Systematic Review

Fisheries Research based on Experimental Fishing methods in the Coastal area of Rembang Regency, Central Java, Indonesia

ABSTRACT

Rembang Regency coastal area is one of the central fishing production in Central Java Province. Various types of fishing gear are used by fishermen for fishing operations and are developed independently. Much research has been conducted in this area related to capture fisheries. This study aims to analyze the research development that uses experimental fishing methods. This study uses a systematic literature review method based on Published or Perish application tools. The results showed that 9 (nine) types of fishing gear were the object of research in the coastal area of Rembang Regency in 2013-2022. Experimental fishing methods have been carried out on 5 (five) types of fishing gear, namely small bottom trawl (arad), folding box traps (bubu lipat), longline (pancing rawai), squid jigging (pancing cumi), and gillnet (jaring insang). Experimental fishing research has been conducted on small bottom trawls, including towing speed and mesh size modification. Folding box traps were studied with escape gap and fishing time variables. Hooks and lines were studied with fish-hook materials and various bait variables. Gill net was studied with webbing modified. The results of this study provide knowledge of the potential for experimental fishing research that can be applied in the future, especially to understand fishing activities in the coastal areas of Rembang regency.

Keywords: experimental, fish, fishing, methods

1. INTRODUCTION

The coastal area of Rembang Regency has many potential fisheries and marine resources. The fishery and marine resources potential include mangroves (Indarsih & Masruri, 2019; Sibero et al., 2020; Sutanto et al., 2022), coral reefs (Handayani & Warsono, 2017; Kurniawati et al., 2019; Putri et al., 2019; Abdillah et al., 2021), pelagic fish (Zamroni et al., 2020) and demersal fish (Saputro et al., 2014; Tarigan et al., 2015). Several types of Pelagic fish groups that are target fish for fishermen in Rembang include Tembang (Sardinella spp.) (Nafthalya, 2021), Layang (Decapterus sp.) (Triharyuni et al., 2016; Dwiyanti et al., 2023), Teri (Stolephorus sp.) (Khairushubhi et al., 2017; Prihantoko & Boesono, 2018), Kembung lelaki (Rastrelliger kanagurta) (Utami et al., 2014), Layur (Trichiurus lepturus) (Pribadi et al., 2015), Selar (Selaroides sp.) (Purwasih et al., 2021), Cumi-cumi (Loligo sp.) (Triharyuni & Puspasari, 2012; Prakarsa et al., 2014), and Rajungan (Portunus pelagicus) (Arios et al., 2013; Primadjati et al., 2014; Juliastuti et al., 2016; Principal et al., 2019). Meanwhile, the demersal fish groups that are target fish include Remang (Muraenasox talabon) (Pamuntjak

et al., 2017), Kurisi (Nemipterus sp.) (Finayani et al., 2020; Yuniar, 2020), Kuniran (Upeneus sp.) (Zamroni & Widiyastuti, 2020; Hanafi et al., 2017), Pari (Dasyatis sp.) (Amir et al., 2018), Swanggi (Priacanthus sp.) (Finayani et al., 2020), Shrimp (Penaeus sp.) (Umam et al., 2021), and Kepiting (Scylla spp.) (Pambudi et al., 2019). Superior fisheries commodity in Rembang Regency are Decapterus sp., Formio sp., Rastrelliger sp., Selaroides sp., Sardinella spp., Loligo sp., and Stolephorus sp. (Ameriyani, 2014).

The potential for abundant fishery resources has an impact on the development of fisheries businesses. Fishing businesses in the coastal areas of Rembang Regency have developed with the use of various types of fishing gear. Some variety of fishing gear include; Gill net (Juliastuti et al., 2016; Fitri et al., 2019), Folding box-shape trap (Arios et al., 2013; Fitri et al., 2017; Jayanto et al., 2018), Folding dome-shape trap (Boesono et al., 2022), Small bottom mini trawl (Ayowa et al., 2022; Umam et al., 2021), Purse seine (Chodrijah & Pralampita, 2010; Nugraha et al., 2014; Wijayanto & Kurohman, 2018; Farida et al., 2019), Boat seine (Al Bayyinah et al., 2014; Nusantara et al., 2014; Wijayanto et al., 2019), and Trammel net (Romadhani et al., 2016).

Fishing is an activity to obtain fish in waters that are not in a state of being cultivated by any means or methods, including activities that use ships to load, transport, store, cool, handle, process, or preserve them (MMFA regulation No. 45 of 2009). Fishing equipment is necessary for fishing operations, consisting of fishing vessels, fishing gear, and fishing aids (SNI 7277.1:2008). Fishing technology is required to optimize catch. The problem is that fisheries' technology development could not be done faster. Therefore, research based on experimental fishing methods needs to be conducted. The latest data and information regarding the development of existing experimental fishing methods are required. Research is an organized investigation. Therefore, it is very important to know and understand previous research that has been done. Thus, the quality of research will be improved and help accelerate the development of fisheries technology. According to Natsir (2003), research is conducted to change the conclusions that have been accepted or change the postulates with the new applications of the postulates. Therefore, research experiments need to be carried out carefully and critically. However, research efforts are often constrained by the basic questions "What will be studied?" and "What is the purpose of the research?". Through this article, researchers can find alternative solutions to conduct experimental-based research on fishing. The scope of this article is based on the administrative area, namely the Rembang Regency area, Central Java Province, Indonesia. The research question in this article is about experimental research on fishing that has been studied in the coastal regions of Rembang Regency. The next question is what capture fisheries and fishing gear topics have been widely studied in 2013 - 2022. This information will be useful to find out what types of fishing gear have been studied. This study aims to analyze research articles with location coverage in the coastal areas of Rembang Regency. The period that is the limitation of this study is 2013-2022.

2. METHODOLOGY

This study uses the Systematic Literature Review (SLR) method. The analysis database is limited to the period 2013-2022. Data search uses the Publish or Perish (PoP) application. The scope of data search is limited to the Google Scholar database. The stages of implementing this research include the data search, selection, and analysis.

2.1.1 Stage of data search

Data search was conducted using Publish or Perish (PoP) software. The keyword used is the location of the object study, namely "Rembang." The keyword is used only in one aspect

of the search, namely the title (Title of words). Data search is only carried out on the Google Scholar database. A data search was conducted for the period 2013-2022. Article searches are performed annually, not simultaneously. The search method in PoP is done by filling in keywords in the Title column. The results of searching for article data with PoP consist of two main pieces of information, namely citation metrics and results paper.

2.1.2 Stage of article data selection

The next stage in this research process is the data selection stage. Data selection is carried out in stages to obtain several articles according to the criteria set to achieve the objectives. The following are the stages of data selection carried out and the criteria used in the data articles obtained from PoP:

1. Stage 1: data year selection
   At this stage, data selection is carried out by creating two data categories: articles with year data availability (Available) and articles that do not have year data (Not Available). The selection results found 2934 articles with Available status and 179 with Not Available status. In the first stage, article data was produced to be processed in Stage 2, amounting to 2934 articles.
2. Stage 2: data cites selection
   At this stage, data selection is done by creating two data categories, na: articles with several citations ≥ 1 and articles with several citations 0. The selection process is based on article data from 2934 articles, which are the results of the Stage 1 selection. Stage 2 selection produced 1041 articles with citations ≥ 1 and 1893 with 0 citations. In Stage 2, article data was created to be processed in Stage 3, amounting to 1041 articles.
3. Stage 3: selection of relevant topics
   Data selection is done at this stage by creating two topic categories: articles on Fisheries and Marine topics (Relevance) and articles not on Fisheries and Marine topics (Not Relevance). The selection process is carried out based on the data from the selection results of Stage 2. The selection results show that 216 articles have relevant status and 825 have no relevance status. In Stage 3, article data was produced to be processed in Stage 4, totaling 216 articles.
4. Stage 4: selection of article type
   At this stage, data selection is done by creating two categories of data article types: Journal articles and Non-Journal articles. The Non-Journal category includes Books, Proceedings, and Repositories. The selection process is based on data from the selection results of Stage 3. The selection results show that 159 articles are journal articles, and 57 are Non-journal articles. In Stage 4, article data was produced to be processed in Stage 5, summing 159 articles.
5. Stage 5: Selection of duplicate articles
   At this stage, data selection is carried out by creating two categories: single articles and duplicate articles. The category of duplicate articles includes the same article but is detected as two-article data. The selection process is carried out based on the data from the selection results of Stage 4. The selection results show that 149 articles are single, and 10 articles are duplicate articles. In Stage 5, article data was produced to be processed in Stage 6, totaling 149 articles.
6. Stage 6: Fisheries topic selection
   Data selection is carried out by creating two categories: capture fisheries topics and Other Fisheries topics. The selection process is carried out based on the data from the selection results of Stage 5. The selection results show that 54 articles are Capture Fisheries topic articles, and 95 articles are Other Fisheries topics. In Stage 6, article data was produced to be processed in Stage 7, totaling 54 articles.
7. Stage 7: Fishing Gear sub-topic selection

At this stage, data selection is carried out by creating two categories: the subtopic of Fishing Gears and the subtopic of Others. The selection process is carried out based on the data from the selection results of Stage 6. The selection results show that 31 articles are articles with the subtopic of Fishing Gears, and 23 articles are subtopics of Others. In Stage 7, article data was generated for analysis of 31 articles.

2.1.3 Stage of data analysis

Data analysis was conducted on 31 articles resulting from the selection process. Furthermore, a descriptive analysis was conducted on the article data. The results of the analysis were then presented in the form of tables and graphs as needed, thus facilitating the distribution of information. In addition, this study also conducted a PRISMA analysis (Haddaway et al., 2022). Figure 1 presents the Prisma Diagram of the results of the data selection process carried out. Following the established criteria, 31 articles were found. A number of these articles are articles that are relevant to the criteria set to answer the research objectives.

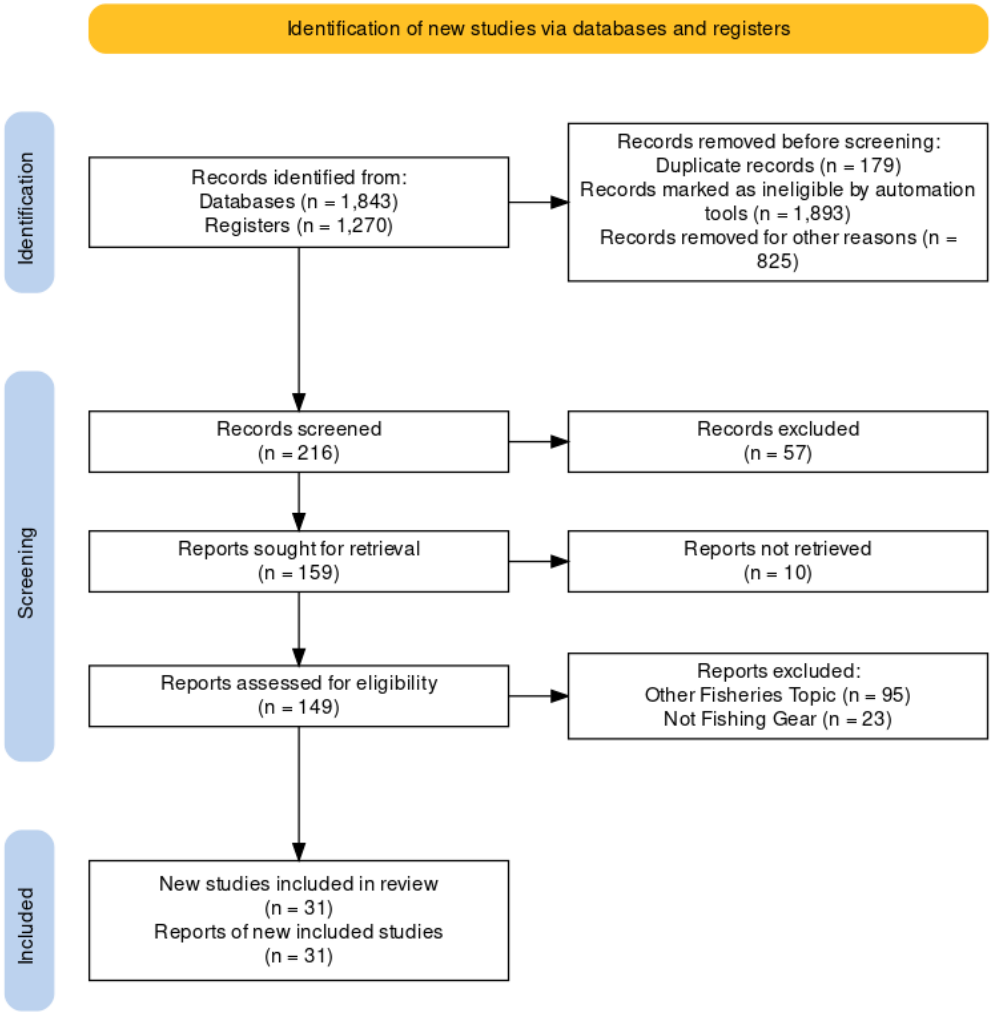


Fig. 1. Prisma Diagram

3. RESULTS AND DISCUSSION

3.1 Distribution of Articles, Citations and Authors

The search results using PoP found 3113 papers from 2013-2022. The number of articles found with PoP was between 181 and 406 papers per year (an average of 311 papers/year) during the period 2013-2022. The largest number of articles was found in 2021, 406 articles (13.04%). The lowest number of articles was found in 2013, 181 articles (5.81%). The number of articles found related to the topic of fishing gear varies each year. The highest number of articles relevant to the objectives of this study was found in 2017, which was eight articles (Fig. 2.A). In 2021, only 1 (one) article was found relevant to the objectives of this study. The article with the highest number of citations, with 13 citations (Fig. 2.B), was known to be written by Wijayanto et al. (2020) on the topic of fisheries bioeconomics on the use of boat seine and purse seine. The article with the second highest number of citations, with 12 citations, was occupied by the article by Sari et al. (2016) on the topic of marketing distribution of Portunus sp., and the third highest, with 11 citations, was occupied by Fitriyashari et al. (2014) on the topic of fishing vessel supplies.

Fisheries bioeconomics, fish marketing distribution, and fishing store supplies are part of the research topics of fisheries economics. Fisheries bioeconomics is the application of bioeconomic concepts in the field of fisheries. Fisheries bioeconomics is the use of economic concepts with the aim of optimizing the use of fisheries resources based on economic reviews (Wijayanto et al., 2007). According to Clucas (1997), fisheries marketing is a series of activities that include planning, organizing, implementing, and controlling the flow of goods and services related to the production, distribution, promotion, and sale of fishery products. Supplies are all goods needed to support the implementation of tasks. These goods can be movable or immovable (Dinita et al., 2015).

Meanwhile, fishing vessel supplies are needed to support fishing operations. These supplies include fuel, oil, ice, freshwater, salt, and food ingredients (Bagaskara et al., 2024). These supplies are needed by fishing vessels to provide fishermen or fishing vessel crews during fishing operations at sea (Fitriyashari et al., 2014).

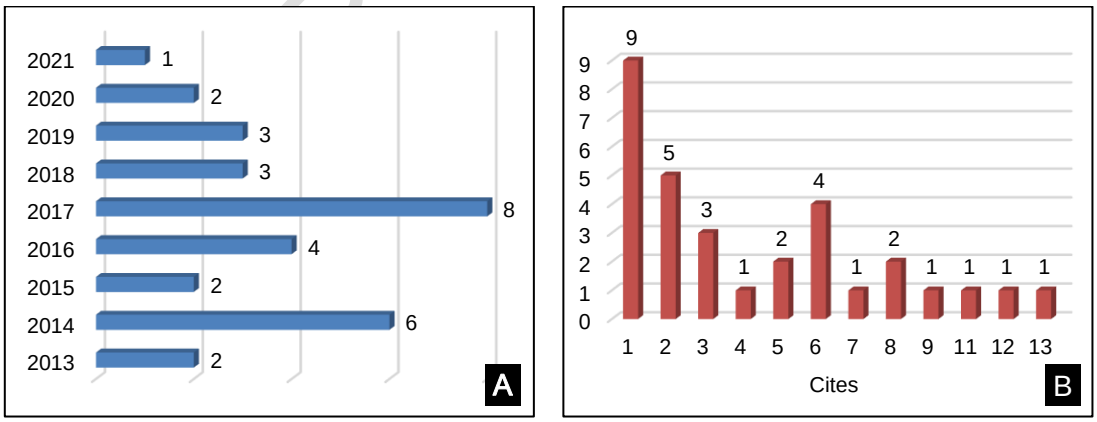


Fig. 2. (A) Number of Selected Articles by Year; (B) Articles Distribution based on Citations number

Articles written by multiple authors indicate collaborative work. Articles produced by multi-authors indicate multispectrum discussions. Collaboration has a positive influence on research impact. The more authors collaborate in compiling an article, the higher the number

of citations to the article (Rahmaida & Amelia, 2018). Collaborating authors will produce higher-quality articles (Rahayu & Tarwan, 2020). Figure 3.A shows that 3 (three) authors wrote 75.00% of the articles found, and only 3.13% were written by 5 (five) authors. Based on observations of selected articles, it shows that most articles are written by 3 (three) authors. As a result of further observations, most of the articles were written by authors from the same institution.

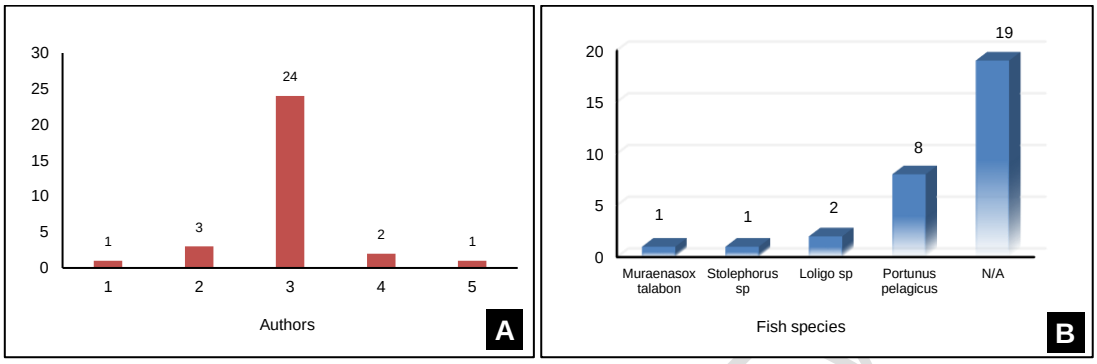


Fig. 3. (A) Articles Distribution based on Authors number; (B) Articles Distribution based on Fish species

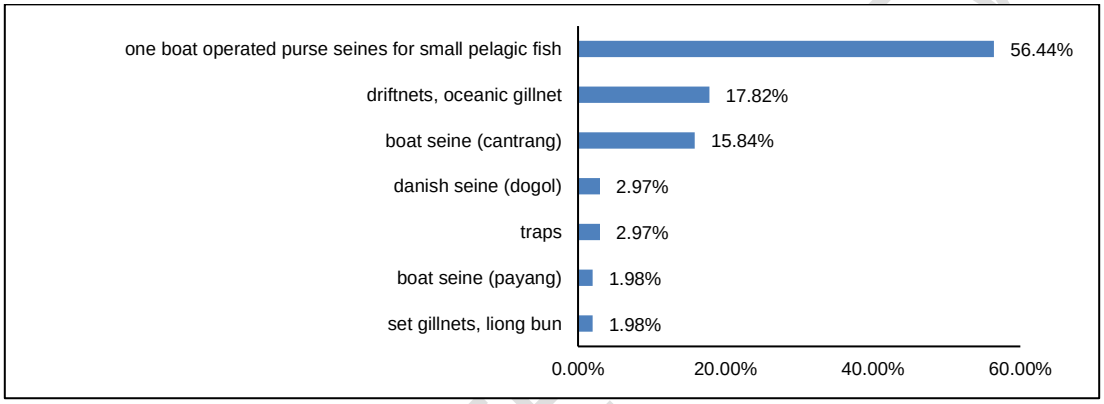
3.2 Types of Fish species Research Objects

Figure 3.B shows the types of fish that are the objects of study. It is known that 4 (four) fish species are the objects of research in the articles found, namely rajungan (Portunus pelagicus) (Arios et al., 2013; Juliastuti et al., 2016; Parahita et al., 2016; Sari et al., 2016; Ferdiansyah et al., 2017; Ummaiyah et al., 2017; Jayanto et al., 2018; Principal et al., 2019), cumi-cumi (Loligo sp) (Widiatmoko et al., 2015; Surachmat, 2018), ikan teri (Stolephorus sp) (Khairushubhi et al., 2017) and ikan remang (Muraenasox talabon) (Pamuntjak et al., 2017). During the period 2013-2022, Portunus pelagicus was the dominant type of fish as the object of research, namely 25.81% of articles discussing Portunus pelagicus. Loligo sp. was found in 6.45% of articles, and 3.23% discussed Stolephorus sp and Muraenasox talabon. As many as 61.29% of the articles found were known not to discuss specific fish species in their research (Not Available = N/A). These data show that research based on specific fish species in the coastal area of Rembang has a high potential to be carried out. Ameriyani (2014) revealed that there were 7 (seven) superior fish commodities in the Rembang regency. Based on the superior fishery commodities produced in Rembang, only Stolephorus sp and Loligo sp were the objects of research in scientific articles for the 2013-2022 period. Thus, there is an opportunity for research based on specific fish species, which are superior fish commodities in the coastal area of Rembang Regency. Some of these fish are Decapterus sp., Formio sp., Rastrelliger sp., Selaroides sp., and Sardinella sp.

The 2021 Marine and Fisheries Statistics of the Ministry of Marine and Fisheries Affairs (https://statistik.kkp.go.id) recorded 27 (twenty-seven) fish species landed in the coastal areas of Rembang regency. The types of fish species are black/white pomfret, squid, Long-jawed mackerel, mackerel scad, Sardinella fish, Yellow stripe shad, Spanish mackerel fish, mackerel tuna, beltfish, stingray, ponyfish, anchovy, shrimp, blue swimming crab, snapper fish, ariid catfish, barracuda, starry triggerfish, common dolphinfish, dusky sleeper, yellow tail fish, grouper fish, threadfin bream, giant trevally, priacanthus, and other fish. Based on 27 (twenty-seven) fish species, only 11.11% were the object of research, and 88.89% were not found in the article.

3.3 Types of Fishing gears Research Objects

The marine and fisheries statistics data 2021 from the Ministry of Marine and Fisheries Affairs (https://statistik.kkp.go.id) recorded 7 (seven) types of fishing gear operating in the coastal areas of Rembang regency. The groups of fishing gear types are One-boat-operated purse seines for small pelagic fish, Driftnets/oceanic gillnets, Boat seine (cantrang), Danish seine (dogol), Traps (folding traps), Set gillnets/liong bun, and Boat seine (payang). The number of fishing gear in the coastal areas of Rembang regency is 101 units (Satu Data KKP, 2021). One-boat-operated purse seines for small pelagic fish are the type of fishing gear predominantly used by fishermen in Rembang Regency, with a percentage reaching 56.44% (Satu Data KKP, 2021). The next type of fishing gear widely used is the driftnets (17.82%) and boat seine (15.84%). Figure 4 shows the composition of the number of types of fishing gear in Rembang regency.



Source: https://statistik.kkp.go.id (2023)

Fig. 4. Proportion of Fishing gear based on government statistical data

Based on the articles analyzed in 2013-2022, it is known that 9 (nine) types of fishing gear have been studied in Rembang Regency. The nine types of fishing gear are one boat operated purse seines for small pelagic fish (Fitriyashari et al., 2014; Nugraha et al., 2014; Mutmainnah et al., 2017; Wijayanto and Kurohman 2018; Farida et al., 2019; Wijayanto et al., 2020; Zamroni et al., 2020), boat seine (cantrang) (Sasmita et al., 2013; Al Bayyinah et al., 2014; Fitriyashari et al., 2014; Nusantara et al., 2014; Tarigan et al., 2015; Pahlefi and Hidayat 2017; Sari and Brata 2017; Sari et al., 2017; Wijayanto et al., 2019; Wijayanto et al., 2020), folding box-shape trap (Arios et al., 2013; Parahita et al., 2016; Ferdiansyah et al., 2017; Ummaiyah et al., 2017; Jayanto et al., 2018; Principal et al., 2019), gillnet (Juliastuti et al., 2016; Nazda et al., 2016; Parahita et al., 2016; Sari et al., 2016; Sari et al., 2017; Fitri et al., 2021), trammel net (Tarigan et al., 2015), arad (small bottom trawl) (Ayowa et al., 2014; Saputro et al., 2014; Widiatmoko et al., 2015), danish seine (dogol) (Khairushubhi et al., 2017), squid jigging (Surachmat, 2018), and longline (Pamuntjak et al., 2017).

The results of the article's identification show that there are two research patterns based on fishing gear. The research patterns are combined fishing gear (multi-gears) and single fishing gear (Fig. 5). The types of fishing gear studied in combination are PCPK and boat seine (cantrang) (Fitriyashari et al., 2014; Wijayanto et al., 2020). However, the number of research is only 2 (two) articles that discuss both types of fishing gear simultaneously. Other types of fishing gear that have been studied simultaneously include folding box-shape traps and gillnet (Parahita et al., 2016), gillnet and boat seine (cantrang) (Sari et al., 2017), and boat seine (cantrang) and trammel net (Tarigan et al., 2015). The types of fishing gear studied using single fishing gear are small bottom trawl (arad) (Ayowa et al., 2014; Saputro

et al., 2014; Widiatmoko et al., 2015), danish seine (dogol) (Khairushubhi et al., 2017), squid jigging (Surachmat, 2018) and longline (Pamuntjak et al., 2017).

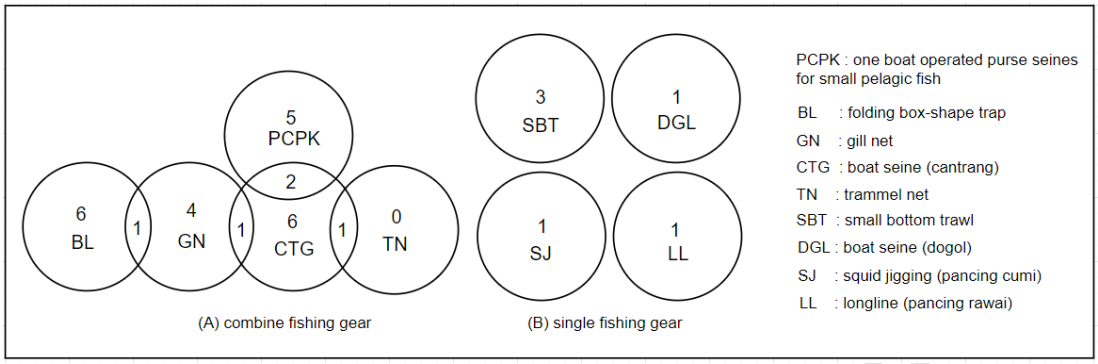


Fig. 5. Fishing gear research objects and number of article

From 2013 through 2022, the types of fishing gear widely studied were one-boat small pelagic purse seine, boat seine (cantrang), and traps (folding traps). The three types of fishing gear were discussed in 6 articles for each type of fishing gear. Boat seine (cantrang) is the type of fishing gear that was most widely discussed in the ten articles found, both combined and single. Figure 5 shows the results of the identification of research patterns based on the types of fishing gear that have been studied from 2013 to 2022 in the Rembang Regency. Based on the articles studied, it is known that the Trammel net type was not found to be studied as a single fishing gear.

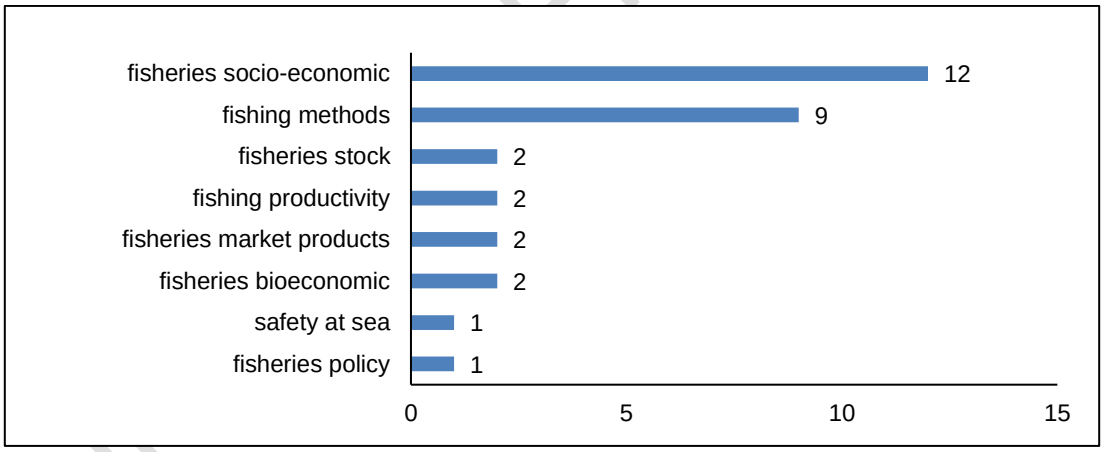


Fig. 6. Main Topics of Research Studies

3.4 Main Topics of Research Studies

Figure 6 presents the results of grouping articles based on the main research topic. The identification results show that there are 8 (eight) main topics. The main topic that is widely studied is the socio-economics of fisheries (Al Bayyinah et al., 2014; Fitriyashari et al., 2014; Nugraha et al., 2014; Juliastuti et al., 2016; Nazda et al., 2016; Parahita et al., 2016; Mutmainnah et al., 2017; Sari & Brata, 2017; Wijayanto & Kurohman, 2018; Farida et al., 2019; Principal et al., 2019; Wijayanto et al., 2019), while the main topic related to fishing methods (Ayowa et al., 2014; Nusantara et al., 2014; Widiatmoko et al., 2015; Ferdiansyah

et al., 2017; Pamuntjak et al., 2017; Sari et al., 2017; Ummaiyah et al., 2017; Jayanto et al., 2018; Surachmat, 2018) is in second place. The results of this identification indicate that fishing gear at the research location is widely reviewed from the perspective of the socio-economics of fisheries and fishing methods. Other seven topics are included in the category of research that has yet to be widely conducted. The potential main research topics to be conducted include fisheries stock (Saputro et al., 2014; Zamroni et al., 2020), fishing productivity (Arios et al., 2013; Fitri et al., 2021), fisheries market products (Sari et al., 2016; Khairushubhi et al., 2017), fisheries bioeconomic (Tarigan et al., 2015; Wijayanto et al., 2020), safety at sea (Sasmita et al., 2013), and fisheries policy (Pahlefi & Hidayat, 2017).

3.5 Experimental Fishing Research Studies

Table 1 presents the types of treatments carried out in experimental fishing research. Folding traps are a type of fishing gear widely studied using experimental fishing methods. An interesting thing about experimental research conducted on folding traps is that all of these studies examine escape gaps and do not use variations in the type of bait. The second highest type of fishing gear studied using experimental fishing methods is line fishing. There are two types of line fishing in the articles studied, namely longline and squid jigging. Both types of fishing gear are included in the hook and line category in the classification of fishing gear. The difference between the two is in terms of construction. The construction of a longline is a series of many fishing hooks, which are operated lengthwise in the seawater. The construction of squid-jigging is a single line, often called a hand line. Based on Table 1, it is known that the variables studied in the type of line fishing are the variables of the type of bait and the material of the fishing hook. The types of bait studied include sardinella sp., fresh ponyfish, and salted ponyfish. The materials for the fishing hooks studied are plastic and wood. Potential studies for line fishing research use other types of bait. Gill net and small bottom trawl are other types of fishing gear that are studied using experimental fishing methods. Small bottom trawls are studied using experimental fishing methods with different mesh sizes and towing speeds. Gill nets are studied using experimental fishing methods with bait treatment.

Small bottom trawl

Towing speed is one of the variables used to determine the ability of small bottom trawls in fishing operations. According to Triharyuni and Hargiyatno (2016), the variable of ship engine power affects fish catch. The power of the ship's engine is related to the ship's ability to reach fishing areas and pull nets (towing). Prisantoso et al. (2017) state that towing speed in small bottom trawls has significant effects on fish catches. To maintain the optimal position of the net mouth opening and otter board in small bottom trawl operations, the ship's speed during towing is 1.5-2.5 knots (Nababan et al., 2018). Widiatmoko et al. (2015) studied the ability of small bottom trawls in fishing operations and specifically their correlation with Loligo sp. Research by Widiatmoko et al. (2015) recommends operating small bottom trawls with a towing speed of 2-3 knots to produce Loligo sp with a catchable size. The minimum and maximum towing speed limits of small bottom trawls carried out by Nababan et al. (2018) and Widiatmoko et al. (2015) show differences, but these differences are not significant. The difference in towing speed between the two is only 0.5 knots. Small bottom trawls are a type of fishing gear that is prohibited from being operated in Indonesia because they are a type of fishing gear that is not environmentally friendly (Indrawasih & Wahyono, 2017; Pahlefi & Hidayat, 2017). However, small bottom trawls are still widely used by traditional fishermen and are a source of their livelihood. Therefore, the development of more friendly small bottom trawl innovations needs to be carried out through scientific research. Various modifications to small bottom trawl designs and fishing performance needed to be tested by quality scientific research. The research of Widiatmoko et al. (2015) provides insight into the performance of small bottom trawls in terms of towing speed and its

relationship to specific fish species. Other potential research opportunities that can be recommended are redesigning small bottom trawls and testing their fishing performance, both on a laboratory and field scale.

Table 1. Experimental Fishing Research Studies

No	Sources	Fishing gears	Object study	Experimental fishing
1	Widiatmoko et al. (2015)	Small bottom trawl (SBT/arad)	Loligo sp. (cumi-cumi)	1. Genuine SBT, Towing speed 2 knot 2. Genuine SBT, Towing speed 3 knot 3. Genuine SBT, Towing speed 4 knot 4. SBT Modification, Towing speed 2 knot 5. SBT Modification, Towing speed 3 knot 6. SBT Modification, Towing speed 4 knot
2	Ferdiansyah et al. (2017)	Folding box-shape trap (bubu lipat kotak); Folding dome-shape strap (bubu lipat kubah)	Portunus pelagicus (rajungan)	1. Folding box-shape trap without escape gap 2. Folding box-shape trap with escape gap 3. Folding dome-shape trap without escape gap 4. Folding dome-shape trap with escape gap
3	Pamuntjak et al. (2017)	Long line (pancing rawai)	Muraenasox talabon (remang)	1. Longline with sardinella sp. bait 2. Longline with fresh ponyfish bait 3. Longline with salted ponyfish bait
4	Ummaiyah et al. (2017)	Folding box-shape trap (bubu lipat)	Portunus pelagicus (rajungan)	1. Folding box-shape trap without escape gap 2. Folding box-shape trap with one escape gap 3. Folding box-shape trap with two escape gap
5	Jayanto et al. (2018)	Folding box-shape trap (bubu lipat)	Portunus pelagicus (rajungan)	1. Folding box-shape trap two funnel, Crepuscular time 2. Folding box-shape trap two funnel, Nocturnal time 3. Folding box-shape trap four funnel, Crepuscular time 4. Folding box-shape trap four funnel, Nocturnal time
6	Surachmat (2018)	Squid jigging (pancing cumi-cumi)	Loligo sp. (cumi-cumi)	1. Jig body plastic with Clupea sp. bait 2. Jig body wood with Clupea sp. bait 3. Jig body plastic without bait 4. Jig body wood without bait
7	Fitri et al. (2021)	Gill net	Total catch	1. Gill net monofilament 2. Gill net mono-multifilament

Hooks and lines

Scientific articles discussing experimental fishing methods for hooks and lines are Pamuntjak et al. (2017) and Surachmat (2018). Pamuntjak et al. (2017) conducted experimental fishing using Longline, and Surachmat (2018) used squid jigging. Both included the bait variable as an intervention factor for their research. The difference between the two is the variable type of material, the jig body, as an experimental intervention factor. In addition, the target fish that were the objects of their research were also different. Pamuntjak et al. (2017) focused on the target fish, namely the Remang fish, while Surachmat (2018) focused on Loligo sp. Longline and Squid jigging are types of fishing gear included in the Hook and Line group in the classification of fishing gear (He et al., 2021). Longline is operated by stretching it horizontally in the water, while squid jigging is operated in the same way as operating a handline. Research by Pamuntjak et al. (2017) provided knowledge that although Sardinella sp bait on Longline resulted in higher Remang fish, the various types of bait used in their research did not significantly affect the Remang fish. Pamuntjak et al. (2017) and Surachmat (2018) studies show the potential for further research that can be conducted using other types of bait to catch fish targets effectively.

Fish target behavior needs to be a determining factor in the various bait before the experiment is carried out. Understanding the feeding preferences and dominant sensory systems of target fish needs to be an important factor in determining the type of bait to be tested. The bait to be tested needs to be adjusted to the feeding preferences and dominant sensory systems of the target fish. Longline is a type of fishing gear that is installed passively in waters, so the type of bait used is an important factor in determining the success

of catching target fish. Surachmat (2018) states that the use of plastic fish hook jig bodies with bait produces better Loligo sp than other experimental designs applied in his research. The use of plastic fishing hook jig bodies with bait is recommended by Surachmat (2018). However, in his research, only one type of bait was used, namely Juwi fish bait (Clupea sp.). Other fishing experiments have the potential to be carried out by providing interventions in the form of varied bait and adjusting them to the eating preferences and dominant sensory systems of the target fish. According to Rahmawati (2021), the color of squid jigging and the duration of the squid jigging operation affect the number of fish caught. The type of bait, the color of squid jigging, and the duration of operation are some of the intervention factors that can be used in fishing experiments with squid jigging.

Traps

The Folding box-shape trap and Portunus pelagicus are an inseparable pair. Various studies proved that Portunus pelagicus is the main target fish of folding box-shape traps (Ernawati et al., 2014; Ningrum et al., 2015; Susanto et al., 2023). In this study, three articles were found discussing experimental fishing using folding box-shape traps, namely research conducted by Ferdiansyah et al. (2017), Ummaiyah et al. (2017), and Jayanto et al. (2018). Ferdiansyah et al. (2017) conducted an experiment using the escape gap as an intervention factor. Ummaiyah et al. (2017) also experimented with using escape gaps as an intervention factor but with a various number of escape gaps. Meanwhile, Jayanto et al. (2018) provided intervention in the form of a different number of funnels and different operating times in their experiment. Research by Ferdiansyah et al. (2017) showed that a folding dome-shaped trap with an escape gap caught Portunus pelagicus with an effectiveness rate of 42.85%. Ummaiyah et al. (2017) stated that based on the proportion of target fish to bycatch, the folding box trap can be declared environmentally friendly because the catch of Portunus pelagicus exceeds 60% of the total catch. However, when viewed from the aspect of the size of crabs that are suitable for catch, the treatments tested still produced crabs that are suitable for catch below 60%. Jayanto et al. (2018) research provides information that folding box-shape traps with four funnels have a better level of effectiveness compared to the use of 2 funnels, and the best time to catch crabs is between noon and evening (Crespular). Research conducted by Ferdiansyah et al. (2017), Ummaiyah et al. (2017), and Jayanto et al. (2018) provide different intervention variables. However, there are similarities in the orientation of the research objectives, namely for the effectiveness of environmentally friendly fishing. Another opportunity for experimental fishing research is to combine intervention variables that have been carried out by Ferdiansyah et al. (2017), Ummaiyah et al. (2017), and Jayanto et al. (2018).

Gillnet

The next experimental fishing is based on gillnet fishing gear, conducted by Fitri et al. (2021). Fitri et al. (2021) experimented with modified gillnets and compared them with local fishermen's gillnets. The results of Fitri et al. (2021) research showed that the productivity of mono-multifilament gillnets was higher than the monofilament gillnets tested. Fitri et al. (2021) research did not target a specific fish but was oriented toward the total catch. Fitri et al. (2021) research has not provided interventions for other variables, so opportunities for further research are still open to be carried out. Several variables that can be intervention factors in experimental fishing with gillnets include operating time (Minggo, 2022), level of selectivity (Rengi et al., 2021), technical specifications and construction (Prihantoko et al., 2023), density and size structure of fish (Olin et al., 2009), and financial feasibility of the fishing business (Zain et al., 2016).

4. CONCLUSION

The results of the study showed that 9 (nine) types of fishing gear were the objects of research in the coastal area of Rembang Regency in 2013-2022, namely Small pelagic purse seine, Boat seine (cantrang), Folding box traps (bubu lipat), Gillnet, Trammel net, Small bottom trawl (arad), Boat seine (dogol), Squid jigging (pancing cumi), and Longline (pancing rawai). The research pattern based on fishing gear consists of a combination of fishing gear (combined fishing gear or multi gears) and one type of fishing gear (single fishing gear). The types of fishing gear studied in combination are Small pelagic purse seine and Cantrang, Folding box trap and Gillnet, Gillnet and Cantrang, and Cantrang and Trammel net. The types of fishing gear studied in single fishing gear are Small bottom trawl, Dogol, Squid jigging, and Longline. The results of grouping articles based on the main topic of the study show that there are 8 (eight) main topics, namely Fisheries policy, Safety at sea, Fisheries bioeconomics, Fisheries market product, Fishing productivity, Fisheries stocks, Fishing methods, and Fisheries socio-economics. Experimental fishing method research has been conducted on 5 (five) types of fishing gear: Small bottom trawl, Folding box traps, Longline, Squid jigging, and Gillnet. The experimental fishing that has been conducted consists of mesh size and pulling speed on small bottom trawl, escape gap and operating time on folding box trap, fish-hook material and bait on line fishing, and material modification on Gillnet.

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