			
Oryzias marmoratus	-	V	Sulawesi
Oryzias matanensis	-	V	Sulawesi
Oryzias nigrimas	Black Buntingi	V	Sulawesi
Oryzias orthognathus	Sharp-jawed Buntingi	E	Sulawesi
Oryziaz profundicola	-	V	Sulawesi
Fam. Hemiramphidae			
Dermogenys megarramphus	-	V	Sulawesi
Dermogenys weberi	-	V	Sulawesi
Nomoramphus celebensis	Poso Halfbeak	R	Sulawesi
Ordo Antheriniformes			
Fam. Telematherinidae			
Paratherina cyanea	-	V	Sulawesi
Paratherina labiosa	-	V	Sulawesi
Paratherina striata	-	V	Sulawesi
Paratherina wolterecki	-	V	Sulawesi
Telmatherina abendanoni	-	V	Sulawesi
Telmatherina bonti	-	V	Sulawesi
Telmatherina celebensis	-	V	Sulawesi
Telmatherina ladigesi	Celebes Rainbow	R	Sulawesi
Ordo Perciformes			
Fam. Gobiidae			
Glossogobius intermedius	-	V	Sulawesi
Glossogobius matanensis	-	V	Sulawesi

Nation, Tribe, and Type Name	English Name (Common Name)	Category of Scarcity	Geographic Distribution
Mugilogobius latifrons	-	V	Sulawesi
Mugilogobius n.sp	-	V	Sulawesi
Stupidogobius flavipinnis	-	V	Sulawesi
Tamanka sarasinorium	Sarasin's Goby	V	Sulawesi
Weberogobis amandi	Poso Bungu	E	Sulawesi

Source: International Union for Concervation pada (IUCN).

From several sources there are several endemic fish species that are threatened with extinction. In Sumatra, there are Betta burdigala, B. chloropharynx (only found in Bangka), B. miniopinna and B. spilotogena (only found in Bintan), Neolissochilus thienemanni (only found in Toba), Poropuntius tawdrensis and Rasbora tauarensis (Wargasasmita et al., 2002). In Tempe Lake, South Sulawesi, the status of iktiofauna is dominated by introduced fish such as anabas, caranx, chana, oreochromis, glossogobius, etc. Some endemic fish can no longer be found (Dina et al., 2019), such as tinhead fish (Aplocheilus panchax), julung-julung (Dermogenys pusilla), bete-bete (Karalla dussumieri), and cecopong (Lagusia micrachantus). Currently, the remaining / *bungo* and tambakan fish are endemic fish whose conditions are decreasing, even for tambakan fish species are no longer found in Tempe Lake.

3.1.3 Pollution

Various community activities around water areas can disrupt the sustainability of inland water areas, posing a real threat to the sustainability of fisheries resources. Pollution that occurs is caused by human activities in aquatic areas and in land areas.(Juwana et al., 2024; Kurnianto et al., 2019). Cage cultivation in the lake area contributes to biochemical contamination of fish feed. The existence of fish cages has an impact on damage to the Lake Toba ecosystem such as deteriorating water quality and the threat of extinction of several fish species (Hebron et al., 2022; Hutajulu & Harahap, 2023; Siregar, 2008). Poor water quality is also caused by microplastic contamination (Haribowo et al., 2024; Henny et al., 2022; Ilmi et al., 2023; Syamsu et al., 2024), rivers with heavy metal contamination are also found in Indonesia (Sukarjo et al., 2023). Data released by the Central Bureau of Statistics in 2023, out of 111 rivers sampled, only 8.1% were fit for consumption.

The agricultural sector also contributes to the pollution of inland water areas. The use of chemical fertilizers and pesticides in agricultural areas leaves residues that flow into water areas. Agriculture in Indonesia is generally located close to water resources such as lakes, rivers and swamps. With the amount of land and massive use, the residue from fertilizer use will flow carried by rain and accumulate in water areas.

3.1.4 Modification and Conversion of Aquatic Areas

The dynamics of rapid development contribute to environmental damage. The increase in population and the increasingly complex needs of human life, one of which has an impact on the increasing need for space both for housing and other supporting areas such as education, health, economy, recreation and entertainment facilities, and agricultural and plantation areas. This encourages the community and government to carry out land use change to support development and as a response to the rate of population growth. Land use by each development activity will change the environmental order, for example from forest areas to new areas. This will have an impact on changes in environmental sustainability such as decreasing the quality of clean water, disrupting the life cycle of certain habitats in an ecosystem.

Land conversion is a problem that occurs in almost all water areas. Land use change in upstream areas such as forest conversion (deforestation) into plantation and settlement areas has a major impact on fisheries resources. Studies on land use change found impacts such as increased peak discharge, inter-seasonal discharge fluctuations, surface flow coefficients, and flooding and drought (Nasrullah & Kartiwa, 2010).

The modification of water areas also has a serious impact on fish resources. The construction of dams, canals, damming of rivers to become reservoirs has fragmented rivers. This prevents fish from spawning towards the sea, which in turn destroys the sustainability of the fish population. The change of fish habitat from running water to stagnant water also has a serious impact on the sustainability of fish resources, such changes have the effect of shrinking the biodeversity of riverine fish and favoring lacustrine fish. (Rahardjo, 2012). Dam construction also has an impact on the decline of fish populations (Fung et al., 2019; Kelkar, 2023; Marini et al., 2020).

3.1.5 Socio-Economic Issues

Inland water areas are narrow areas and are very prone to ecosystem changes such as siltation due to

sedimentation and drought, narrowing, and decreasing water quality.Capture fisheries are activities that are generally found in inland fisheries resources, aquaculture is only an option for some people because it is related to the capital to start the business. As a *common pool* resource, it opens up opportunities for anyone to carry out activities. One of the disadvantages of open resources is the difficulty of monitoring (Barnes, 2009), and the possibility of social exclusion.

Weak governance, including supervision, makes it impossible for joint and continuous utilization to cause damage, this event can be called "tragedy of the commons"(Chawla et al., 2022; Hardin, 1968). Common resources are vulnerable to overexploitation, and do not receive attention (Thiele, 2014). Hardin explained that every human being (is a rational being) seeks to maximize profits. Illustrating it with a shepherd, the shepherd will consciously ask questions about the benefits to him of each additional farm animal. In that case Hardin suggests that the question contains utility which has a positive and negative component. The positive component is a function of the additional livestock and the sale value, hence the positive utility increases by 1. The negative component is a function of the additional livestock, since the effect of excess livestock is shared by all herders, the negative utility for the herder is only a fraction. If the partial utility components are combined, then a rational herder would conclude that the most rational way to maximize benefits is to add livestock. While this would certainly be the rational choice of any herder, it is the beginning of the *tragedy of the commons*. We can imagine that if the herder is in one pasture, then the increase in the number of children's livestock exceeds the carrying capacity of the environment.

In the context of inland fisheries, the *tragedy of the commons* is *over fishing,* water pollution. Every fisherman will consciously maximize the catch or cultivation production. Catching 1 mother fish will not have an impact, because there are still many other mother fish. It will be devastating if it is done by many fishermen and done repeatedly. It is the same with aquaculture, biochemical contamination does not have a big effect if the number of ponds is small, but what happens is that ponds are the choice for most fishermen. What happens is that biochemical contamination is high and pollutes the water. This includes water pollution from domestic and agricultural waste. Initially household waste was generated by a few households, the water flow would purify it every 10 miles. But as the population continues to grow, the amount of waste generated is much higher than the water's ability to purify the waste.

Next is social exclusion, which takes place through privatization. The process takes place within complex power relations consisting of coercive regulation (Li, 2014), markets, and moral legitimacy. Social exclusion through restrictions on access, restrictions on individuals and groups (Silver, 2019). The impact of social exclusion is community resistance such as destruction, and poverty due to lack of access to resources. The poverty of fishermen is not only caused by social exclusion, there are several factors such as policy, production inconsistency, geographical isolation, limited capital, exploitative social relations, and low income (Retnowati, 2011). Privatization of resource assets by the state is the management of traditional natural resource management (Adger et al., 2005).

3.2 Practice Management

The management and protection of inland fisheries areas is not only a matter for the government. Communities from various elements can take a role according to their capacity. The government has a role as a regulator through protection and management policies. The Government of the Republic of Indonesia regulates the protection and management of fisheries resources through various policies at the central to regional levels. At the central government level, it is specifically regulated in various regulations such as (1) Undang-Undang Nomor 31 Tahun 2004 tentang Perikanan; (2) Undang-Undang Nomor 23 Tahun 2014 tentang Pemerintahan Daerah; (3) Undang-Undang Nomor 7 Tahun 2016 tentang Perlindungan dan Pemberdayaan Nelayan, Pembudi Daya Ikan, dan Petambak Garam; (4) Peraturan Pemerintah Nomor 60 Tahun 2007 tentang Konservasi Sumber Daya Ikan; (5) Peraturan Pemerintah Nomor 50 Tahun 2015 tentang Pemberdayaan Nelayan Kecil dan Pembudidaya Ikan Kecil; (6) Peraturan Pemerintah Nomor 28 Tahun 2017 tentang Pembudidayaan Ikan; (7) Peraturan Menteri Kelautan Dan Perikanan Republik Indonesia Nomor 41/PERMEN-KP/2014 Tentang Larangan Pemasukan Jenis Ikan Berbahaya Dari Luar Negeri Ke Dalam Wilayah Negara Republik Indonesia; (8) Peraturan Menteri Kelautan Dan Perikanan Republik Indonesia Nomor 18 Tahun 2021 tentang Penempatan Alat Penangkapan Ikan Dan Alat Bantu Penangkapan Ikan Di Wilayah Pengelolaan Perikanan Negara Republik Indonesia Dan Laut Lepas Serta Penataan Andon Penangkapan Ikan.

Similar to the central government, local governments have also issued various regulations to regulate management and protection, for example in South Sulawesi with South Sulawesi Provincial Regulation Number 1 of 2021 concerning Protection of Fisheries Resources; Central Sulawesi with Central Sulawesi Provincial Regulation Number 04 of 2014 concerning Lake Management; Agam Regency, West Sumatra with a Regional Regulation on the Management of Maninjau Lake Area Sustainability.

Collaboration in the sustainable management of inland fisheries resources also places the community as the main actor. The community is the beneficiary so that the impact of damage can be directly felt. In various regions, communities have felt the damage to inland aquatic ecosystems. Communities around Lake Limboto began to abandon their fishing activities due to the deteriorating condition of the lake. People's livelihoods are no longer fully dependent on the lake, people do not have permanent jobs, they work according to the season and the lake surface (Baga et al., 2024).

Every community has governance that comes from local wisdom. Such governance is usually institutionalized in customary rules, deliberations, whether written or not. Communities on the coast of Tempe Lake, South Sulawesi, in managing the lake are governed by a set of rules that regulate the method, time and place of fishing. The rules are called *Ade' Assamaturuseng* (customs that are obeyed together) in which there are meanings of preservation, social justice, manifestations of trust practices, and social justice (S. Tabbu & Amrullah, 2022). In the district of Lima Puluh Kota, West Sumatra Province, the community preserves fishery resources with the system of "*Lubuk Larangan*" (Yuliaty et al., n.d.) which is a regulation that establishes areas that are prohibited from fishing within a certain period of time. Communities in Lake Toba play a role in protecting the lake ecosystem from the threat of red devil fish. Communities participate in catching *red* devil fish and increase their understanding of the impact of red devil fish on the lake ecosystem (Lumbanraja & Nasution, 2024).

3.3 Paradigm of Natural Resource Management

The paradigm of natural resource management is closely related to a country's development paradigm. After the Second World War, the *developmentalism* paradigm emerged as a new paradigm introduced by the United States. This paradigm views that third world countries are countries that are in a position of underdevelopment so that they need to get support to improve these conditions. The development paradigm emphasizes 4 (four) main issues, namely (1) growth, (capital accumulation), (3) structural transformation, and (4) the role of government. The logic is that development can create economic growth, which is characterized by an increase in per capita income. The conditions for growth are capital accumulation, investment and industrialization. These three methods are very effective in promoting structural transformation. Structural transformation can be reflected through the process of modernization in various aspects, such as changes in subsistence livelihood patterns to economically oriented livelihood patterns, or changes in production methods from traditional to industrialization. For the adherents of *developmentalism*, traditional and subsistence methods are a form of underdevelopment of third world countries.

Developmentalism is on an anthropocentric trajectory, its interaction with natural resources is exploitative. In its interactions, nature is only placed as a component to satisfy all human needs. The result is the destruction of ecosystems and the subsequent decline in the quality of human life. This can be seen in how fisheries resources are managed. For example, large-scale cage cultivation that results in decreased water quality and fish mortality, and the introduction of fish with the aim of increasing productivity without and ignoring aspects of sustainability, the use of banned fishing gear, and uncontrolled fishing.

The study of damage to ecosystems and natural resources due to the process of development and modernization was also put forward by Ulrich Beck in his writing entitled *Risk Society: Toward A New Modernity* (Beck, 1992). Beck explains 3 (three) important concepts in risk society, namely risk. Reflectivity and the boomera effect. Risk is the possibility of physical damage caused by technological processes and other processes such as social, economic and political processes. Thus, risk has a close relationship with the systems, models, and processes of change in society (industrialization, modernization, development) that determine the level of risk. Another study explains the curse of natural resources (Palley, n.d.). The resource curse is a paradox that occurs in countries with a wealth of natural resources, but this wealth does not produce prosperity for its people(Humphreys et al., 2007).

Shiva criticizes the management of natural resources in developing countries, that the management practices adopt colonialism practices (Jati, 2013). He firmly calls it the *exploitation syndrome*, through two stages, namely privatization

and the establishment of bureaucratic institutions that legalize the commercialization of public goods. Privatization can encourage consumptive behavior or exploitative actions to maximize benefits. to support privatization, the government bureaucracy legalizes it through a set of rules.

Natural resource management with the paradigm of *developmentalism* will lead to *top-down* management, the state has the power to regulate the management and distribution of the benefits of natural resources. *Top down* management presents the privatization of natural resources, whereas previously they were communal resources. Shiva criticizes the *top down* approach to governance, that *top down* natural resource governance places the community only as implementers without any room to question why, why, or even protest, which ultimately harms the community (Shiva, 1988a). Therefore, natural resource management must be affirmative for the community, and place the community as a key actor as well as the state.

The anthoropocentric paradigm coincided with the beginning of the Enlightenment era in Europe. There is a boundary between the human body and nature, the relationship between humans and nature is in cause and effect, which has an impact on changing the way of looking at nature. That is, nature is seen as an entity that aims to fulfill all human needs. Anthropocentric views are present in human knowledge systems, one of which is the knowledge system about food. Humans place land, water, forests as objects that can be exploited to fulfill human needs. It got worse when Malthus in the 18th century warned about the threat of famine due to population growth that exceeded food availability.

The threat of famine in Malthus' theory can be said to be one of the triggers for massive exploitation of nature. The development of agricultural areas through deforestation, the construction of dams for agriculture, and the use of science and technology to spur food production. In the aspect of fisheries, especially in Indonesia, management with an anthropocentric face began to appear when the introduction of fish into

Indonesian waters. Introduced fish are generally consumer fish that have a relatively large size, have resistance to new ecosystems, and reproduce quickly. Introductions have shown positive results with increased stock availability, but less attention has been paid to the fact that introduced fish are generally invasive, threatening populations of endemic species.

There are three dimensions to natural resource management: social, economic, and biological. Harmonization of the three dimensions is very important, carried out by paying attention to the balance of each dimension. Alternative natural resource management can be found in the political ecology paradigm. Political ecology can be defined as a political study that understands the relationship between human issues and environmental changes as a result of the political process. The basic assumption of political ecology is that holistically politics and the environment are interconnected, the core of political ecology is that politics must be directed to understand the interaction of humans and the environment in relation to environmental degradation (Campbell, 2018; McCarthy, 2017; Quandt, 2016). Political ecology provides a critique of the concepts of political economy that have been established in *developmentalism* and have contributed to environmental change. Political ecology offers an ecocentrism perspective as a critique and solution to anthropocentrism. Ecocentrism positions humans and nature in a reciprocal relationship and need each other as part of the biosphere community. Humans and nature are entities that complement and support each other in a causal relationship through exchanges. The exchanges between humans and nature consist of energy, material and information as depicted in the following **Figure 1**. (Dharmawan, 2007).

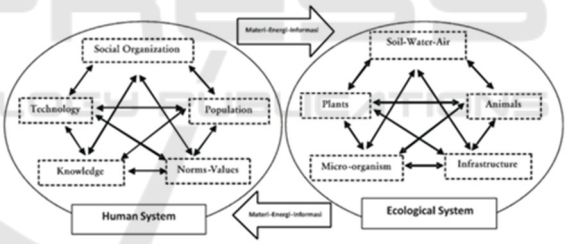

Figure 1: Exchange of Energy, Matter and Information between Two Systems. Source: Dharmawan (Dharmawan, 2007)

The figure explains that in the human system there are five interrelated components: knowledge, values, population, technology, and social organization. The ecological system consists of micro-organisms, infrastructure, animals, plants, water-soil-air. The two systems interact through exchange. Humans need the components of the ecological system to survive, while the ecological system receives waste and pollution, causing much harm to the earth and its inhabitants. The exchange should result in sustainability, as the ecological system provides basic human needs.

The dimensions of sustainability in the perspective of political ecology consist of

community-based natural resource management and justice for the environment (Shiva, 1988b).

For Shiva, privatization is the beginning of the ecological crisis, because it allows actors to exploit on the basis of ownership, privatization limits the rights of the community to carry out natural resource management. The ecological crisis is characterized by food crisis, scarcity of energy sources, poor quality of life due to pollution and increasingly narrow living space, topographical changes due to natural disasters, *biodiversity loss,* increasing deviant behavior (Ahmed, 2020; Dharmawan, 2007; Liodakis, 2018).

The New Order government adopted the concept of the green revolution, a movement to boost food productivity packaged in the Panca Usaha Tani policy. This movement replicated the modernization of agricultural systems and culture in developing countries such as Asia and South America. In Indonesia, panca modernization of agriculture consists of agricultural intensification, agricultural extensification, agricultural diversification, and rehabilitation. Based on this, the five farming efforts consist of the use of superior seeds, (chemical) fertilization, irrigation, pest eradication, and organized planting techniques. The results were very significant in increasing production. But behind these results, the policy left environmental problems, such as population decline and extinction of some species due to the use of pesticides, river water pollution, social inequality, and capitalization of rural livelihoods. The policy was formulated in a very authoritarian government situation, there was no room for the community to be involved in policy making. In addition, the policies that were implemented reduced the local knowledge of the community about the food system and the knowledge of the community in preserving the environment. The green revolution paved the way for legalized privatization by the government and neglected environmental justice.

The exchange mechanism in the previous figure is not sustainable. Human needs from time to time continue to increase which exceeds the carrying capacity of the environment. Humans then develop exploitative adaptive mechanisms. In the long run, this will create an ecological crisis. In the object of inland fisheries resources, the exploitation of fish continuously and in large quantities will have an impact on the decline in fish populations. As a result, to fulfill the need for fish, fish fry will also be caught for consumption. Another example is, the choice to introduce fish as a way to meet the needs of increasing fish consumption in an area, a new type of fish will certainly have an impact on the existing ecosystem.

Ostorm describes three models of natural resource management, namely the *state way, maerket way, and common pool resources* (Ostrom, 1990). The *states way* is state-centered natural resource management, equally distributing the results of natural resource wealth to the community, but limiting other actors to participate in natural resource management. The second model, the *market way*, is management that provides many consumptive choices, while at the same time tends to be expansive to commodify public goods into private goods. The third and alternative model, *common pool resuorces*, is implemented by redistributing the benefits of natural resources in a fair and sustainable manner to the community.

The alternative offered by political ecology is a synergy between the state, society, educational institutions, and academics. This synergy is a solution to policies that are state-centric, not top down. Open access for cross-sector participation. The state has a role in shaping natural resource management regulations, in the formation process involving other parties as users. The interests of each actor can be accommodated, including the interest to create environmental justice.

The alternative offered by political ecology is a synergy between the state, society, educational institutions, and academics (Cowx & Portocarrero Aya, 2011).

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Fisheries resources have long been stressed beyond their carrying capacity, leaving them vulnerable to ecological crises. Current practices focus only on the economic aspect of increasing fish production. This has neglected the social and biological aspects. Activities have centered on efforts to increase catch and aquaculture yields, for example by introducing high-value fish species, restocking, and expanding aquaculture areas. To reduce the pressure on fisheries resources, policies should not only be centered on efforts to increase fisheries yields, social and biological aspects must get the same intervention. In the social aspect, for example, improving the welfare of fishermen as the main beneficiaries in fulfilling basic needs, and providing equal access to the utilization of natural resources. No less important is the recognition of local knowledge and local wisdom in management. In the biological aspect, the policies set should pay attention to

sustainability aspects such as regulation of fishing gear, types of fish cultivated, and regulation of fishing time.

4 CONCLUSION

Indonesia's inland fisheries resources are facing an ecological crisis. There are four problems faced, namely uncontrolled fishing, degradation of endemic species, pollution, problems in the socio-economic aspect. If this condition continues, food security from inland fisheries resources will not be achieved. Management so far has been directed at efforts to increase production and ignore aspects of sustainability. The use of prohibited fishing gear, fish introduction without study and supervision, water contamination with chemicals, and social exclusion in the utilization of fishery resources are severe challenges in the management of fishery resources. Political ecology understands the relationship between human issues and environmental changes as a result of political processes. Political ecology is an alternative in natural resource management, by integrating the state, society, educational institutions, and academics.

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