BIODIVERSITAS
Volume 23, Number 10, October 2022
Pages: 5278-5289

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d231037

The impact of fishermen's conflict on the sustainability of crab (*Portunus pelagicus*) resources in the coastal areas of Maros District, South Sulawesi, Indonesia

LUKMAN DARIS[1,♥], ANDI NUR APUNG MASSISENG[1], MARDIANA ETHRAWATY FACHRI[2], JAYA JAYA[3], ST. ZAENAB[3]

[1]Department of Fishery Agrobussiness, Faculty of Fisheries, Universitas Cokroaminoto Makassar. Jl. Perintis Kemerdekaan Km.11, Tamalanrea, Makassar 90245, South Sulawesi, Indonesia. Tel./fax.: +62-813-39772906, ♥email: daris.lukman70@gmail.com

[2]Department of Fishery Agrobussiness, Faculty of Marine Sciences and Fisheries, Universitas Hasanuddin. Jl. Perintis Kemerdekaan Km.10, Tamalanrea, Makassar 90245, South Sulawesi, Indonesia

[3]Department of Aquaculture, Faculty of Fisheries, Universitas Cokroaminoto Makassar. Jl. Perintis Kemerdekaan Km.11, Tamalanrea, Makassar 90245, South Sulawesi, Indonesia

Manuscript received: 2 September 2022. Revision accepted: 4 October 2022.

Abstract. *Daris L, Massiseng ANA, Fachri ME, Jaya, Zaenab ST. 2022. The impact of fishermen's conflict on the sustainability of crab (*Portunus pelagicus*) resources in the coastal areas of Maros District, South Sulawesi, Indonesia. Biodiversitas 23: 5278-5289.* Using environmentally unfriendly fishing gear causes damage to coral reefs and seagrass, which are the habitat of crabs. The prohibition on using ecologically unfriendly fishing gear, such as mini trawl, in catching crabs and shrimps in the coastal area of Maros District, South Sulawesi, Indonesia, has triggered horizontal conflicts between traditional fishermen from 1985 until now. This study aims to identify the types of fishing conflicts and analyze the distribution of conflict areas and the maximum fishing rate that could threaten the sustainability of crab (*Portunus pelagicus)* resources. This research was conducted from February to July 2022 in the coastal area of Maros, South Sulawesi Province, Indonesia. The type of data is primary and secondary data. The data collection methods used in this study were observation, interviews, and Participatory Rural Appraisal (PRA). The analysis data used qualitative by reducing and presenting data obtained from observations, interviews, and PRA, as well as spatial analysis and Geographic Information Systems (GIS) to describe the distribution map of fishermen's conflicts. The results showed that the types of conflicts between fishermen using crab resources were agrarian conflicts, technological conflicts, and perception conflicts between fishermen using trammel nets and traps and fishermen using mini trawls. Conflicts between fishermen in resource utilization crabs occur between 2.71-3.26 km from the coast during dark moons and 2.17-3.26 km during bright moons. Fishing conflicts have an impact on decreasing crab catches from 2015 until 2021, where the fishing effort (trip) has exceeded the sustainable fishing effort (MSY) by 690 trips/year with a total catch of 1232.3 tons/year.

Keywords: Crabs, fishermen's conflict, mini trawl, trammel net, traps

INTRODUCTION

The development of world population growth causes the management of fisheries resources to become increasingly complex. In developing countries such as Indonesia, the management of fishery resources has not been fully supported by social, political, economic, and demographic factors, so this is a big challenge for those involved (FAO 2020). The fisheries sector has not been managed optimally, both in terms of its potential as a superior sector and in improving the welfare of coastal communities, even though the reality of the physical and geographical potential of fishery resources is much better than the other developing countries. Jimenez et al. (2019), confirm that weak government governance and government performance in law enforcement, monitoring and supervision can lead to a natural resource crisis in a region. Further added by Boucquey (2017), government policies must be able to accommodate moral politics in the economy in groups of users of fishery resources. Siakwah (2018) provides an overview of the conditions in Ghana where bad policies have been taken by the government, which can create tension between local actors and the communities in the region. Boustany et al. (2021) provided the results of a study in the California region on legal protections that have been enacted during the 20th century to restore a long-extinct Dungeness crab (*Cancer magister*) population; according to Fitzgerald et al. (2019) that government policies are significant for the sustainability and availability of stocks of biological resources, including developing an environmentally friendly fishing gear system for the recovery of fishery resources (Wang et al. 2022). It is emphasized by Murray et al. (2015) that a sound policy must pay attention to the economic, ecological and social aspects of the community to balance. Eriksson et al. (2019) add that policies related to conservation efforts by considering community socio-economic factors, such as new livelihoods in their planning, provide a greater chance of success.

Regarding the strategic role and potential prospects of coastal and marine ecosystems and natural resources, various obstacles and trends threaten sustainable carrying

capacity, including anthropogenic factors (Yeon et al. 2011; Miah 2015). Human activities that threaten the sustainability of fishery resources come from the use of fishing gear that is not environmentally friendly and differences in fishing ground areas that can cause conflict in the community. The type of conflict and conflict resolution strategies influence the sustainability of fishery resources in the future (Askar et al. 2021; Dahlet et al. 2021; Stacey et al. 2021). The gap between the use of fishery resources and sustainability must be regulated in governance in the form of pro-ecological, social and economic development policies for global food security (Fachry et al. 2021; Warren et al. 2021). Small-scale fisheries management is a challenge for the government because it affects social stability (Ameyaw et al. 2021), leading to conflicts that can damage conservation if not appropriately handled (Bueno et al. 2019). Ciera et al. (2021) research on fishermen's conflicts in Puerto Rico from 2010 to 2019 resulted in 35 fisherman conflicts that led to a decline in fish populations, poverty and ecosystem changes.

The trend of decreasing production of fish resources and changes in their composition, such as reducing the average length of fish caught, by-catch fish increasingly dominating, and fishing areas getting farther. The exploitation of fishery resources in Indonesia has suffered heavy damage due to the burden of commercial exploitation, which is only aimed at pursuing short-term profits. Changes in the fishing ground from the coast to open waters with limited technological support. As a result, production costs, such as fuel, increase while the catch is reduced. Economically, this condition shows that fishing by traditional fishermen is no longer profitable. The search for more profitable fishing areas has led to horizontal and vertical conflicts in the coastal area of Maros District, South Sulawesi, Indonesia, that has occurred since 1985. However, the negative impact of the battle causes some fishermen to catch fish using fishing gear that is environmentally unfriendly. Fishermen conflict cases in the coastal areas of South Sulawesi show the same or almost the same patterns and indications as fisherman conflict cases in general in Indonesia (Daris et al. 2017, 2019, 2020) and have not been well documented as a policy indicator (Sjostrom et al. 2021).

The use of fishing gear that is not environmentally friendly by dredging the seabed causes damage to coral reefs and seagrass beds, which are crabs' habitats. In addition, export demand and conflicts between fishermen can affect the sustainability of small crabs (Huda et al. 2021). Collaborative research is needed in handling fisherman conflicts in triggering a decrease in crab resources, especially awareness through a scientific approach (Dubois et al. 2016; Bell et al. 2020), including providing a promising solution for local communities (Apine et al. 2019). Therefore, it is essential to know the types of fishing conflicts and the distribution of conflict areas for the sustainability of small crabs in the coastal area of Maros. The study aims to identify the types of fishing conflicts and analyze the distribution of conflict areas and the maximum fishing rate that could threaten the sustainability of crab resources in the coastal area of Maros. The intervention in this study is to identify the most basic types of conflict that cause prolonged conflict, thereby reducing the catch of crab fisheries resources which are made in the form of conflict maps to make it easier to see the picture of the fishermen's conflicts that occur. Based on the information provided in this paper can be input for stakeholders, and policymakers in both local and provincial governments, so that in the future, they can make appropriate management models to reduce fishermen's conflicts and their impact on fishery resources in the coastal area of Maros.

MATERIALS AND METHODS

Study area

This research was conducted from February to July 2022 in the coastal area of Maros District, South Sulawesi Province, Indonesia. The map of the research location is presented in Figure 1.

Types and sources of data

The types of data used in this study are primary and secondary data. Preliminary data from measurements, observations and interviews were obtained directly from the research location. Secondary data were obtained through existing documents from various relevant sources to research problems and support the achievement of research objectives (Snyder 2019). Primary data were collected through observation activities, in-depth interviews, notes, recordings, and participatory maps from Participatory Rural Appraisal (PRA) results and Geographic Information System (GIS). Secondary data in this study were obtained from previous journal publications, data from the government, and reports on the results of government activities. The types and sources of data needed in this study can be seen in Table 1.

Table 1. Types of data source data

Type of data	Source of data	Location/unit
Types of conflict and distribution of conflict areas fisherman	Observation, Interview and PRA	4 Sub-district
Map of conflict location of fishermen	Observation and GIS	4 Sub-district
Data on crab capture and production	Observation, interviews, PRA and annual report of the Fisheries Service of Maros District	4 Sub-district

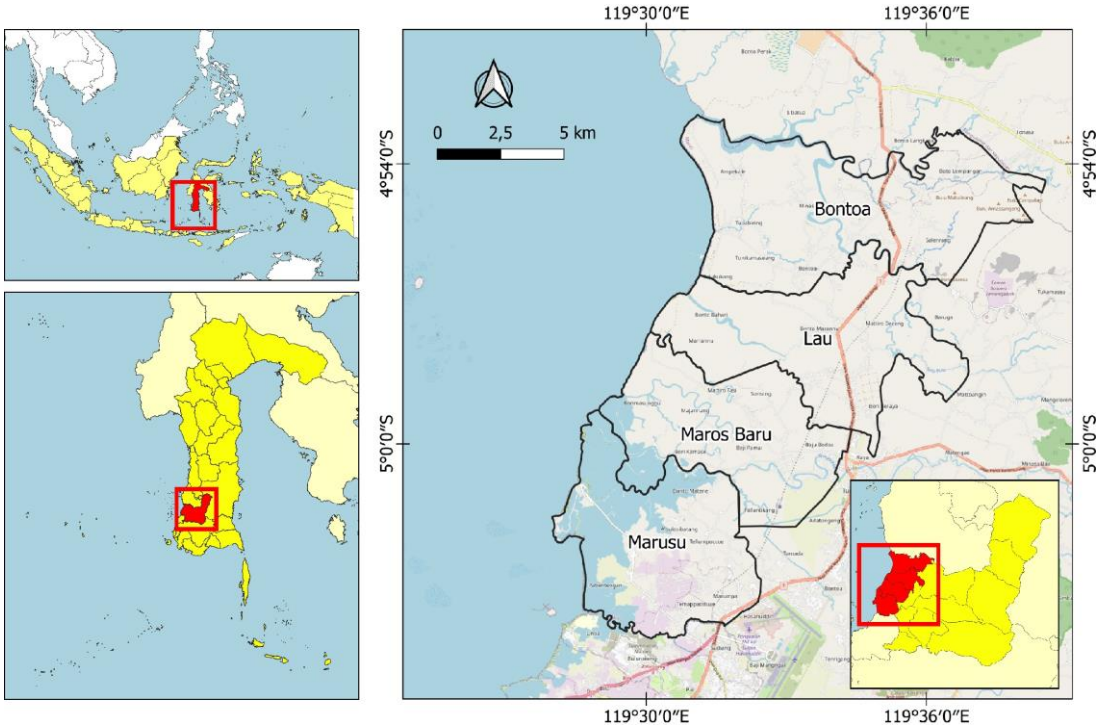

Figure 1. Research site map in the coastal area of Maros District, South Sulawesi Province, Indonesia

Collecting data method

Data collection methods in the study were observation, interviews, and Participatory Rural Appraisal (PRA). Observations were made by researchers directly observing the overall social interaction and activities of fishermen in carrying out fishing activities at the research location. Interviews were conducted to obtain clear, complete and in-depth information or data about the object study. PRA activities are used in the problem identification process, fishing data and the distribution of fishing areas map by involving the participation of people living in the coastal areas of Maros.

Observations were made through visits to research sites to see fishermen's social interactions and activities using traps, trammel nets, and mini trawls in the Bontoa, Lau, Maros Baru, and Marusu sub-districts. Observation activities were also carried out by looking directly at traditional fishermen's fishing zones in the Maros's coastal area. Daris et al. (2017) argue that researchers must participate now, openly, and publicly known to obtain sufficiently in-depth information. The type of research participation is moderate, which maintains the continuity of the position between outsiders and insiders, as observers and participants. The approach is carried out starting from the local government level (village head, hamlet head, fishery instructor) and community (community leaders, courtiers, fishermen). Before observations, researchers play a role in creating a situation of mutual trust, so researchers are considered part of them. Participatory observations of each actor were carried out on fishing communities using trammel nets, traps, and mini trawls operating in the coastal area of Maros.

Interviews were conducted to obtain more complete and in-depth information or data. Researchers directly deal with informants and conduct intensive interviews, so it is possible to get a complete picture of the object study (Bengtsson 2016; Massiseng et al. 2020). According to Mishra (2017), this type of research is a key instrudinasment that must be actively involved in conducting in-depth interviews and tracing documentation. In-depth interviews were conducted to obtain data on the forms of social interaction of fishing communities, forms and types of conflicts between fishermen, and types of conflicts between fishermen that can damage the habitat and sustainability of crab resources in the coastal area of Maros. In-depth interviews were conducted with village heads, hamlet heads, fishery instructors, courtiers, and fishing community leaders who use trammel nets, traps, and mini trawls in Bontoa, Lau, Maros Baru, and Marusu sub-districts.

The Participatory Rural Appraisal (PRA) method is used to identify problems and make maps of the distribution of fishing areas by involving community participation. PRA activities at the location were carried out in 4 sub-districts (Bontoa, Lau, Maros Baru, and Marusu), involving the participation of village heads, hamlet heads, fishery extension workers, fishing community leaders, fishermen using trammel nets, traps, and mini trawling fishing gear. The participatory method with a practical PRA approach is used in the problem identification process, including in coastal zoning areas (Benham et al. 2016). Therefore, Daris et al. (2017) argue that the participatory approach method is used to obtain information in the form of a participatory map regarding

the fishing area space by involving the fishing communities in the research location. This PRA technique can also be used to find out the opinions, views, ideas, and desires of the community or stakeholders in tackling a problem. Furthermore, Indar (2008) stated that the stages of implementing PRA used in mapping areas with GIS are; (i) initial discussion and identification of issues with the community; (ii) exposure of maps or pictures of research/study locations; (iii) community participation in providing input on the material in the exposure; (iv) plotting the results of the discussion on a map and recording attributes; (v) together with key informants conduct field observations and determine positions using the Global Positioning System (GPS) or other positioning methods; (vi) plot the results of field observations on a map; (vii) discuss the results of observations with local communities for validation; (viii) plots of discussion results in maps and management with GIS; (ix) maps and other geographic information ready as a basis for community-based area management.

Data analysis

Fishermen conflict type analysis method

The primary analytical method is qualitative data analysis. Qualitative research refers to the natural aspect and does not describe calculations (Kielmann et al. 2012). This study's data from interviews and observations were written in a field note to be analyzed qualitatively. The stages of analysis start from: (i) reducing the data obtained and carried out since the researcher was at the research location, although in limited conditions. The researcher edited all the information to see the completeness of the data, then analyzed it according to the research topic and arranged it according to the sequence of events in the field notes. (ii) after the data were analyzed, a presentation is prepared that can provide the possibility to conclude, such as; (a) excerpts from interviews to describe the views of informants; (b) a description of the capture fisheries resource utilization system carried out by fishermen using trammel net, traps, and mini trawling fishing gear in the research location; and (c) patterns of social interaction and types of conflicts that occur in fishing communities. The presentation is made in a unified form to make it easier to see all events or phenomena that occur in fishing communities to provide an overview to draw conclusions or conduct analysis. (iii) drawing conclusions that include verification of all social phenomena found in the research location. This temporary conclusion was discussed with related (fishermen, courtiers, community leaders, village heads, hamlet heads, and fishery instructors). If the study's findings are by the interpretation of the relevant parties, then the results will be the study's conclusions. However, if the research conclusions do not conform with the interpretation, the researchers conduct data search activities, analyze and formulate conclusions again.

Methods of analysis of the distribution of fishing conflict areas

The analysis method for distributing fishermen's conflict areas uses spatial analysis. Spatial analysis is an analytical model related to spatial studies of geographical phenomena along with their spatial dimensions, and Geographic Information System (GIS) as a tool (toll) for analysis (Kavadas et al. 2014). GIS is a tool of spatial analysis helpful in deriving new information based on thematic spatial data sets, either done manually or with the help of computers as electronic data managers. The spatial data collected were analyzed manually or with the help of a computer by using the method of overlaying thematic maps to produce patterns of spatial use of fishing areas by fishermen using trammel nets, traps, and mini trawl.

Some analysis commands used in ArcView are intersected, union, dissolve, clip one, and buffer. Intersect is used to merge two overlapping maps. The collaboration combines all parts of the map, including maps that do not overlap. Dissolve is used to eliminate polygons or regions that have the same value or identity. Clip one is used to cutting more polygons than the other. Meanwhile, the buffer is used to make the diameter of a particular point or area.

The spatial analysis in this study is used to describe a map of fishing patterns for fishermen using trammel nets, traps, and mini trawls (both during dark and light months), as well as a map of the distribution of conflict areas for fishermen in the coastal areas of Maros. The use of spatial analysis is essential to describe the use of marine space in marine spatial planning (Prestrelo et al. 2016).

Method of analysis of crab resource sustainability

An assessment of small-scale fisheries needs to be carried out to determine the approach that can be used for fisheries resource management (Prince et al. 2020). The process of analyzing the sustainability of crab resources in calculating the sustainable potential (Maximum Sustainable Yield) with CPUE and MSY analysis with the following equation:

CPUE (Catch per Unit Effort). According to Noijja et al. (2014), the formula used is as follows:

$$CPUE = \frac{Catch_t}{Effort_t}$$

Where:
CPUEt : catch per fishing effort in year t (kg/trip)
Catch : catch in year t (kg)
Efforts : fishing effort in year t (trip)

The catch rate (CPUE) determined is the average CPUE of each fishing gear. The fishing gear with the highest CPUE value is assumed to be the standard fishing gear.

Maximum Sustainable Yield (MSY) analysis

$$y = a - bx$$

Where:
Y : dependent variable (CPUE) in kg/trip
x : independent variable (effort) in trip
a and b: regression parameters

The potential of small crabs can be estimated by analyzing the catch and effort. According to Castro et al. (2020), the relationship between yield and effort can use the production surplus method of the Schaefer model. The data processing steps are: (i) Plotting the value of f against c/f and predicting the value of the intercept (a) and the value of the slope (b) with linear regression. (ii) Calculating the estimation of sustainable potential (C_{MSY}) and optimum effort (E_{MSY}).

The determination of the value of optimum catch (C_{MSY}) and optimum effort (E_{MSY}) with Schaefer are:

The equation model can be written as CPUE = a-b(f)

The relationship between C and f can be written as $C = af-b(f)^2$

Where:

CPUE/C: number of catches per unit of fishing effort (kg/trip)

A : intercept

b : regression coefficient/variable f

f : fishing effort (trip) in period-i

According to Pan (2021), the Schaefer model only applies if the parameter value (b) is negative, meaning that every additional fishing effort will cause a decrease in the CPUE value. Suppose the calculation of the coefficient value (b) is positive. In that case, the analysis of the potential and optimum fishing effort does not need to be continued because this indicates that adding fishing effort can still increase the catch.

After knowing the values of a and b, the next step is calculating the optimal catch and fishing effort value. It can be known by using the following formula (Jamaluddin et al. 2019):

Optimal capture effort (C_{MSY})

$$E_{MSY} = \frac{a}{2b}$$

Sustainable potential (C_{MSY}) or is the optimal catch

$$C_{MSY} = \frac{a^2}{4b}$$

Where:

a : intercept

b : regression coefficient/variable f

E_{MSY}: optimal capture effort

C_{MSY} : optimal catch

RESULTS AND DISCUSSION

Types of conflict between fishermen in the use of crab resources

Based on the results, it was shown that the kinds of conflicts between fishermen in the utilization of crab (*Portunus pelagicus*) resources in the coastal area of Maros, such as agrarian conflicts, technological conflicts, and conflicts of perception. More details are shown in Table 2.

Based on the study results shows that the fishing pattern carried out by fishermen using trammel nets and traps and fishermen who use mini trawls in the utilization of crab resources has triggered conflict between fishermen in the coastal area of Maros. The types of fishermen conflicts that arise in the coastal areas of Maros, among others.

Agrarian conflict

One of the sources of conflict in the coastal area of Maros is the struggle for fishing grounds between fishermen using trammel nets and traps and fishermen using mini trawls. This conflict over fishing areas is better known as agrarian conflict. Fishermen who use mini trawl fishing gear often engage in fishing activities in coastal areas (0-3 miles from the coast) which are fishing areas for traditional fishermen (according to the Minister of Agriculture Decree No. 392 of 1999), including fishermen using trammel net fishing gear and fishermen traps. As a result, fishermen who use trammel nets and traps are angry and evict fishermen using mini trawls because the fishing gears that use trammel nets and pitfalls that they install in coastal areas are often lost or damaged. The damage was caused by fishermen using mini trawls who entered the coastal area (0-3 miles from the coast), a fishing area for fishermen using trammel nets and traps.

Table 2. Types of conflict between fishermen in the last ten years (2012-2021)

Year	Type of conflict fishermen	Conflict parties
2012	Agrarian conflicts, technological conflicts	Fishermen using mini trawl vs fishermen using trammel net and fishermen using traps
2013	Perceptual conflict	Fishermen using mini trawl vs fishermen using trammel net and fishermen using traps
2014	Perceptual conflict	Fishermen using mini trawl vs fishermen using trammel net and fishermen using traps
2015	Agrarian conflicts, technological conflicts	-
2016	-	Fishermen using mini trawl vs fishermen using trammel net and fishermen using traps
2017	Perceptual conflict	Fishermen using mini trawl vs fishermen using traps
2018	Technology conflict	Fishermen using mini trawl vs fishermen using trammel net
2019	Agrarian conflicts, technological conflicts	Fishermen using mini trawl vs fishermen using traps
2020	Technology conflict	Fishermen using mini trawl vs fishermen using trammel net and fishermen using traps
2021	Technological conflict, perception conflict	-

Meanwhile, fishermen using mini trawls argue that in fishing activities in coastal areas, there is no intentional element to damage the fishing gear of fishermen who use trammel nets and traps. Still, because it is at the mouth of the Kaddorobobbo river, which is rich in crab resources, fishermen also use mini trawls often operate in the fishing area, even though the area is a fishing area for traditional fishermen, including fishermen who use trammel nets and traps. Fishermen using mini trawls think that mini trawl fishermen also have the right to carry out fishing activities in the coastal area of Maros because there are no clear regulations regarding the fishing area for mini trawl fishermen. Mini trawling also does not necessarily include the type of trawl fishing gear prohibited from operating by the government, which is regulated in the Decree of the President of the Republic of Indonesia Number 39 of 1980.

This condition is categorized by Utami et al. (2022) as an agrarian conflict, where conflicts occur due to the seizure of fishing grounds. This conflict can occur in fishermen between the same social class and fishermen in different social classes (inter-class). This conflict can also arise between fishermen and non-fishers, such as between pond farmers who conserve mangroves and fishermen who use sodo in the coastal areas of Maros District and Wajo District, where sodo fishermen are carrying out fishing activities and have to deal with pond farmers. Pond farmers objected because the shoots of mangrove forests were damaged by fishermen using sodo when catching fish in coastal areas (Daris et al. 2017). This fishing area conflict can cause horizontal and vertical conflicts, both latent and manifest.

Technology conflict

Differences in fishing gear or fishing technology used by fishing communities in fishing activities are one of the potential conflicts between fishermen in coastal and marine areas (Silva et al. 2015). This conflict in using different fishing technologies is known as technological conflict. Semi-modern fishing gear (including fishermen using mini trawls) is an active type of fishing gear. The mini trawl is operated at the bottom of the water, so that it often damages the fishing gear of traditional fishermen (users of trammel nets and traps) passively installed by conventional fishermen in the coastal area of Maros. In addition, traditional fishermen also assume that mini trawl fishermen have a significant role in destroying seagrass beds and fish resources (including small crabs), decreasing fish catches for traditional fishermen. This condition triggers technological conflicts, where conflicts occur because of the use of environmentally unfriendly fishing technology by fishermen who use mini trawls.

Differences in the views of fishing communities on the use of active fishing technology (including mini trawl) occur in almost all regions in Indonesia, including South Sulawesi. The fishing technology used generally causes damage and destruction of fishery resources, for example, mini trawls, mini trawls, and bagan rambo, which are still widely operating in the coastal areas of Barru, Pangkep and Maros Regencies (Satria 2009).

Perceptual conflict

The perception of coastal communities towards fishery resources or marine resources that are open access. Open access means that the sea and all its potential are seen as a "free battle area" for anyone who wants to use it (Marpaung 2016). Fishermen or groups of fishermen with their fishing technology (modern, semi-modern, traditional) must compete freely and competitively among themselves to get fish resources. In this unequal free competition between traditional fishermen (fishers who use trammel nets and traps) and semi-modern fishermen (fishers who use mini trawls), the iron law of "who is strong, he wins" is one of the triggers for the opening of regional conflicts fishing ground in the form of horizontal and vertical between them, so this better known as the conflict of perception (Daris et al. 2017).

In general, fishermen using semi-modern fishing gear (mini trawls) still perceive that coastal and marine areas are open access, in the sense that every fisherman, including fishermen using mini trawls, trap fishermen, trammel net fishermen, or other fishermen, may use or access these coastal and oceanic areas, because coastal and marine areas are also common property areas. Meanwhile, the government maintains the view that fishermen who use mini trawls are prohibited from operating their fishing gear at 0-3 miles of the shore, which are intended for traditional fishermen (fishers who use passive fishing gear) as stipulated in the Decree of the Minister of Agriculture No. 392 of 1999, concerning the fishing line. The decree stipulates fishing routes for fishing communities. In principle, traditional fishermen operate in coastal areas (0-3 miles from the coast), while large fishermen (semi-modern and modern) operate offshore (Monintja and Yusfiandayani 2009).

Violation of fishing routes is a source of conflict due to differences in fishermen's perceptions of common property resources. Therefore, in utilizing marine resources as shared resources, fishing areas between fishermen must be regulated so that conflicts between fishermen can be minimized. Fishermen's understanding of the type of fishing gear mini trawl, often equated with the type of trawl or mini trawl, has created a conflict of perceptions in the coastal area of Maros. Fishermen who use mini trawls are often threatened and chased away by fishermen who use nets and traps. Fishermen who use trammel nets and traps think that mini trawl's operation is prohibited as regulated in Presidential Decree of the Republic of Indonesia No. 39 of 1980 concerning the elimination of trawling nets.

Distribution of conflict areas for the use of crab resources

The fishing ground is where fishermen carry out fishing operations at sea. To avoid conflicts between fishermen in fishing activities, the government, through the Minister of Agriculture, has issued Decree No. 392 of 1999 concerning fishing routes in Indonesian waters. For more details, the fishing routes can be seen in Figure 2 and Table 4.

Fishermen use trammel nets and traps generally catching crab activities on fishing line I (0-3 nautical miles), which is intended explicitly for fishermen who use fixed (passive) fishing gear and active fishing gear not modified using a

boat without a motor measuring 10 meters. Meanwhile, fishermen who use mini trawl fishing gear generally carry out crab-catching activities on fishing line I (3-6 miles) and fishing line II (6-12 miles). Fishing line I (3-6 miles) is for fishermen who use modified non-permanent fishing gear (including mini trawl gear) using fishing boats without motors or outboard motors measuring ≤12 m or ≤5 GT.

Based on interviews and observations at the research location, it shows fishermen who use trammel net fishing gear for fishing crab activities in the area 0-3.26 miles from the coast (Figure 3). Meanwhile, fishermen using mini trawl fishing gear carried out fishing activities for small crabs in an area of 2.17-3.80 miles from the coast when the moon was dark (Figure 4) and in an area of 2.71-4.88 miles from the beach when the moon was bright (Figure 5).

The conflict between fishermen in the utilization of crab resources in the coastal area of Maros occurs because fishermen using mini trawl fishing gear operate their fishing gear on fishing line I (0-3 miles), which is designated for traditional fishermen (including fishermen who use trammel nets and traps). Especially when the moon is bright. During the bright moon, many fishermen using mini trawl operate their fishing gear on the fishing line I (0-3 miles) because it is estimated that there are many small crabs on this route, causing agrarian conflicts and technological conflicts between fishermen using mini trawl (semi-modern) and fishermen using trammel nets and traps (traditional). During the dark months, fishermen using mini trawl are afraid to enter fishing line I (0-3 miles) because they get supervision from fishermen using fixed charts which carry out fishing activities during dark months, so the chances of conflict between fishermen are much less if compared to the bright moon. The selected chart does not carry out fishing operations during the bright moon. The fixed chart is one of the signs used as a boundary for the fishing area of traditional fishermen (users of trammel nets and traps) with fishermen who use mini trawls in the coastal area of Maros.

The technological conflicts between fishermen continue to occur due to the weak supervision and law enforcement carried out by fisheries supervisors and the police. Fishermen using mini trawl gears continue fishing activities on fishing line I (0-3 miles), designated for fishermen using passive fishing gear (trammel nets and traps). This causes agrarian conflicts between fellow local fishermen in the coastal area of Maros, where fishermen conflict due to the seizure and control of the fishing ground (fishing ground) between fishermen who use trammel nets and traps and fishermen who use mini trawls. Conflict areas for the use of crab resources between fishermen using trammel nets and traps and fishermen using mini trawls in the area of 2.71-3.26 miles from the coast when the moon is dark (Figure 6) and 2.17-3.26 miles from the beach when the moon is bright (Figure 7).

The impact of fishermen's conflicts on crab resources

The effect of fishermen's conflicts on the production of crabs

This study showed that fishermen's conflicts also affected the production of small crabs in the coastal area of Maros. Crab production data in the last ten years (2012-2021) can be seen in Table 5.

The impact of fishermen's conflicts on the sustainability of crab resources

The conflict of fishermen in the utilization of fishery resources in the coastal area of Maros has an impact on the catch of crabs; this is to the research of Akpona et al. (2015) in the Hlan River Benin area, which resulted that the conflict of fishermen in the area caused a decrease in the species of necked otters. Spotted the decline in crab catches began to occur in 2015 until 2021 when the fishing effort (trips) had exceeded the sustainable fishing effort (MSY) by 690 trips/year with a total catch of 1232.3 tons/year (Table 3). The decrease in catch results was due to conflicts between fishermen and an increase in the number of fishing gear. The results of CPUE analysis get a value of y = 0.0031 + 4.0389 and R2 = 0.9014 (Figure 8).

Based on Figure 8, it can be seen that the point of intersection of the straight line on the CPUE graph between effort (trip) (x) and CPUE (y), which shows the catch per effort of capture (CPUE) that is still sustainable is 1.79 sustainable fishing effort (MSY) with an effort of approx. 690 trips in 2014, 2015 to 2021 occurred overfishing due to sustainable catches above 690 trips (Table 3). This occurs because fishermen using mini trawler fishing gear carry out fishing activities (including crabs) on fishing line I (0-3 miles) from the coast, which are carried out during dark moons and bright moons (Figure 4 and Figure 5). This can trigger conflict because fishing line I (0-3 miles) is a fishing route for fishermen using trammel nets as regulated in the Decree of the Minister of Agriculture No. 392 of 1999 concerning fishing routes (Figure 2 and Table 4).

Table 3. Effort standard, catch, CPUE, and types of fishermen conflict in the last 10 years (2012-2021)

Tahun	Effort standart (trip)	Catch (tons)	CPUE (tons/trips)	Types of conflict fishermen
2012	436	1250.2	2.867431193	Agrarian conflicts, technological conflicts, conflicts of perception.
2013	532	1095.4	2.059022556	Perceptual conflict
2014	690	998.5	1.785942029	Agrarian conflicts, technological conflicts
2015	731	1306.9	1.787824897	-
2016	756	1382.4	1.807058824	Perceptual conflict
2017	844	1433.5	1.698459716	Technology conflict
2018	876	1097.6	1.252968037	Agrarian conflicts, technological conflicts
2019	889	982.1	1.104724409	Technology conflict
2020	954	871.6	0.913626834	Technological conflict, perception conflict
2021	990	977.6	1.408645533	-

Table 4. Fishing routes with references to Monintja and Yusfiandayani (2009)

Catch path	Allowed fishing gear/ships
Catch Path I: Coastal waters are measured from sea level at the lowest tide on each island up to 6 miles to the sea	**0-3 nautical miles:** • Fixed fishing gear • Unmodified permanent fishing gear • Fishing boat without motor 10 m **3-6 nautical miles:** • Modified non-permanent fishing gear • Fishing boats without motor or outboard motor measuring 12 m or 5 GT • Purse seine 150 m • Gillnet drift 1000 m
Path of capture II: Waters outside the fishing line I up to 12 miles to the sea	• Deep motor fishing vessel, maximum 60 GT • The Seine rings, a maximum of 600 m (1 vessel) and a maximum of 1000 m (2 boats) • Drifting gill nets, max. 2500 m
Path of capture III: The waters outside fishing lane II up to the outer limit of the Indonesian Exclusive Economic Zone (ZEEI)	• Indonesian-flagged fishing vessels, maximum 200 GT, except large pelagic purse seines in Tomini Bay, Maluku Sea, Seram Sea, Banda Sea, Flores Sea, and Sawu Sea are prohibited • The ZEEI of the Malacca Strait is allowed for Indonesian-flagged fishing vessels, a maximum of 200 GT, except for fishing trawls with a minimum size of 60 GT • ZEEI outside the Malacca Strait may share: (i) Indonesian and foreign fishing vessels 350 GT; (ii) Purse seine vessels > 350 GT-800 GT outside 100 nautical miles from the baseline of the Indonesian archipelago; (iii) Purse seine system group vessels may only be outside 100 nautical miles from the baseline of the Indonesian archipelago

Figure 9 above shows the maximum sustainable crab catch (MSY) of 1232.3 tons/year with a maximum fishing effort (trip) of 690 trips/year. The decline in yields began in 2015 and until 2021, marked by a decrease in crab catches. This is due to the occurrence of fishermen's conflicts where fishermen compete to make efforts to win in the same area with different technologies. The fisherman conflict occurred because it was triggered by fishermen using mini trawler fishing gear using <5 GT machines had violated fishing lanes by entering fishing lane I (0-3 miles), which should have been fishermen using mini trawls operating on the fishing lane I (3-6 miles). miles) from the coast (Table 4). Fishermen using mini trawls participate in catching crabs on fishing line I (0-3 miles), which is the fishing area for fishermen who use trammel net fishing gear, so this not only triggers fisherman conflicts but also causes overfishing of crab resources in the area. The coast of Maros. This overfishing occurs not only because fishermen using trammel net fishing gear are catching crabs but also because fishermen using mini trawl fishing gear. Fishermen using trammel nets who experience a decrease in crab catches who feel threatened by fishermen using mini trawls add fishing gear to increase their yield. This condition further exacerbates the overfishing of crab resources in the coastal area of Maros.

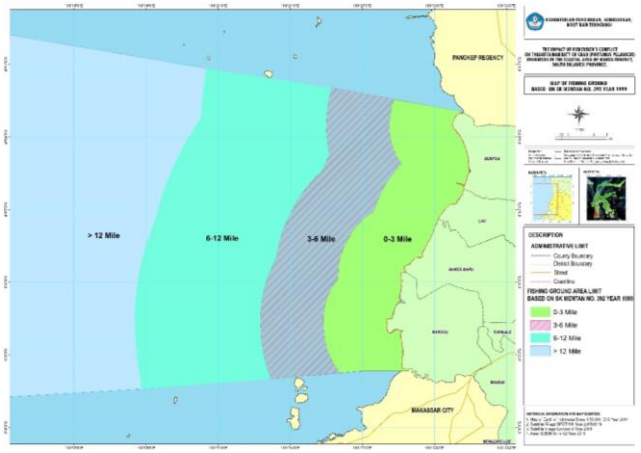

Figure 2. Distribution of conflict areas for fishermen using crab resources (Map of Fishing Routes Based on SK. Minister of Agriculture Number 392 of 1999)

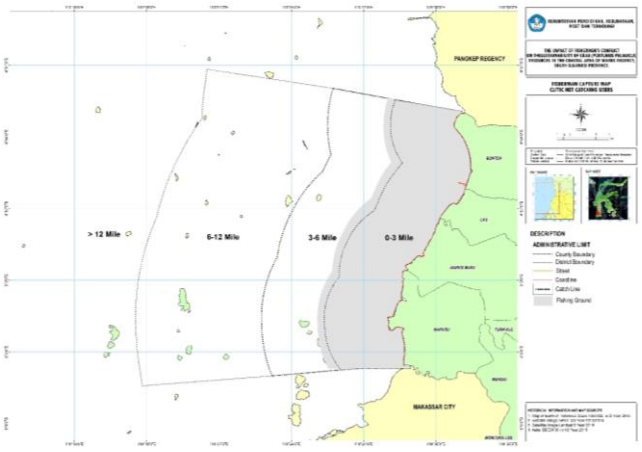

Figure 3. Map of fishing areas fishermen using trammel nets and traps

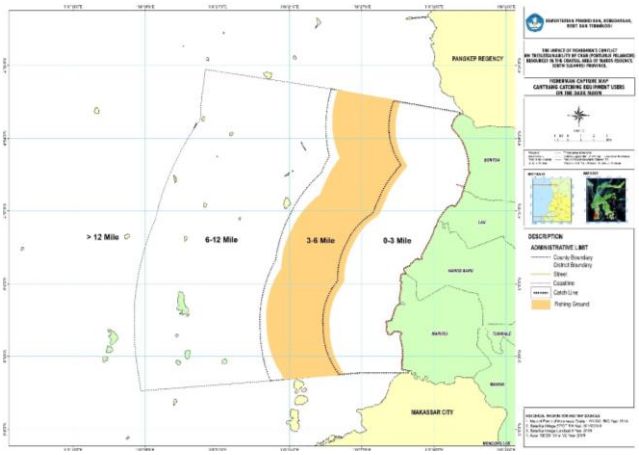

Figure 4. Map of fishing areas fishermen using mini trawl fishing equipment during dark moon

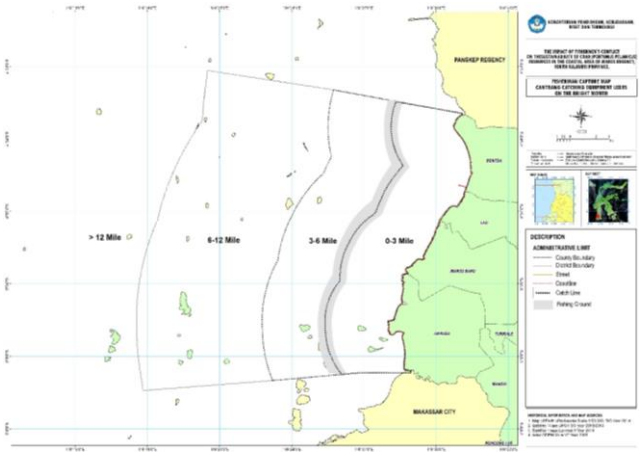

Figure 5. Map of fishing areas fishermen using mini trawl fishing equipment during a bright moon

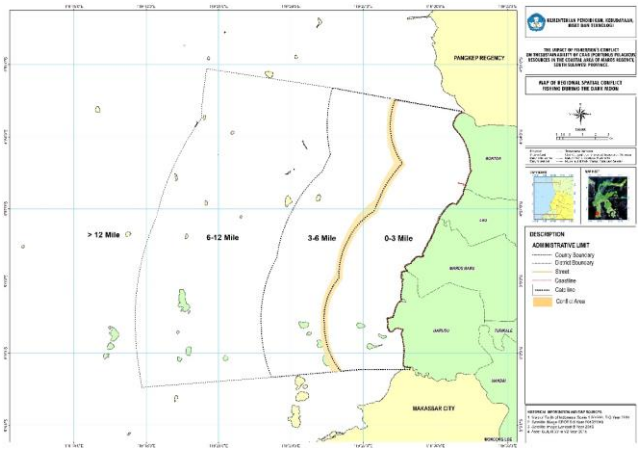

Figure 6. Map of conflict areas for crab crab resource utilization during dark moon

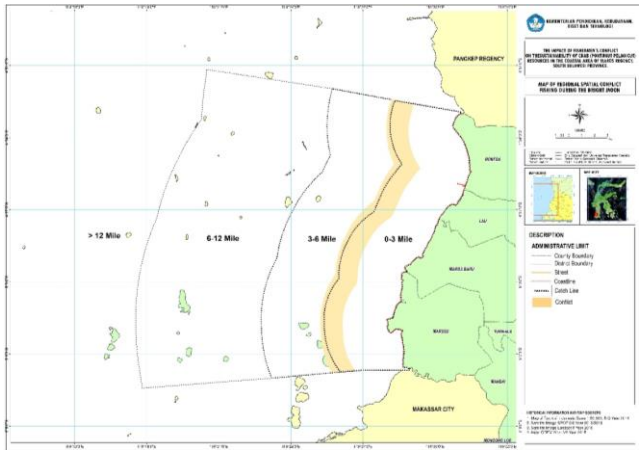

Figure 7. Map of conflict areas in the utilization of crab crab resources during a bright moon

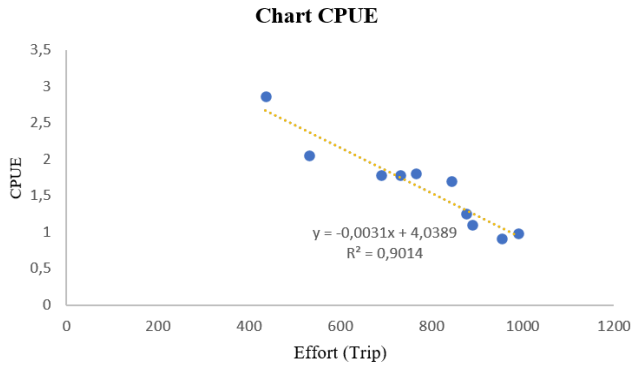

Figure 8. CPUE crab catching

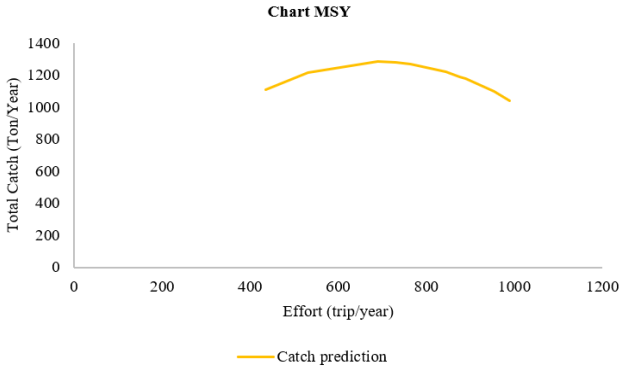

Figure 9. The sustainable potential of crab catching

Table 5. Conflict chronology, types of fishing conflicts, and crab catches in the last ten years (2012-2021)

Year	Fisherman conflict chronology [1)]	Fisherman conflict type [1)]	Catch (tons)[2)]
2012	Fishermen using mini trawls violated the agreement that had been made (mini trawl fishermen operating in traditional fishing areas), so that mini trawls' boats were brought (towed) by traditional fishermen (users of trammel nets and traps) to the beachfront of Pajukukang Village. There was tension between them, but after being given warnings (advice) by community leaders, the mini trawl fishermen from Tuppabiring Village were allowed to return to their areas. In contrast, their fishing gear (mini trawls) was confiscated (taken) by fishermen using trammel nets and traps.	Agrarian conflict, technology conflict, perceptual conflict	1250.2
2013	There were expulsions and threats to fishermen using mini trawls carried out by traditional fishermen in the coastal area of Bontoa Sub-district. The fishermen who use the mini trawl ask for help from an NGO in Makassar to facilitate their meeting so that the conflicts that often occur between traditional fishermen (fishers who use trammel nets and traps) and fishermen who use mini trawls can be appropriately resolved. The meeting resulted in agreements, among others; A fishing zone (lanes) will be created, the 0-1 mile line from the shoreline is for traditional fishermen, while the 1-3 mile line is for mini trawl fishermen.	Perceptual conflict	1095.4
2014	Fishermen using mini trawls catch fish too far into the coastal area, causing damage to the traps belonging to the people of Pajukukang Village. This made the people of Pajukukang Village furious, and they took action to burn fishing gear belonging to fishermen who use mini trawls. In the same year, tensions arose again when fishermen using mini trawls brandished sharp weapons with threatening expressions from their boats as a form of resistance to the arson actions carried out by the people of Pajukukang Village. Their expressions are fishermen who use mini trawls by slashing trammel net buoys and traps belonging to fishermen from Pajukukang Village, which are installed in the coastal area.	Agrarian conflict, technology conflict	998.5
2015	The Maros District Fisheries Service employees, the Bontoa Sub-district Head and the Pajukukang Village Head held a marine patrol around the Pajukukang coast. This patrol activity managed to find three units of mini trawling boats operating. They warned fishermen who use mini trawls are prohibited from catching fish along the coast of Pajukukang Village because many trammel nets and traps are installed. If they are found again, the government confiscates their fishing gear.	--	1306.9
2016	Feeling insecure and constantly monitored in their fishing activities, fisherman figures using mini trawls (punggawa) from Nisombalia and Tuppabiring villages protested to the Maros District Fisheries Service. They asked for an explanation about the types of fishing gear the government has prohibited according to regulations. Applicable. At that time, it was explained that, in principle, mini trawling fishing gear was not banned. Still, the fishing lanes should not enter the traditional fishing lanes (0-3 miles from the coast), which are intended for fishermen who use passive fishing gear (such as fixed gill nets, trammel nets, traps, fixed chart, and fishing line).	Perceptual conflict	1382.4
2017	Conflict of perceptions On August 15 2017, a football match took place in Bontoa Village to commemorate Indonesia's independence day. At night, approximately 40 fishing gear traps were destroyed on the coast of Pajukukang Village. After the incident, the people of Pajukukang Village carried out sea patrols, and some were on guard on the beach after getting permission from the local police. During the sea patrols, they never found a mini trawl carrying out a fishing operation in the coastal area of Pajukukang Village.	Perceptual conflict	1433.5
2018	In October 2018, fishermen using trammel net fishing gear again caught fishing boats using mini trawls carrying out fishing operations around their net installation areas. The fishermen using the trammel net shouted at the fishermen using the mini trawl, so the fishermen using the mini trawl left the location.	Agrarian conflict, technology conflict	1097.6
2019	In December 2019, another trap was destroyed by an unknown group of people. Fishermen using traps had reported the incident to the Pajukukang Village Head and the Lau Sector Police, but the perpetrators were not found.	Technology conflict	982.1
2020	There was an incident of stealth-taking mini trawl fishing gear carried out by an unknown person using a face covering (mask). From this incident, several fishermen still using mini trawls agreed to hand over their mini trawls to the Bontoa Sub-district apparatus. The number of mini trawl fishermen who hand over their tools (mini trawl) is significantly less (around 17 people). The Head of Bontoa Sub-district and the Head of Pajukukang Village mediate fishermen using mini trawls with fishermen using trammel nets and traps to hold a meeting, where at the meeting, it is hoped that the fishermen in conflict can comply with the agreements that have been made previously. The meeting was attended by community leaders from Pajukukang Village and Tupabbiring Village, Bontoa Sub-district.	Technology conflict, perception conflict	871.6
2021	Although there is no open conflict, latent conflicts still occur, where fishermen who use trammel nets and traps are suspicious of fishermen using mini trawls who are suspected of frequently catching a fishing on traditional fishing routes (0-3 miles from the coast). However, there is no evidence of damage to the fishing gear of fishermen using trammel nets and traps.	--	1232.3

Note: [1)] Processed results of primary data, 2022; [2)] Maros District Fisheries Service Annual Report, 2022

In conclusion, the study is; (i) types of conflicts between fishermen in the utilization of crab resources in the coastal area of Maros, such as agrarian conflicts, technological conflicts, and conflicts of perception between fishermen using trammel nets and traps, and fishermen use mini trawls; (ii) fishermen who use trammel net fishing gear carry out activities catching crabs in an area of 0-3.26 miles from the coast, while fishermen using mini trawl fishing gear carry out fishing activities in an area of 2.17-3.80 miles from the coast when the moon is dark and in an area of 2.71-4.88 miles from the beach on a bright moon. This causes conflicts in the use of crab resources in the area of 2.71-3.26 miles from the coast when the moon is dark, and 2.17-3.26 miles from the coast during bright moons; and (3) fishermen conflicts have an impact on decreasing yields crab catches that began to occur in 2015 until 2021 where the fishing effort (trips) had exceeded the sustainable fishing effort (MSY) limit of 690 trips/year.

ACKNOWLEDGEMENTS

We would like to thank the Director General of Higher Education, Research, and Technology at the Ministry of Education, Culture, Research and Technology of the Republic of Indonesia for funding the National Competitive Program research. We also express our gratitude to the Head of the Maros District Fisheries Service and the Cokroaminoto University Makassar's Chancellor for the permission to carry out research activities in the coastal area of Maros District, Indonesia. To fishery instructors, fishing community leaders, and all parties who have helped in the process of carrying out this research.

REFERENCES

Akpona AH, Djagoun CAMS, Harrington LA, Kabré AT, Mensah GA, Sinsin B. 2015. The conflict between spotted-necked otters and fishermen in Hlan River, Benin. J Nat Conserv 27: 63-71. DOI: 10.1016/j.jnc.2015.06.007.

Ameyaw GA, Tsamenyi M, McIlgorm A, Aheto DW. 2021. Challenges in the management of small-scale marine fisheries conflicts in Ghana. Ocean Coast Manag 211: 1-9. DOI: 10.1016/j.ocecoaman.2021.1057.

Apine E, Turner LM, Rodwell LD, Bhatta R. 2019. The application of the sustainable livelihood approach to small scale-fisheries: The case of mud crab *Scylla serrata* in South west India. Ocean Coast Manag 170: 17-28. DOI: 10.1016/j.ocecoaman.2018.12.024.

Askar H, Tahang H, Sutinah S, Fakhriyyah S, Bahar A, Tresnati J, Tuwo A. 2021. Short communication: Using ecological parameters to assess the sustainability of mangrove ecotourism in Jeneponto, South Sulawesi, Indonesia. Biodiversitas 22 (8): 3571-3577. DOI: 10.13057/biodiv/d220858.

Bell RJ, Odell J, Kirchner G, Lomonico S. 2020. Action to promote and achieve climate-ready fisheries: Summary of current practice. Mar Coast Fish Dyn Manag Ecosyst Sci 12: 166-190. DOI: 10.1002/mcf2.10112166.

Bengtsson M. 2016. How to plan and perform a qualitative study using content analysis. Nurs Plus Open 2: 8-14. DOI: 10.1016/j.npls.2016.01.00.

Benham CF, Daniell KA. 2016. Putting transdisciplinary research into practice: A participatory approach to understanding change in coastal social-ecological systems. Ocean Coast Manag 128: 29-39. DOI: 10.1016/j.ocecoaman.2016.04.0.

Boucquey N. 2017. That's my livelihood, it's your fun': The conflicting moral economies of commercial and recreational fishing. J Rural Stud 54: 138-150. DOI: 10.1016/j.jrurstud.2017.06.01.

Boustany AM, Hernandez DA, Miller EA, Fujii JA, Nicholson TE, Tomoleoni JA, Van Houtan KS. 2021. Examining the potential conflict between sea otter recovery and Dungeness crab fisheries in California. Biol Conserv 253: 1-8. DOI: 10.1016/j.biocon.2020.108830.

Bueno PF, Schiavetti A. 2019. The influence of fisherman scale in the resilience of socio-ecological systems: An analysis using Q methodology. Ocean Coast Manag 169: 214-224. DOI: 10.1016/j.ocecoaman.2018.12.0.

Castro JHR, Fuente SEO, Baez WO, Sandoval AC, Leon AR. 2020. Estimation of the Maximum Sustainable Yield and the Optimal Fishing Effort of the Brue Crab (*Callinectes sapidus*, Rathbun 1896) of Laguna Madre, Tamaulipas, Mexico. IntechOpen, Mexico.

Ciera V, Nicolás X, Gómez A, Harte M, Glaser SM, Watson JR. 2021. Cooperation and conflict in the small-scale fisheries of Puerto Rico. Mar Policy 134 : 1-13. DOI: 10.1016/j.marpol.2021.104809.

Dahlet LI, Himes-Cornell A, Metzner R. 2021. Fisheries conflicts as drivers of social transformation. Curr Opin Environ Sustain 53: 9-19. DOI: 10.1016/j.cosust.2021.03.011.

Daris L, Aslinda A, Rapi NL. 2017. Forms and strategies of conflict resolution in fishing resources utilization in the coastal area of Maros District, South Sulawesi Province. AACL Bioflux 10 (6): 1540-1545.

Daris L, Wahyuti, Yusuf M. 2019. Conflict dynamics of fishery resources utilization in Maros District, South Sulawesi Province, Indonesia. AACL Bioflux 12 (3): 786-791.

Daris L, Yusuf M, Ali MSS, Wahyuti. 2020 Priority strategies for conflict resolution of traditional fishermen and mini trawl in Maros District, South Sulawesi Province, Indonesia. AACL Bioflux 13 (2): 496-502.

Dubois M, Hadjimichael M, Raakjær J. 2016. The rise of the scientific fisherman: Mobilising knowledge and negotiating user rights in the Devon inshore brown crab fishery, UK. Mar Policy 65: 48-55. DOI: 10.1016/j.marpol.2015.12.013.

Eriksson B, Johansson F, Blicharska M. 2019. Socio-economic impacts of marine conservation efforts in three Indonesian fishing communities. Mar Policy 103: 59-67. DOI: 10.1016/j.marpol.2019.02.007.

Fachry ME, Massiseng ANA, Bahar A, Tuwo A. 2021. Stakeholder roles in the Baluno Mangrove Learning Center Ecotourism. AACL Bioflux 14 (4): 2525-2536.

FAO [Food and Agriculture Organization of the United Nations]. 2020. The State of World Fisheries and Aquaculture; Sustainability in Action. The Flagship Publication, Rome.

Fitzgerald SP, Lenihan HS, Wilson JR, Culver CS, Potoski M. 2019. Collaborative research reveals cryptic declines within the multispecies California rock crab fishery. Fish Res 220: 1-12. DOI: 10.1016/j.fishres.2019.105340.

Huda HM, Wijaya RA, Triyanti R, Sari YD, Zamroni A. 2021. The status and problems of using crab resources in Indonesia. J Marine Fish Soc-Econ Policy 11 (2): 119-126. DOI: 10.15578/jksekp.v11i2.9536. [Indonesian].

Indar MYN. 2008. Study of Conflict Over Fishing Areas in Maros District. DKPP Maros and CV. Marina Lestari, Makassar. [Indonesian].

Jamaluddin NA, Hussin SAS, Zahid Z, Kahiri SSM. 2019. Estimation of Maximum Sustainable Yield (MSY) for sustainable fish catch. J Phys Conf Ser 1366: 1-6. DOI: 10.1088/1742-6596/1366/1/012074.

Jimenez ÉA, Barboza RSL, Amaral MT, Frédou LF. 2019. Understanding changes to fish stock abundance and associated conflicts: Perceptions of small-scale fishers from the Amazon coast of Brazil. Ocean Coast Manag 104954: 1-12. DOI: 10.1016/j.ocecoaman.2019.1049.

Kavadas S, Santojanni A, Maida I, Martinelli M. 2014. Common methodological procedurs for analysis of VMS data, including web-based GIS applications related to the spatial extent and intensity of fishing effort deliverable Nr. 3.4. Policy Oriented Marine Environmental Research in The Southern European Seas (PERSEUS).

Kielmann K, Cataldo F, Seeley J. 2012. Introduction to Qualitative Research Methodology: A Training Manual. Write Arm, UK.

Maros District Fisheries Service. 2022. Annual Report of the Maros District Fisheries Service. Maros District Government. Maros.

Marpaung BO. 2016. Communication strategy planning of fisherman kampung Medan Belawan as a tourist destination. Proc-Soc Behav Sci 234: 344-352. DOI: 10.1016/j.sbspro.2016.10.251.

Massiseng ANA, Tuwo A, Fachry ME, Bahar A. 2020. A dynamic simulation of mangrove ecotourism management at the Lantebung of

Makassar City. IOP Conf Ser: Earth Environ Sci 584: 012039. DOI: 10.1088/1755-1315/584/1/012039.
Miah SM. 2015. Climatic and anthropogenic factors changing spawning pattern and production zone of Hilsa fishery in the Bay of Bengal. Weather Climate Extremes 7: 109-115. DOI: 10.1016/j.wace.2015.01.001.
Mishra SB. 2017. Handbook of Research Methodology; A Compendium for Scholars, Researchers. Educreation Publishing, New Delhi.
Monintja D, Yusfiandayani R. 2009. Utilization of Coastal Resources in the Field of Capture Fisheries. Institur Pertanian Bogor. Bogor. [Indonesian].
Murray GD, Ings D. 2015. Adaptation in a time of stress: A social-ecological perspective on changing fishing strategies in the Canadian snow crab fishery. Mar Policy 60: 280-286. DOI: 10.1016/j.marpol.2015.07.014.
Noija D, Martasuganda S, Murdiyanto B, Taurusman AA. 2014. The potential and level of utilization of demersal fish resources in the waters of Ambon Island, Maluku Province. J Fish Mar Technol 5 (1): 55-64. DOI: 10.24319/jtpk.5.55-64. [Indonesian].
Pan M. 2021. Maximum Econimic Yield and nonlinear catchability. N Am J Fish Manag 41: 1229-1245. DOI: 10.1002/nafm.10661.
Prestrelo L, Vianna EM. 2016. Identifying multiple-use conflicts prior to marine spatial planning: A case study of A multi-legislative estuary in Brazil. Mar Policy 67: 83-93. DOI: 10.1016/j.marpol.2016.02.001.
Prince J, Creech S, Madduppa H, Hordyk A. 2020. Length based assessment of spawning potential ratio in data-poor fisheries for blue swimming crab (*Portunus spp*.) in Sri Lanka and Indonesia: Implications for sustainable management. Reg Stud Mar Sci 36: 1-13. DOI: 10.1016/j.rsma.2020.101309.
Satria A. 2009. Fisherman's Political Ecology. LKiS, Yogyakarta. [Indonesian].
Siakwah P. 2018. Actors, networks, and globalised assemblages: Rethinking oil, the environment and conflict in Ghana. Energy Res Soc Sci 38: 68-76. DOI: 10.1016/j.erss.2018.01.021.
Silva MRO, Lopes PFM. 2015. Each fisherman is different: Taking the environmental perception of small-scale fishermen into account to manage marine protected areas. Mar Policy 51: 347-355. DOI: 10.1016/j.marpol.2014.09.01.
Sjostrom AJC, Ciannelli L, Conway F, Wakefield WW. 2021. Gathering local ecological knowledge to augment scientific and management understanding of a living coastal resource: The case of Oregon's nearshore groundfish trawl fishery. Mar Policy 131: 1-16. DOI: 10.1016/j.marpol.2021.104617.
Snyder H. 2019. Literature review as a research methodology: An overview and guidelines. J Bus Res 104: 333-339. DOI: 10.1016/j.jbusres.2019.07.039.
Stacey N, Gibson E, Loneragan NR, Warren C, Wiryawan B, Adhuri DS, Fitriana R. 2021. Developing sustainable small-scale fisheries livelihoods in Indonesia: Trends, enabling and constraining factors, and future opportunities. Mar Policy 132: 1-12. DOI: 10.1016/j.marpol.2021.104654.
Utami IN, Widiono S, Romdhon MM. 2022. Conflict among fishers: A case study of conflict in using fishing gears in Makumuko District, Bengkulu Province-Indonesia. Proceedings of the 2nd International Conference on Rural Socio-Economic Transformation: Agrarian, Ecology, Communication and Community Development Perspectives, RUSET 2021. Bogor, 14-15 September 2021.
Wang Z, Tang H, Xu L, Zhang J. 2022. A review on fishing gear in China: Selectivity and application. Aquac Fish 7 (4): 345-358. DOI: 10.1016/j.aaf.2022.02.006.
Warren C, Steenbergen D J. 2021. Fisheries decline, local livelihoods and conflicted governance: An Indonesian case. Ocean Coast Manag 202: 105498. DOI: 10.1016/j.ocecoaman.2020.105.
Yeon I, Song MY, Sohn MH, Hwang HJ. Im YJ, Kim DH, Zhang CI. 2011. An ecosystem-based assessment of the Korean blue crab trammel net fishery in the Yellow Sea and management implications. Fish Res 112 (3): 179-188. DOI: 10.1016/j.fishres.2011.08.002.