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Analysis of The Environmental Impact of Floating Net Cage Waste on The Water Quality of Ekas Bay West Nusa Tenggara Province, Indonesia

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Abstract. The living environment given by God Almighty to the Indonesian people is a gift that must be developed and preserved. The aim is that the environment can support the lives of the nation, people and other living creatures and improve the overall quality of life. Floating Net Cage technology is a very productive and intensive aquaculture method, with a structure consisting of several net cages placed on floating rafts in coastal waters. This article was written using the library research method, namely by codifying scientific sources from various journals and articles with the same data and then combining them to obtain information about the impact of feed waste from floating net cage cultivation. Intensive cultivation in floating net cage produces waste that is discharged into the aquatic environment and can significantly affect water quality. The waste load from floating net cage cultivation can cause the loss of seagrass beds (Posidonia oceanica). Another impact is a decrease in the diversity of infauna in sediments and degradation of the bottom of the waters. Steps that can be taken to prevent environmental pollution in floating net cage cultivation are by paying attention to several aspects such as the use of quality and effective feed, and minimizing leftover feed that is wasted into the sea and using the right amount thus reducing pollution.

Keywords: Environmental impact, feed waste, floating net cages

INTRODUCTION

The living environment given by God Almighty to the Indonesian people is a gift that must be developed. Regarding the AMDAL document, which is the basis for assessing environmental suitability as regulated in Article 24, changes have been made. Feasibility assessment This can be done before or at the start of business activities, depending on the resulting environmental impact. For high-risk businesses (AMDAL required), a feasibility assessment must be carried out before business activities begin (Budi et al., 2021). Most of the residents of Ekas Bay work as fishermen who use this bay to earn a living. Due to relatively low socio-economic conditions and the use of traditional technology, fishermen's access and mobility are very limited, so they can only operate in the Gulf area, which is a densely populated area (Indrayanti, 2005).

Floating net cages are a tool for keeping fish or aquatic biota made from materials such as bamboo, wood, paralon pipe or iron, with a square shape. This tool is equipped with a net and a float, such as a plastic drum or styrofoam, to keep it floating on the surface of the water (Basir et al., 2022). Cultivation using Floating Net Cages is utilized by the community for economic purposes, namely obtaining income from the use of natural resources , workforce, and existing technology (Ardiani et al., 2023).

One of the advantages of cultivating fish using floating net cage technology compared to other methods is the ability to raise fish at high densities without worrying about lack of oxygen. Apart from that, other advantages of floating net cage technology include efficient land use, high productivity, and minimal need for special water management, which helps reduce production costs (Junaidi, 2016). Based on the background previously explained, the aim of this research is to determine the impact of the use of floating net cages on the aquatic ecosystem in the Ekas Bay area, West Nusa Tenggara.

RESEARCH METHODS

This article was written using the library research method, namely by codifying scientific sources from various journals and articles with the same data and then combining them to obtain information about the impact of feed waste from floating net cage cultivation. The emphasis of this article is the negative impact of the use of floating net cages which can pollute waters and damage the ecosystem in Ekas Bay, East Lombok Regency, West Nusa Tenggara (Figure 1).

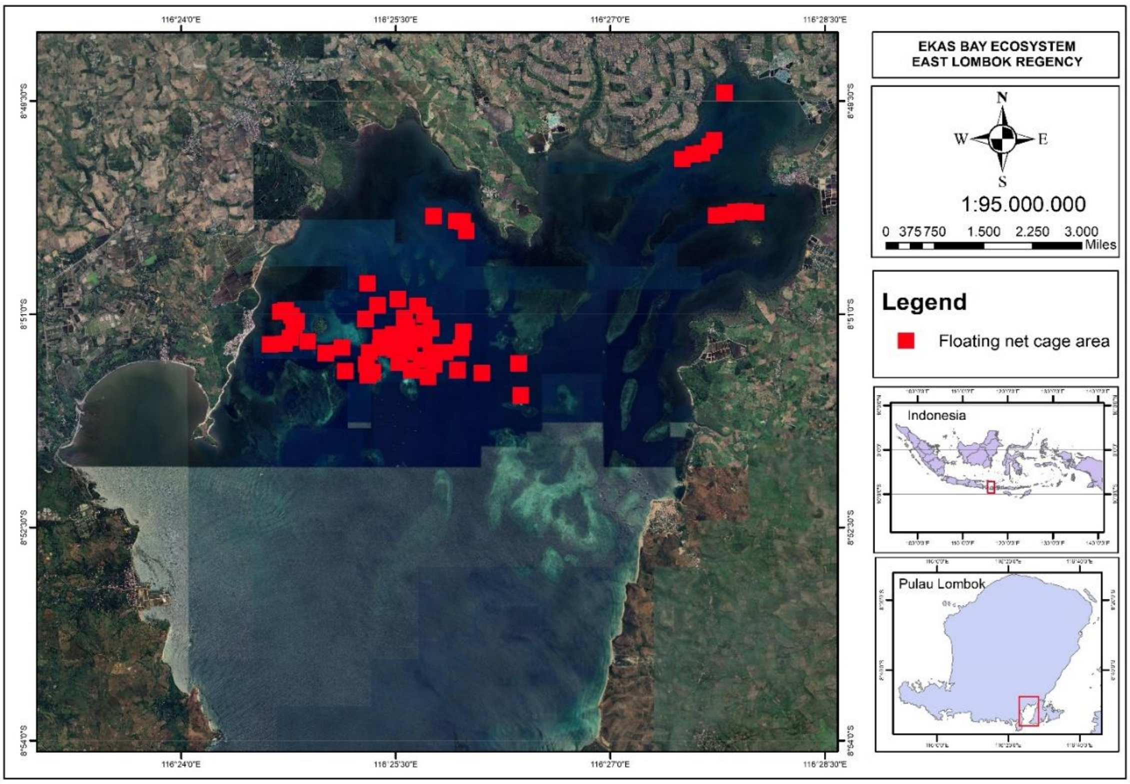

Figure 1. Teluk Ekas, Batu Nampar village, Jerowaru sub-district, East Lombok, West Nusa Tenggara.

RESULTS AND DISCUSSION

Each body of water has unique characteristics and is different from one another. Assessing the suitability of waters for cultivation can reduce negative human impacts on natural resource management and help determine the most appropriate use of waters (Anhar et al., 2020). One method to optimize the use of sea area for cultivation is by establishing floating net cages in the open sea. In fact, fish cultivation using floating net cages has been started since the 20th century (Atmojo & Ariastita, 2018).

Ekas Bay is the largest bay located in the southern part of Lombok Island. This bay is located at coordinates 116°23'-116°29' East Longitude and 8°49'-8°55' South Latitude, stretching from west to east. Ekas Bay has a water area of 5,313 hectares and a coastline length of 44 km. These semi-enclosed waters are separated by a very narrow and shallow threshold, which influences the flow of water masses in and out (Junaidi, 2016). Based on research conducted by Widodo. S that the waters of Ekas Bay have a pH that is alkaline, ranging from 8-9. The degree of acidity (pH) of Ekas Bay, East Lombok exceeds sea water quality standards. Namely 7-8.5. The closer you go towards the head of the bay, the higher or more alkaline the pH becomes (Marpaung et al., 2015).

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Floating net cage cultivation began to develop in the waters of Lombok, West Nusa Tenggara Province since 2000. Such as shrimp and fish cultivation. Fish cultivation systems using floating net cages can apply monoculture or polyculture methods. Monoculture is a method where only one type of fish commodity is cultivated, while polyculture involves cultivating two types of commodities at once. These two systems aim to achieve higher yields at lower costs (Rahmadhani et al., 2023). Fish cultivation in floating net cages is a fishing business carried out intensively in limited waters with regular provision of additional feed, allows it to be developed on an industrial scale (Subkhan, 2020).

The success of floating net cage technology has opened up opportunities for business analysis in marine fisheries cultivation (Siswono & Cahyaningtias, 2018) It is noted that lobster seeds used in rearing businesses in Indonesia are generally caught from the wild. Lobster cultivation has brighter prospects compared to lobster species from temperate waters (temperate species), due to the more abundant availability of natural seeds and faster growth rates (Junaidi et al., 2018).

Impact of results from feed waste

Floating net cage cultivation in the waters of Ekas Bay. Especially the cultivation of lobsters or crayfish (*Panulirus* spp) is completely dependent on trash fish feed, which is a by-product of capture fisheries activities. Even though it is relatively cheap, the use of trash fish can have significant environmental impacts. Trash fish contains higher waste residues compared to artificial feed, and the impact is more widespread, and the decomposition process of organic matter in trash fish takes place more slowly.

The results of calculations from research Bramana (2015) that the estimate total of nitrogen from floating net cage activities show that with a total fish production of 300 kg, 1800 kg of trash feed is needed. Based on proximate analysis, trash feed contains 12.6% of nitrogen, which is equivalent to 226.80 kg. Of the total feed used, 82% or 1476 kg was eaten with a trogen content of 12.6%, which means 185.98 kg of nitrogen. Meanwhile, feed that was not eaten or wasted amounted to 324 kg with a nitrogen content of 40.82 kg (Bramana et al., 2015).

Waste load (P) and (N)

The level of organic waste load originating from uneaten feed residue and feces entering the environment is increasing. The load of organic waste coming from external sources and fish farming activities in floating net cages will affect the quality parameters of the aquatic environment, especially total phosphorus (P) levels and the availability of dissolved oxygen (Siagian et al., 2010). The decomposition of organic substances is a natural process that occurs when water bodies are polluted by organic substances. During this process, bacteria can consume dissolved oxygen in the water, which can cause fish death and make conditions anaerobic, giving rise to a foul smell (Ernawati & Dewi, 2016).

The results of calculations from research conducted by Brama data obtained to estimate total nitrogen from floating net cage activities show that with a total fish production of 300 kg, 1800 kg of trash feed is needed. Based on proximate analysis, trash feed contains 12.6% nitrogen, which is equivalent to 226.80 kg. Of the total feed used, 82% or 1476 kg was eaten with a nitrogen content of 12.60%, which means 185.98 kg of nitrogen. Meanwhile, feed that was not eaten or wasted amounted to 324 kg with a nitrogen content of 40.82 kg (Adhar et al., 2021).

Nitrogen and phosphorus are chemical elements that are important for the growth of phytoplankton. The decomposition process of these compounds, both nitrogen and phosphorus, can stimulate the growth of phytoplankton. An increase in the concentration of organic matter in water bodies can cause a decrease in water quality, one of which is characterized by an increase in BOD (Biochemical Oxygen Demand) levels. BOD is a measurement that shows the amount of dissolved oxygen required by microorganisms to degrade organic matter. High BOD levels are often caused by fish farming activities in waters, which leads to increased concentrations of organic matter (Sinurat et al., 2024).

Several studies show that intensive cultivation in marine cages produces waste that is discharged into the aquatic environment and can significantly affect the quality of coastal waters. Approximately 30% of the feed given is usually left behind as unconsumed feed, and 25-30% of the feed consumed will be excreted in the form of feces. The feed constants are N = 4.86% and P = 0.26%. Of the feed provided, only 70% is consumed by fish, while the remaining 30% is released into reservoir waters as pollutants. Furthermore, around 15-30% of the nitrogen and phosphorus in the feed will be stored in the fish flesh, while the rest will be wasted into the lake waters (Heriyanto et al., 2018).

Impact on Waters

Cultivation activities in floating net cage also have significant environmental impacts, especially related to with a decrease in abiotic quality and toxicity, organic particle waste originating from floating net cage significantly affects the benthic environment. This decrease in carrying capacity is caused by waste pollution resulting from floating net cage activities. This waste consists of nitrogen and phosphorus compounds that come from leftover feed (The et al., 2024). This leftover feed arises from feed management that is not in accordance with the needs of the fish being farmed. The waste load from fish farming (30 floating net cage in an area of 7 ha and a depth of 20 m) can cause the loss of seagrass beds (Posidonia oceanica) covering an area of 11.29 ha. Another impact is a decrease in infauna diversity in sediments and degradation of bottom waters, especially if waste produces organic carbon deposits of more than 0.7 kg.C/m²/year (Science & Tropics, 2015).

Waste from this cultivation has the potential to be a source of nutrients in waters, both from uneaten feed and feces, which can increase the fertility of waters. An increase in organic matter can result in a decrease in cultivation productivity and increase the mortality rate of cultivation commodities due to changes in sediment conditions under the cages (Junaidi & Hamzah, 2014).

When the nutrient concentration in a water body increases to a certain limit, water productivity will also increase because phytoplankton utilize dissolved nutrients for their growth. However, the phytoplankton blooming phenomenon is often accompanied by a sharp decrease in dissolved oxygen levels, due to excessive oxygen consumption for the decomposition of organic compounds. A significant decrease in dissolved oxygen, or even reaching zero, can result in the death of fish and other organisms that cannot survive in these conditions (Heriyanto et al., 2018). A decrease in dissolved oxygen levels can reduce the efficiency of oxygen absorption by aquatic organisms, which results in a decrease in their ability to live a normal life. The minimum dissolved oxygen level required to support fish life is around 4 ppm (Anas et al., 2017).

Not only that, the use of drums as a tool in floating net cages has an impact on the environment. due to the use of rusty drums, used oil drums, and nets containing carbolic elements. Apart from that, other impacts arising from floating net cage activities are pollution and decreased water quality (Amalia Yunia Rahmawati, 2020). Plastic drums also have an effect because of the cobalt content in plastic, so it is important to carefully consider the choice of basic materials when making nets (Hutajulu & Harahap, 2023).

According to research conducted by Adhar (2024), floating net cage activity is the main cause of the addition of phosphorus. Excessive accumulation of phosphorus results in pollution, especially through the eutrophication process in waters (Adhar et al., 2024). Not only phosphorus, turbidity in water conditions also has a big impact, this happens because of the high density of floating net cages. As a result, the remaining feed produced adds organic matter to the waters, causing turbidity and decreasing brightness. The buildup of organic material reduces brightness and inhibits the penetration of sunlight, which impacts the photosynthesis process and influences the abundance of organisms (Siagian, 2018) This sensitivity condition indicates the need for an ecological response or policy, especially regarding water pollution by floating net cage waste (Hidayat et al., 2017).

Preventive solutions

The impacts arising from cultivation activities using the floating net cage system are closely related to this stage. Therefore, Every cultivation operational activity must be evaluated and managed environmentally to reduce the impact that may occur in the next cultivation cycle. To maintain environmental balance in ponds, measures need to be taken to maintain water quality and prevent negative impacts such as fish deaths, environmental damage and decreased productivity of pond farmers. Water quality monitoring must be carried out to ensure environmental conditions remain ideal.

Steps that can be taken to prevent environmental pollution in floating net cage cultivation are by paying attention to several aspects such as the use of quality and effective feed, and minimizing the remaining feed that is wasted into the sea and using the right amount so as to reduce pollution. then processing waste by collecting and processing fish waste can prevent the accumulation of organic material at the bottom of the waters which can cause pollution. And monitoring environmental quality regularly to help detect impacts that occur in the ecosystem so that they can be handled directly.

Nutrients in waters originating from marine fish cages can be utilized by seaweed. By cultivating seaweed around fish cages, we can take advantage of the availability of these nutrients while reducing nutrient enrichment which can cause eutrophication. Seaweed (Ulva) cultivation integrated with fish can reduce nutrient waste to less than 30% of the total input of 2,271 g N per year (Radiarta & Erlania, 2015). Cultivation of the floating net cage system combined with seaweed cultivation, or integrated multitrophic aquaculture (IMTA), is one approach to dealing with environmental problems. By utilizing waste pollutants, especially nitrogen (N) and phosphorus (P), seaweed can reduce the potential for pollution in waters (Aonullah et al., 2024).

CONCLUSION

Floating net cage technology is a very productive and intensive aquaculture method, with a structure consisting of several net cages placed on floating rafts in coastal waters. Cultivation activities in floating net cages also have significant environmental impacts, especially related to the reduction in abiotic quality and toxicity due to the use of rusty drums, used oil drums, and nets containing carbolic elements. Apart from that, other impacts arising from floating net cage activities are pollution and decreased water quality. Organic waste particles originating from floating net cage significantly affect the benthic environment.

Therefore, every cultivation operational activity must be evaluated and managed environmentally to reduce the impact that may occur in the next cultivation cycle. To maintain environmental balance in ponds, measures need to be taken to maintain water quality and prevent negative impacts such as fish deaths, environmental damage and decreased productivity of pond farmers. Water quality monitoring must be carried out to ensure environmental conditions remain ideal.

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