

# Brackishwater pond development: present status and problems in the Padang Pariaman Regency of West Sumatera, Indonesia

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**Abstract.** Padang Pariaman Regency is one of the coastal regencies in West Sumatra which brackish aquaculture have been developed recently, especially shrimp pond aquaculture. This study was conducted to convey the pond's general condition, including the current status and the problems in aquaculture development. The method used was a desk study through the description of the status and the problems. Based on the study, the development of shrimp ponds increased quickly (63.77 ha) until 2019, which the largest number of ponds was in Batang Anai District, and spreading over 35 points. The production of that shrimp ponds in Padang Pariaman Regency reached 1,500 tons or Rp. 135 million (in 2017), which is marketed locally and outside Padang Pariaman. Problems that arose along with shrimp pond activities are 1. Shrimp pond construction is built very close to coastal areas 2. Shrimp pond activities do not have a business license, 3. Poor waste management of shrimp culture, 4. It is low involvement of the local community as technicians at the shrimp ponds, 5. Business license arrangement is done through third parties, and 6. It is an incompatibility between the area of ponds in the license and the real size of the ponds.

## 1 Introduction

The coastal area is a transition area (interface area) between land and marine ecosystems [1]. The boundaries of the coastal area towards the land include terrestrial that is still influenced by sea processes such as tides, splashing waves, seawater intrusion, and sea breezes. The boundaries of coastal areas towards the sea include sea waters that are still influenced by natural processes and human activities on terrestrial, including rivers, surface water (run-off), sedimentation, pollution, and others [2]. Coastal areas have a variety of resources and environmental services that are very important in ecology, economy, education, research, and defense and security for a country, so this area has the potential to be developed.

One potential development of coastal areas, which is quite a lot, is the development of marine culture. Aquaculture activities are carried out by feeding for organisms maintained. One area that began developing marine culture activities, namely Padang Pariaman Regency

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of West Sumatra Province, with its main commodity, namely *Vaname* Shrimp Pond (*Litopenaeus vannamei*). This *vaname* shrimp is chosen because it has many advantages, including its high selling price, is easily cultivated, and is resistant to disease [3].

The beginning of the shrimp pond appearance aquaculture in Padang Pariaman Regency was initiated by Padang Pariaman Regency Government in 2014 but failed in the same year. So at that time, aquaculture was dismissed. Then at the end of 2016, shrimp culture activities were again raised by investors from outside Padang Pariaman Regency and showed success. Since then, shrimp culture activities have developed very rapidly [4].

As a result of the increasing demand for *vaname* shrimp, aquaculture has become a very profitable commercial activity. This led to an effort to improve the pond production by increasing the technology used, from traditional switching to semi-intensive and intensive. The fitting area extends, and more land is converted into a shrimp pond. The expansion of this pond also occurred in Padang Pariaman Regency, which at the beginning of development (in 2014), was around 1.2 Ha and in 2019, increased to 63.77 ha [4]. According to the administrative staff of the Padang Pariaman Regency Fisheries official, the area of shrimp culture will continue to increase until the following year.

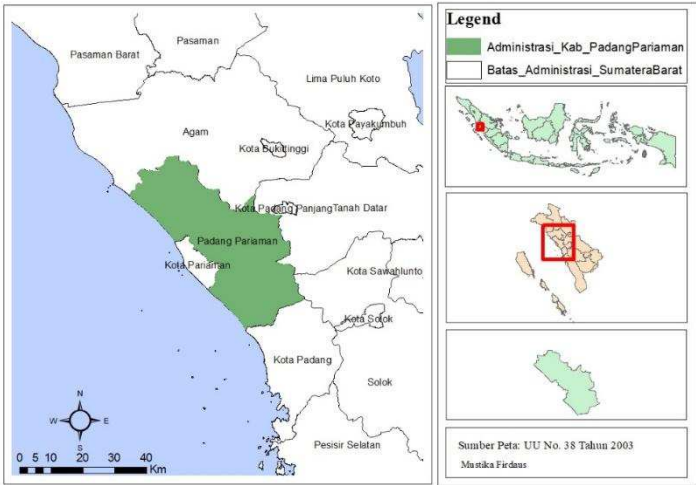
Several studies that have been carried out on the coast of Padang Pariaman Regency, including a model of the payment system for environmental services about the water conversion and land resources: a case study in Batang Anai, West Sumatra [22], the abrasion threat level in Padang Pariaman Regency using the coastal vulnerability method. Index (CVI) [23], identification of liquefaction potential in Sungai Limau District, Padang Pariaman Regency using the 2D geoelectric method of resistivity [24], and directions and strategies for developing fisheries in the coastal area of Padang Pariaman Regency [18].

The purposes of this study are: to identify the level of coastal space utilization in Padang Pariaman Regency as a shrimp culture; Identify problems caused by shrimp culture activities; Formulate the direction of the management of the coastal area of Padang Pariaman Regency under the actual conditions. The benefit of this research is to become a source of information related to utilizing natural resources in the coastal area of Padang Pariaman Regency, mainly for shrimp culture activities. The results of this study will also provide solutions to the problems in the Padang Pariaman Regency.

## 2 Methods

### 2.1 Time and location

This research was conducted on the coast of Padang Pariaman Regency, Indonesia in June 2021 (Fig 1.)



**Fig. 1.** The coastal area of shrimp culture in Padang Pariaman Regency, Indonesia.

**2.2 Data collection method**

This study refers to shrimp culture activities in Batang Anai District, Padang Pariaman Regency, using the desk study method to review existing data or information. Then the second method is the field observation method. Field observations were conducted to collect limited data from a large number of cases. Furthermore, the data obtained is used to solve the problem without testing the hypothesis [5].

The data collected in this study include the coastal characteristics of Padang Pariaman Regency, the area of ponds operating in Padang Pariaman Regency, ownership of shrimp ponds, and the problems caused by these activities.

**2.3 Data analysis**

The data obtained from this research was analyzed descriptively. Descriptive analysis is the collection, processing, presentation, and interpretation of quantitative data presented in tables or graphs.

**3 Results and discussion**

**3.1 General condition of shrimp culture pond**

The topography of the coastal area of Padang Pariaman Regency consists of lowlands with an altitude between 0–10 meters above sea level, so the beach is categorized as sloping. The total length of the Padang Pariaman coastline is about 72.5 km which is the longest coastline in West Sumatra. Based on research conducted by Solihuddin [6], all beaches' characteristics in Padang Pariaman Regency are sandy beaches.

The lithology that composes the coast is alluvium, low relief [6]. The coastal dynamics of the Padang Pariaman Regency are strongly influenced by Indian Ocean waves that reach the coast [7]. This causes abrasion along the coast to be dominant. Batang Anai District is one of the beaches affected by abrasion with a fairly severe rating. This is indicated by the

formation of an abrasion escarpment as high as 0.5 -1 meter and the falling of coconut trees around the coast due to soil erosion [6].

Eleven rivers traverse the Regency of Padang Pariaman. The longest rivers are the Batang Mangau River, with a length of 46 km, and the Batang Anai River, which also has a length of 46 km. These large rivers eventually emptied into the coastal area. While the shortest rivers are Batang Kamumuan River and Batang Piaman River, with 12 km. Economically, these rivers are supported for irrigation activities and fish cultivation by the people of Padang Pariaman Regency [8].

The coastal area of Padang Pariaman Regency is overgrown by a variety of coastal vegetation, such as coconut trees, sea pine, and mangroves which are spread in almost all coastal regencies in Padang Pariaman Regency. The following is a table of the distribution and area of mangroves in Padang Pariaman Regency (Table 1).

**Table 1.** Distribution and area of mangroves in Padang Pariaman

Districts	Mangrove Area (ha)
Batang Gasan	40,70
V Koto	20,80
Ulakan Tapakis	88
Batang Anai	52,50
Sungai Limau	-
Nan Sabaris	-

Padang Pariaman Regency has great potential in developing fisheries, especially marine aquaculture. In 2001, the Padang Pariaman government stated that several aquaculture species such as black tiger prawn, mangrove crabs, milkfish, and clams have significant economic value and can be cultivated. The coastal areas of Padang Pariaman Regency meet the general coastal cultivation locations [9] in Table 2.

**Table 2.** Criteria for coastal cultivation locations in Padang Pariaman Regency.

No	District	Village	General Criteria Location
1	Sungai Limau	a. Tanjung b. Malai Bawah	● There are tidal areas ● Free from flooding
2	Nana Sabaris	Sunur	● Can reach seed sources
3	Ulakan	Batang Tiram	● Have marketing areas
4	Batang Anai	Ketaping Selatan	● Have strong infrastructure ● Can reach supply sources

Source: Bappeda Padang Pariaman (2001).

Shrimp culture ponds in Padang Pariaman Regency are spread across all coastal sub-districts in this district. Among them are Batang Anai District, Nan Sabaris District, Batang Gasan District, Lima Koto District, Ulakan Tapakis District and Sungai Limau District. Among these six sub-districts, the Batang Anai sub-district has the highest number of ponds.

The rapid growth of shrimp ponds in the Padang Pariaman Regency increases the coastal environment's ecological pressure. Waste of shrimp farming activities and land conversion activities may be a cause root of this impact that can threaten the existence and sustainability of coastal ecosystems and resources. The higher the rate of development in coastal areas, the higher the level of utilization of space, resources, and other environmental services. The higher the level of changes in the environment that can threaten the capacity of sustainable resources.

Based on the description above, it can be seen that shrimp culture activities affect the ecological conditions of coastal areas. In addition, shrimp farming activities will also affect the economic and social conditions of the coastal communities of Padang Pariaman Regency. For this reason, it is necessary to have a study related to the current conditions and problems

caused by shrimp farming activities in Padang Pariaman Regency because this study has never been done before.

3.2 Water quality of the coastal Padang Pariaman Regency

Water quality is one of the important factors that affect vanamei shrimp aquaculture activities. Good water quality will provide a pond environment that supports the life of vanamei shrimp to increase shrimp production. Therefore, in the aquaculture of vaname shrimp ponds, it is very dependent on the quality of the surrounding waters [10]. Water quality parameter data in the Coastal area of Padang Pariama Regency refers to [10].

Table 3. Water quality in the coastal area of Padang Pariaman Regency, Indonesia.

No	Parameter	L	M	P1	P2	P3	P4	T
1	Temperature (°C) Air	27	26	26	26	26	26	26
	Surface	26	27	26	26	26	26	26
	Basic	25	25	25	25	-	-	-
2	Salinity (‰) Low	30	6	5	2	4	4	0,5
	Ride	-	21	11	10	10	10	-
3	Brightness (m)	2-3	0,5-1	0,5	0,5-2	-	-	1
4	pH	7,8	7,6	7,4	8,2	7	7	7,2
5	Current Speed (m/s)	-	5/7	-	5/7	-	-	-
6	DO (mg/L)	7,51	-	5,69	-	5,48	-	6,32
7	NO <sub>3</sub> (mg/L)	0,087	-	0,074	-	0,132	-	0,106
8	PO <sub>4</sub> (mg/L)	3,086	-	2,855	-	2,624	-	3,086
9	NH <sub>3</sub> (mg/L)	-	-	-	-	0,343	-	-

Description: L = Sea, M = River Estuary, P = Brackish, T = Fresh  
Source: Efrizal, 2015

Based on the data above, it is known that the temperature in the waters of Padang Pariaman Regency ranges from 25-27°C. According to [22], the recommended temperature for shrimp farming activities is 21-32°C, and the optimal temperature is between 29–30°C. If the temperature measurement results are obtained [10] compared to a good temperature for shrimp farming, then the waters of Padang Pariaman Regency can support shrimp farming activities.

The result of salinity measurement in the coastal area of Padang Pariaman Regency is 0.5-30‰. Based on the table above, salinity in the coastal area of Padang Pariaman Regency has high fluctuations. The highest salinity is in the marine area and then decreases from the estuary to freshwater. This is because the river estuary is a transitional area between salt water and fresh water, which is influenced by tides, so the higher the salinity and the lower the salinity to the mainland. According to Nababan [12], a good salinity range for vanamei shrimp is 10-30 ppt. Then according to [22], waters that can be used for shrimp farming activities must have a salinity of around 5-35‰. Therefore, the coastal waters of Padang Pariaman Regency can still support shrimp farming activities.

The level of transparency of the waters of Padang Pariaman Regency ranges from 0.5-3 m. The highest transparency is in the marine area and the lowest in the estuary and brackish waters. This is because estuary and brackish waters are affected by the tides of seawater containing suspended particles. The pH value of the waters of Padang Pariaman Regency ranges from 7.2-8.2. This value is categorized as optimal for shrimp life because, according to Boyd [13], a good pH range for fish and shrimp is between 6.8–8.5.

DO values obtained in the waters of Padang Pariaman Regency ranged from 5.48-7.51 mg/L. The dissolved oxygen content is still within the recommended range for shrimp

farming activities, around 4-8 ppm. This statement is also reinforced by Sudaryanti and Marsoedi [15] that organisms can live in dissolved oxygen conditions of more than 3 mg/L.

The concentration of nitrate in the coastal waters of Padang Pariaman Regency ranged from 0.074-0.132 mg/L. The concentration of nitrate in water is used to estimate the level of fertility of water. Waters that have a nitrate concentration of more than 2 mg/L can result in the eutrophication of waters. Based on this, the waters of Padang Pariaman Regency are still suitable for shrimp farming activities.

The concentration of free ammonia in the waters of Padang Pariaman Regency is 0.343 mg/L. This concentration is higher than the threshold for free ammonia in the surrounding waters, which is 0.02 mg/L [16]. This shows that the coastal waters of Padang Pariaman Regency have been contaminated with organic matter originating from anthropogenic activities on the mainland or waste from the cultivation activities themselves. Overall, water quality in the coastal waters of Padang Pariaman Regency can support vanamei shrimp aquaculture activities. However, one of the parameters has shown the occurrence of water eutrophication.

3.3 Shrimp pond development

Since 2017, aquaculture commodities that have important economic value and become a leading commodity in Padang Pariaman Regency have turned into vaname shrimp (*Litopenaeus vannamei*). Vanamei shrimp was chosen because it has promising prospects and profits. According to Efrizal *et al.* [10], that shrimp has an important economic value to be developed in Kabupaten Padang Pariaman and then added by Suparno [17] that other advantages possessed by vaname shrimp are fast growth, high survival rate, high appetite, and relatively short maintenance time of 90-100 days per cycle.

Vaname shrimp cultivation activities in Padang Pariaman Regency generally only include maintenance activities. This is because the shrimp seeds used for aquaculture activities are imported from outside the district of Padang Pariaman. Based on an interview with one of the pond managers in Padang Pariaman Regency, the seed sources used came from several cities, including Medan, Sidoarjo, Banten, and Lampung.

Along with the development of investment in Padang Pariaman Regency, this vaname shrimp cultivation activity has experienced a rapid increase until 2020. So the location used for shrimp cultivation has expanded to several other villages in Padang Pariaman Regency. The distribution of shrimp ponds in Padang Pariaman Regency in 2019 can be seen in Table 4.

Table 4. Distribution of Ponds in Kabupaten Padang Pariaman.

No	District	Village
1	Sungai Limau	- Tanjung - Malai Bawah
2	Nana Sabaris	- Sunur - Kuraitaji
3	Ulakan	- Batang Tiram - Manggopoh
4	Batang Anai	- Ketaping
5	Batang Gasan	- Gasan Gadang
6	IV Koto	- Kampuang Dalam

Source: Fisheries and Marine Affairs official of Padang Pariaman Regency (2019).

The first shrimp pond activity was built in 2014. This pond was established by the local government of Padang Pariaman Regency and managed by a farmer group called Saiyo Tambak Group with an area of 1.2 ha. However, this pool only lasted one year. This is

because, in the first year of pond operation, cultivation activities experienced crop failure, so that the shrimp ponds stopped operating. Then in 2016, the shrimp ponds resumed operations in a different location from the previous location, with a pond area of 2.4 ha. Investors initiated the return of shrimp farming cultivation from outside Padang Pariaman Regency. From 2017 to 2019, the development of shrimp ponds occurred very quickly. In 2019, there was 63.77 ha spread over 35 points along the coast of Padang Pariaman Regency. The following is a breakdown of the area of shrimp ponds per sub-district in Padang Pariaman Regency in 2019, Table 5.

**Table 5.** Shrimp pond area per sub-district in Indonesia Padang Pariaman Regency in 2019.

No	District	Village
1	Sungai Limau	1,85
2	Nana Sabaris	12,9
3	Ulakan	8,02
4	Batang Anai	35,8
5	Batang Gasan	1,2
6	IV Koto	4

Source: Fisheries and Marine Affairs official of Padang Pariaman Regency (2019).

Based on the table above, it can be seen that the Batang Anai sub-district has the largest pond area among other sub-districts. This is because Batang Anai District is the largest sub-district in Padang Pariaman Regency and still has a lot of vacant lands. So that the community and investors can use these vacant lands to build vaname shrimp ponds, unlike other districts, many residential areas have been built.

Since it was built from 2014 to 2021, the area of vaname shrimp ponds in Padang Pariaman Regency has always been increasing. The following is the development of shrimp ponds in Padang Pariaman Regency from 2014 to 2021, Table 6.

**Table 6.** Shrimp pond area and total shrimp pond production in 2014-2021.

Year	Total Shrimp Farm Area (ha)	Total Production (ton/ha/year)
2014	1,2	-
2015	-	-
2016	2,8	15,35
2017	9,22	1.509,78
2018	13,83	313,20
2019	63,77	416,39
2020	80	1.760,20
2021	84	600 ton/ July

Source: Padang Pariaman Marine and Fisheries Service

**3.4 Aquaculture technology and ownership status**

The ownership status of shrimp ponds operating in Padang Pariaman Regency is generally owned by individuals (85.7%), group ownership (8.5%), SUPM Pariaman schools (2.8%), and DKP assistance from West Sumatra Province (2.8%). On average, shrimp ponds are owned by investors outside the region who invest in Padang Pariaman Regency, then managed by other parties from Padang Pariaman Regency and from outside Padang Pariaman Regency. They understand the management of shrimp ponds. The investment system that exists between investors and landowners is carried out in two forms. First, investors rent land owned by residents to be used as shrimp ponds for a certain period, and second, by looking for profit. A profit-sharing system, where during the harvest period, part of the results is given. To landowners (results of interviews with pond managers). The existence of a profit-



sharing system that occurs between investors and landowners to share profits from shrimp farming activities. So that the goal of increasing the level of the regional economy can be achieved.

Workers from various regions carry out the operation of shrimp ponds. Some are from within the Padang Pariaman Regency area, and others outside the Padang Pariaman Regency area. In general, workers from within the Padang Pariaman Regency are employed as pond security guards, while those who work as aquaculture technicians are generally brought in from outside the Padang Pariaman Regency. According to an interview with one of the managers of shrimp ponds in Padang Pariaman Regency, the recruitment of technicians from outside the region is due to the lack of shrimp culture experts from within the region. Therefore, the manager brought in experts from outside the district of Padang Pariaman. The number of workers working in shrimp ponds in Padang Pariaman Regency is 162 people, both from the local community and outside the region.

Shrimp pond production in Padang Pariaman Regency fluctuated from 2016-2021 (Table 6). In 2018 the production of vaname shrimp had decreased. This is because shrimp pond cultivation activities are attacked by White Spot disease or white spot disease. Then in the following year, shrimp production began to increase until 2021. This production was marketed to local markets and outside the Padang Pariaman Regency area. Among them are Jakarta, Padang, Medan, Batam, Pekanbaru, Lampung, and Payakumbuh.

### **3.5 Problems and solutions**

The problem that arises from shrimp farming activities is that many pond owners entrust the management of their pond business permits to third parties or other people. This creates problems because the pond business permit administrator does not explain the terms and conditions of aquaculture management correctly and thoroughly to the pond owner. So that the management of shrimp farming business permits is always in conflict. According to the Head of the Investment and Integrated Services Agency (DPMPTP), the difficulty of obtaining a cultivation principle permit is also caused by shrimp pond cultivation in the coastal border area, which is less than 100 meters from the shoreline.

The next problem is the occurrence of fraudulent practices related to the size of the pool registered by the pool owner. Shrimp farming business owners who already have business licenses and other permits secretly expand the area of shrimp ponds and do not report back to the Fisheries and Marine Service. This, of course, will cause a data gap owned by the Department of Fisheries and Maritime Affairs with conditions in the field.

Shrimp cultivation activities in Batang Anai District, Padang Pariaman Regency generally have not been equipped with IPAL (Wastewater Treatment Agency). This happens because of the lack of understanding of business actors regarding the impact of pond waste that will impact the coastal environment, as well as the lack of compliance with regulations regarding the processing of aquaculture waste. Based on the results of an interview with one of the pond managers in Padang Pariaman Regency, they do not apply wastewater treatment from pond activities because the impact caused by the disposal of pond waste that has been carried out so far is invisible. So, according to him, the disposal of pond waste into the sea does not cause problems or side effects.

According to Rifqi [18], public awareness of the coastal areas of Padang Pariaman Regency towards natural resources and the environment can be said to be low, and residents are not aware of the interrelated relationships between coastal ecosystems, reciprocal relationships, and cause and effect. Activity in the coastal area to the environment.

The center of shrimp farming activities in Padang Pariaman Regency is centered in Batang Anai District. This is because the Batang Anai region has the largest number of shrimp ponds in the Padang Pariaman Regency. Several problems arise along with the rapid



increase in investment in vaname shrimp ponds in Padang Pariaman Regency. Among them are 1). The number of shrimp farming ponds that do not have a business license, 2). Regional Spatial Plan (RTRW) of Padang Pariaman Regency, which does not yet exist, allocates space for shrimp pond cultivation, 3). There is no WWTP application yet, 4). Studies on the carrying capacity that do not yet exist, and the number of ponds made by converting coastal border areas [17].

Based on the results of interviews with the Department of Fisheries and Marine Affairs of Padang Pariaman Regency, several problems related to shrimp farming in Padang Pariaman Regency are 1). Management of fishpond business permits through third parties so that it often causes misunderstandings in the management of business licenses, 2). Management of shrimp farming business licenses that are carried out after the shrimp ponds are built 3). The gap between the area of ponds that already have a permit and the area of ponds in the field, 4). The low involvement of local communities as technicians in shrimp ponds, and 5). Conversion of mangrove land.

The basic problem of shrimp farming activities in the coastal area of Padang Pariaman Regency is that there is no RTRW of Padang Pariaman Regency for the allotment of land for shrimp farming. As a result, shrimp ponds are built randomly without considering the spatial layout of the coastal area. As a result, border areas, mangrove forest areas, and coastal vegetation are used for vaname shrimp ponds.

The coastal border area and its vegetation are areas that should not be used for any development. This is because the coastal border area is a buffer area that functions as a coastal protector, which is very vulnerable to natural changes or human activities. An example of the function of a coastal border area is to protect the beach from abrasion. As stated by Solihuddin [6] that the coastal area of Padang Pariaman is dominantly experiencing abrasion. So the existence of a coastal border is very important for the coastal area of Padang Pariaman Regency. If this coastal border area is lost, it will cause more severe damage to the coastal area than before. In addition, continuous abrasion can also threaten the existing ponds in the coastal border area.

The allocation of coastal areas to designations such as shrimp ponds legally requires several permits. Permits that pond owners must complete in the context of their management include, among others, a business principle permit, a business permit for environmental management and monitoring, a building permit, and reporting of their fishery business to the Padang Pariaman Fisheries Service. However, in practice in the field, most of the shrimp ponds in Batang Anai Sub-district, Padang Pariaman Regency, do not have this permit. This is because the location of the pond construction is carried out in the coastal border area and the high cost of consultants for the management of environmental management and monitoring efforts, which is around 30 million, so that business owners are reluctant to incur such large costs.

A waste treatment agency is an installation that treats pond waste before it is discharged into the environment. This waste treatment agency is one component of the three main components of the pond structure that must exist after reservoir ponds and shrimp ponds. This is because waste from cultivation activities basically cannot be discharged directly into the environment due to the high organic matter contained in it. Shrimp pond waste that is not treated before being discharged into the environment can lead to a high intake of organic matter into the aquatic environment, which triggers eutrophication. The contribution of organic matter from vaname shrimp pond cultivation activities can come from unused feed residue, feces from aquaculture organisms, dead plankton bodies, and other organic materials carried with water entering the pond.

Currently, shrimp farming activities in Padang Pariaman Regency are intensively improving the technology used. It aims to increase the productivity of shrimp ponds. However, the improvement of this technology will lead to an increase in the amount of

organic waste produced. So that if cultivation activities are not equipped with WWTP, it will have a negative impact on the environment. According to Suparno [17], waste from shrimp farming produces about 35% organic waste consisting of unused feed residues and shrimp metabolism residues. Leftover feed is a key factor affecting pond water quality degradation, while dead shrimp in ponds has a smaller effect than leftover feed or feces on water quality degradation [20].

The entry of organic matter into the waters can cause eutrophication or nutrient enrichment. Eutrophication is the effect of very high nitrate and phosphate pollution in water. According to SLHD [21], the concentration of nutrients in the waters greatly affects the presence of phytoplankton. Therefore, the aquatic environment will affect the condition of water quality. An increase in nutrients in the waters will trigger the very rapid growth of phytoplankton, causing algae to breed.

The algal bloom phenomenon becomes dangerous when algae die, causing a buildup of organic matter at the bottom of the water. The higher the organic matter at the bottom of the water, the greater the amount of oxygen needed to decompose it. Therefore, the increase in organic matter in the waters will lead to reduced oxygen content in the waters (oxygen depletion), which can result in the mass death of aquatic biota.

In addition to not having an IPAL, shrimp farming activities in Padang Pariaman Regency also contribute to the destruction of the mangrove ecosystem. According to [22], one of the causes of the destruction of mangrove areas in Padang Pariaman Regency is the conversion of mangrove land to shrimp pond cultivation. Another cause is the conversion of land into residential areas, coastal tourism areas, and oil palm plantations. Palm plantations. One of the researchers from the Center for Mangrove and Coastal Studies at Bungkhatta University (UBH), Suardi ML, stated that the damage to mangrove land in Padang Pariaman Regency is around 200 ha.

Another problem related to shrimp farming in Padang Pariaman Regency is the lack of absorption of local workers. This cultivation activity has not been effective in reducing unemployment in Padang Pariaman Regency. If the above problem conditions are not immediately resolved from the start, it is possible that in the next few years, more serious environmental problems will emerge. Such as pollution of the aquatic environment, mass disease attacks on shrimp, unproductive shrimp ponds, and others. According to Suparno [17] that the solutions that can be given to overcome the problems above include:

1. Revise the Regional Spatial Plan (RTRW) regarding the allocation of the shrimp pond area. For the rules on shrimp farming to be firmly enforced,
2. Integrating the RTRW with the Zoning Plan for Coastal Zone and Small Islands (RWZP3K). So that the applied rules do not overlap each other,
3. The development of shrimp ponds should not be located on the shoreline, which is 100 meters from the shoreline at the time of the highest tide, which is following Law no. 26 of 2007 concerning Spatial Planning, Law no. 27 of 2007 concerning the Management of Coastal Areas and Small Islands, and Law no. 11 of 2020 concerning Job Creation and its derivatives,
4. Each pool building must have a separate water inlet and outlet system,
5. Every shrimp farm is obliged to apply IPAL (Waste Processing Agency) to treat its liquid waste, in accordance with Ministerial Decree no. 28 of 2005 concerning General Guidelines for Shrimp Cultivation in Ponds,
6. Every pond that is built must have proof of ownership or processing of coastal land in Padang Pariaman Regency, have a Fishery Business Permit (SIUP), have a cultivation business permit following Permen KP No. 12 of 2007 or Certificate Fisheries Activities Registration (TDKP),
7. Every technician who works in shrimp ponds has a sufficient understanding of shrimp feeding, both feeding time and feeding time,

8. Shrimp ponds are not allowed to cut down mangrove forests because mangrove forests are protected coastal vegetation.

Furthermore, the strategy that can be applied in shrimp farming activities in Padang Pariaman Regency is to disseminate information to the surrounding community, especially pond entrepreneurs, about the importance of preserving coastal areas. Then carry out training related to vaname shrimp cultivation techniques, so that local people have knowledge related to vaname shrimp cultivation and can carry out small-scale cultivation themselves. Finally, there is a need for synergy between various layers ranging from the community, pond entrepreneurs, workers, and the government, committed to implementing all existing regulations related to this shrimp farm.

## 4 Conclusion

Shrimp farming activities are developing very rapidly in Padang Pariaman Regency. Until 2020, the area of shrimp ponds in Padang Pariaman Regency will reach 84 ha. In addition to the development of aquaculture, several obstacles were also encountered, including the problem of fishpond business permits, the absence of an RTRW regarding the allocation of aquaculture space so that ponds are built inland and coastal areas, the existence of mangrove land conversion activities for shrimp ponds, and the lack of waste management pool fluid. Problems that arise along with shrimp farming activities are 1. Development of ponds built very close to the coastal area 2. Pond activities do not have business permits, 3. Poor management of shrimp farming waste, 4. Low involvement of local communities as technicians in shrimp ponds, 5. The management of business licenses is carried out through a third party, and 6. The discrepancy between the permitted area of the pond and the actual area of the pond. So to overcome the above problems, the management strategy that can be applied is to revise the RTRW for shrimp farming activities. Each pond must have an IPAL and operate an IPAL optimally, and permits related to the shrimp farming business must be clear.

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## References

1. M. Effendy, J. Kelaut. **2**, 6 (2009)
2. Y. Aswiati, F. Yulianda, R. Dahuri, S.R.P. Sitorus, S. B. Susilo, JPWK. **10**, 1 (2010)
3. J. Dahlan, M. Hamzah, A. Kurnia, JSIPi. **1**, 9 (2017)
4. Department of Fisheries and Marine of Padang Pariaman Regency, 2019 (Department of Fisheries and Marine of Padang Pariaman Regency, Padang Pariaman, 2019)
5. D.G. Bengen, PKSPL IPB (PKSPL, Bogor, 1998)
6. T.B. Solihuddin, Maj. ilm. Globe. **13**, 8 (2011)
7. P3GL, Marine Geology Research and Development Center (in Bahasa Indonesia) (Marine Geology Research and Development Center, Bandung, 2004)
8. Kabupaten Padang Pariaman, Pemerintahan Kabupaten Padang Pariaman, <https://padangpariamankab.go.id/> accessed on (2021)
9. Regional Development Planning Agency of Padang Pariaman Regency and the Center for Fisheries Research and Development, Bung Hatta University, Padang (2001)
10. Efrizal, Elfrida, Ikhsan, Prosiding Semirata, 145-153 (2015)

11. T.F. Hakiki, I. Setyobudiandi, Sulistiono, Omni-Akuatika. **13**, 16 (2017)
12. E. Nababan, I. Putra, Rusliadi, J. Ilm. Perikan. Kelaut. **3**, 8 (2015)
13. C.E. Boyd, *Water quality in ponds for aquaculture* (Auburn University, Alabama, 1991)
14. K. Amri, *Budi daya udang windu secara intensif* (PT Agromedia Pustaka, Depok, 2006)
15. S. Sudaryanti, Marsoedi, Buletin Perikanan. **6**, 8 (1995)
16. C. N. Sawyer, P.L. McCarty, *Chemistry for environmental engineering. Third edition* (McGrow-Hill Book Co, Tokyo, 1978)
17. Suparno, Postgraduate Thesis, Padang (ID): Universitas Bung Hatta (2021)
18. M. Rifqi, D.G. Bengen, V.P.H. Nikijuluw, J. Penelit Perikanan Indones. **9**, 75-103 (2003)
19. R. Syah, M.C. Makmur, J. Ris Akuakultur. **9**, 439-448 (2014)
20. H. Pratiwi, A. Damar, Sulistiono, Biodivers. **19**, 2104-2110 (2018)
21. Department of Environment and Forestry, *Regional Environmental Status Report of Padang Pariaman Regency* (in Bahasa Indonesia) (Department of Environment and Forestry, Padang Pariaman, 2007)
22. Dasrizal, Ansofino, E.Juita, Jolianis, Economica. **1**, 16-31 (2012)
23. R. Husna, H. Edial, J. Buana. **4**, 73-79 (2020)
24. F. Monica, D. Pujiastuti, Afdal, U.J. Wisha, J. Fisika Unand **9**, 6 (2020)