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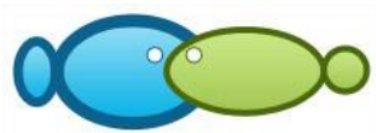
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Flow trade pattern of blast fishing raw materials and the occurrence of destructive fishing in the Makassar City waters, South Sulawesi, Indonesia

Fadly Fadly, Muhammad Kasnir, Asbar Asbar, Ihsan Ihsan

Fisheries Science, School of Postgraduate, Indonesia Muslim University, Makassar, Indonesia. Corresponding author: F. Fadly, fadly91@gmail.com

Abstract. The coastal waters of Makassar City have abundant fishing resources, but their utilization is sometimes done in ways that are not environmentally friendly, like blast fishing. The fishermen in Makassar City waters still do that forbidden activity because the raw material still exists. This study aims to determine the pattern of raw materials flow trade and to identify cases of destructive fishing activities in Makassar City, South Sulawesi, Indonesia. The research was taking place in the eleven islands of Makassar City. The data used in this study included primary data and secondary data. Respondents involved in this study were representatives of the population studied. Data analysis was done through analog models, using system features such as flow charts and network graphs. The raw material for blast fishing is the fertilizer produced in Malaysia and was initially intended for agriculture when shipped to Indonesia. Because now it is forbidden by Indonesian law, this fertilizer is sent illegally to Indonesia via Batam, Pangkep, and Selayar. From Pangkep, it moves to the islands of Makassar City until it reaches the fishermen's boss (Punggawa). Destructive fishing activities especially blast fishing, still happen in Makassar City waters. The location was around Lanjukang and Langkai islands, but only in the peak of the wet season (December-January) or when the fishermen cannot go to their fishing ground due to bad weather.

Key Words: blast fishing, destructive fishing, distribution map, Makassar waters, trade pattern.

Introduction. Indonesia is one of the biggest archipelago countries in the world, with a total of 3.25 million km² of ocean and 2.55 million km² in the Exclusive Economic Zone. With that vast sea area, Indonesia was awarding many potential marine resources. This makes the Indonesian people dependent on these marine resources, especially those on coasts and islands. Facts show that around 60% of the 140 million Indonesians live and depend on coastal areas for their livelihood (Rudiarto et al 2018; Nopiana et al 2021). Unfortunately, some people explore marine resources with unsustainable methods. These methods cause damage and habitat degradation for fish and kills numerous species still in the developing stage. In the future, these activities can affect the number of fish caught in the sea. Reports on the poor condition of Indonesia's coral reefs in 2018 showed that 6.50% of coral reefs are in excellent condition, 22.96% in good condition, and 36.18% are heavily damaged (Hadi et al 2018).

One of the causes of the damage is the use of blast fishing and anesthetic in exploiting fishery resources. Indonesian Law Number 45 of 2009 on the amendment of Law Number 31 of 2004 concerning Fisheries in Article 8, paragraph 1 reads: "Everyone is prohibited from catching fish and/or cultivating fish using chemicals, biological materials, explosives, tools and or methods, and or buildings that can harm and/or endanger the sustainability of fish resources and/or the environment in the fisheries management area of the Republic of Indonesia."

Destructive fishing activities (blast and anesthetic) in catching fish or utilizing fisheries resources infringe Indonesian law. In the sea, destructive fishing activities can be practiced with several methods such as blast, anesthetic, detonator, and using nets of small sizes (Saila et al 1993; Munyi 2009). The popular gear in Makassar waters for fishermen doing destructive fishing is blast and anesthetic fishing using cyanide and

potassium, which can cause massive damage to marine biota and coral reefs. For fishermen, using bombs in fishing is a method that is not only easy to do and without a lot of human resources but also does not require much money. However, catching fish using bombs and anesthetic is very dangerous because it can not only take the lives of the fishermen themselves but can also destroy all types of fish in the fishing area. Those activities can endanger fish development, destroy coral reefs as their habitat, and reduce the overall stock of fish resources (Nyompa et al 2021).

Destructive fishing causes extensive damage to coral reefs. Damaged coral reefs cause fish to lose their habitat and make it difficult for fishermen to catch fish. On the other hand, restoring damaged coral reefs takes a very long time. This condition becomes a continuous misery for fishermen and other fisheries stakeholders. The perpetrators of destructive fishing aim to get huge profits instantly, but this action results in a scarcity of fish which ultimately harms them (Munyi 2009; Zaelany 2019).

Makassar City consists of 10 (ten) islands that have abundant marine resources, but some fishermen catch the fish using destructive methods. This activity is commonly found in Kodingareng, Barrang Caddi, and Barrang Lompo islands (DFW & COREMAP 2003). The main problem is destructive fishing, including the availability and ease of obtaining raw materials for blast fishing, which is still rampant. To overcome or at least to reduce these destructive fishing activities, we need to know the flow trade of destructive fishing materials. So we can arrange a strategy or policy to overcome the destructive fishing problems in Makassar city waters. This study aims to determine the pattern of trade flows for raw materials and cases of destructive fishing activities in the waters of Makassar City, South Sulawesi, Indonesia.

Material and Method

Description of the study sites. The research took place from April to July 2022 in the ten islands of Makassar City, South Sulawesi, Indonesia. The study location map is presented in Figure 1.

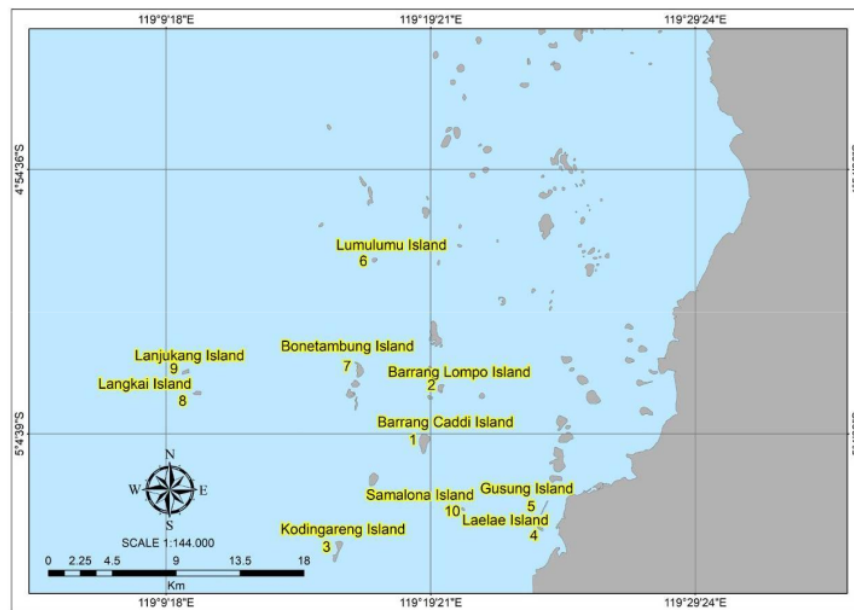


Figure 1. The research locations in the Makassar City waters area.

Data collection. This study used a survey method in which we collected data and information using a questionnaire as a data collection instrument. The data sources

consisted of two types, namely: primary data was obtained from direct observation and in-depth interviews with respondents, using questionnaire instruments and conducting interviews with the respondent and key informant; the secondary data was obtained from documents/literature/papers from several agencies related to this research, such as the work unit of Supervision of the Directorate General of PDSKP of the Ministry of Marine Affairs and Fisheries, the Office of Marine and Fisheries of South Sulawesi Province, Branch of the Marine Service of South Sulawesi Province, Makassar City Fisheries and Agriculture Service, Water, and Air Police (Polairud) South Sulawesi Police. We also visited some fishermen who had been imprisoned for destructive fishing. A questionnaire list was used in the data collection process. The authors employed observation, interviews, and documentation-gathering procedures to collect the data required for this study to improve, develop, and add information to the data processed and used as research findings.

Data analysis. The steps of the data analysis technique consisted of: 1) coding; 2) categorization; 3) synthesis, and 4) conceptualization. The data were descriptively analyzed using schematic diagrams, flow charts, and network graphs. The locations of destructive fishing activities were mapped using a geographic information system (GIS).

Results. We interviewed 100 fishermen as respondents from 10 islands of Makassar City waters (Table 1). Among the respondents, we also had a crucial informant on every island. They gave us the information about the practice of destructive fishing in the Makassar City waters. Also, they obtained valuable information about the flow trade of destructive fishing (blast and anesthetic) material, including where they can get the material and the specific location for the blast fishing.

Table 1

Location and amount of fishermen respondents

<i>Island origin</i>	<i>Amount</i>
Barrang Caddi Island	15
Barrang Lompo Island	16
Kodingareng Island	11
Lae-Lae Island	6
Gusung Island	3
Lumu-Lumu Island	13
Bonetambung Island	10
Langkai Island	14
Lanjukang Island	9
Samalona Island	3
Directorate General of PDSKP of the Ministry of Marine Affairs and Fisheries	2
Officer of Marine and Fisheries of South Sulawesi Province	2
Makassar City Fisheries and Agriculture Service	2
Water and Air Police (Polairud) South Sulawesi	2
Local public figure	4

The pattern of flow trade of the destructive fishing raw materials in Makassar City. The interviews with fishermen and former perpetrators showed that the main ingredient of blast fishing activities was fertilizer with high ammonium sulfate content, which the fisherman commonly called "*Pupuk Matahari*". For now, this fertilizer is difficult to obtain on the market. So, fishermen switched to using fertilizers with other brands despite the less explosive power than "*Pupuk Matahari*". The fisherman is commonly called "*Pupuk Cantik*". The names "*Pupuk Matahari*" and "*Pupuk Cantik*" came from the fertilizer brand that they use as blast fishing material. The fishermen and former destructive fishing actors also said that the raw materials for destructive fishing used for blast fishing were obtained illegally and came from Malaysia and entered Indonesia illegally - the entry route from Johor and Kinabalu. The material enters Makassar waters

from two main routes, Selayar Island and Pangkep district. The flow of the blast fishing materials to reach local fishermen in Makassar can be seen in Figure 2.



Figure 2. Estimated material flow scheme for blast fishing in Makassar city waters.

The fishermen in Makassar City waters commonly use ammonia (urea) fertilizer mixed with explosives, diesel fuel, and black powder to create a blast fishing. Generally, there are two types of blast fishing. The first one comes from urea fertilizer mixed with diesel fuel, then dried and put in a bottle, then given a detonator as a burnt wick. The second one is a bomb made of gunpowder. According to Onthoni et al (2010) this type of bomb is made from an ex-war bomb which the fishermen usually found it when they dive with an air compressor. They take the gunpowder and assemble it into a fish bomb. But according to fishermen, the familiar blast fishing type in Makassar waters is that made from fertilizer because it is cheaper than the gunpowder.

The destructive fishing activity, especially blasts fishing, still exists today in Makassar waters. For example, eight fishermen were caught in several areas in Makassar by the Makassar Waters and Air Police (Polairud) (Fajar 2021). They were caught due to smuggling raw material blast fishing materials like ammonium nitrate and detonator from Malaysia to Kalimantan. They then sold it to the local fishermen around Makassar waters. In another case, a blast fishing assembler from Madura is caught by the Indonesia Water and Air Police (Polairud) and admits that the blast fishing and the detonator are an order from a Makassar fisherman (Faizal 2020). If we see this case, it can be assumed that the material of blast fishing probably comes from Bali or Batam. According to an interview with the local fishermen, the blast fishing material probably comes from Selayar or Pangkep.

This pathway is nearly the same as in several studies that had been conducted before. The movement is tidy, unpredictable, and undetected by law enforcement. It is probably because the dealers (who usually come from outside Makassar) have a good partnership with the fishermen's boss (*Punggawa*) and local fishermen (Nurdin 2010; Asri et al 2019; Zaelany 2019). This is probably the main problem why law enforcement had a hard time overcoming this situation. Even when caught, they remained silent and did not point to the actual person or organization behind this blast fishing material trade.

From the explanation above, we can figure out that destructive fishing practices still exist in Makassar. Many factors that made this forbidden activity possible still exist. Besides the availability of raw materials, their economic needs and the demand for live fish are the main factors in destructive fishing (Prasetyamartati et al 2006; Onthoni et al 2010; Zaelany 2019). According to our interview, many fishermen in Makassar waters understand that if they catch the fish using destructive methods (blast and anaesthetic) and get caught by the law enforcer, they will get law consequences referring to Indonesian Law Number 45 2009. Even though they know the consequences, it does not make them deterrents because of the economic factor. They do not care about the ecological and the law sanction as long as their needs are fulfilled (Puspitasari 2019).

Destructive fishing locations in the Makassar City waters. According to the interviews with the local fishermen and former blast fishing actors, they know their fishing ground is far from their home. Are they doing destructive fishing in their location? They did not answer clearly. When we asked them if destructive fishing still happens in Makassar waters, they all said it still happens, especially around Langkai and Lanjukang islands (Figure 3).

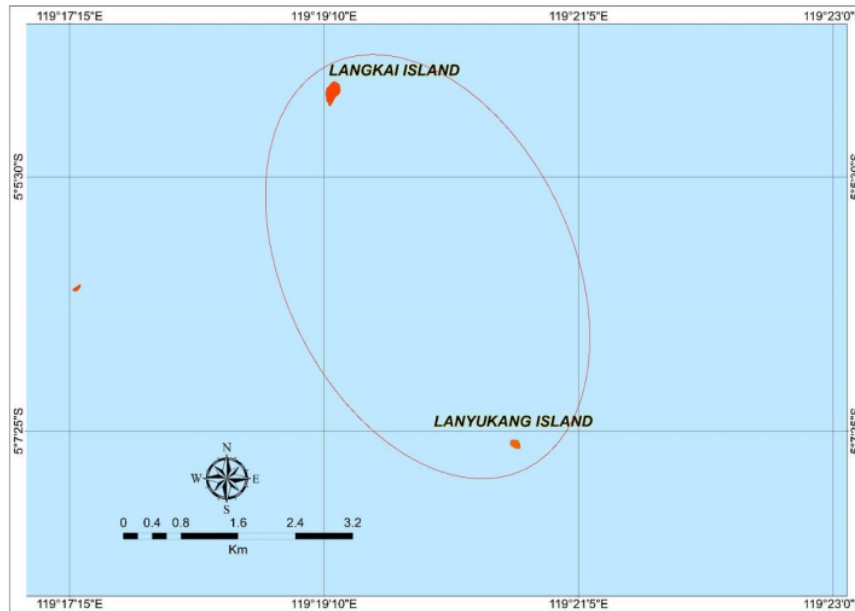


Figure 3. Estimated locations of destructive fishing in Makassar City waters.

According to the statement from the local fishermen and former blast fishing actors, destructive fishing locations are the same as those described by studies in 2003 which is Langkai and Lanjukang islands (DFW & COREMAP 2003). As for these locations, fishermen typically only visit them during the peak of the wet season (December-January), especially when the weather is unfavorable and cannot catch fish in their usual locations. Destructive fishing has already existed for so long in Makassar city waters and leaves damage traces in the Makassar waters ecosystem. The most prominent and visible damage is the coral reef ecosystem. According to traces, it can be found along the waters of islands in Makassar City, such as Barrang Lompo (Mosriula et al 2018), Kodingareng Island, Barang Caddi Island, and Samalona Island (Arifin & Kepel 2013).

Destructive fishing practices can have a significant impact on the marine ecosystem. They can lead to the depletion of fish populations, affecting the livelihoods of people who depend on fishing for their income. The number of findings and handling of destructive fishing cases in Indonesia in 2013-2019 was 653 (six hundred and fifty-three) cases in various water areas in Indonesia. The highest number of cases in the waters of South Sulawesi was 470 (four hundred and seventy) cases of using explosives and toxic materials. Furthermore, the handling of destructive fishing cases in Makassar City in 2018-2020 was 4 cases (Ditjen PSDKP 2022). To overcome this, it needs cooperation among all fisheries stakeholders, including the government and all fishermen in coastal and islands. The government must make firm policies as the primary leader in regulation and supervision. Conversely, fishermen must change their mindset to avoid destructive fishing again. It is all for the sustainability of fishery resources and to increase the welfare of fishermen and the community among them.

Those cases above indicate that destructive fishing activity, specifically blast fishing, still happens inside Makassar City waters or outside that area. It is probably done

by fishermen that have not been caught by law enforcement, already caught but been deterred, or new generation of fishermen fully grasp how to operate blast fishing because they are imitating the older generation. Whatever it is, destructive fishing needs to be stopped because it causes massive damage to the ecosystem. Besides the decreasing amount of fish they can catch due to the damaged ecosystem, fishermen also have to find new fishing grounds. Finding new fishing grounds will impact their sales profits as they must spend additional operational costs searching and operating in those new fishing grounds.

A particular behaviour from Lanyukang and Langkai islands people can be a good example. The local people in those two islands already consider that they need to do something for the sea so they can catch fish continuously. Recent news says that people in those two islands, with help from several non-government organizations, have initiated an open-closed system alongside 200 hectares near the island (Wahyu 2022). They expected that this system could give a recovery time for the ecosystem even though the result of this system needs to be studied further because it has not lasted long yet.

Conclusions. The pattern of trade flow of blast fishing raw materials through the black market originates from Malaysia. Buyers from Indonesia conduct transactions through the black market, and the raw materials for blast fishing are sent to Indonesia illegally through Batam, Bali, and Kalimantan to enter Pangkep and Selayar. From Pangkep, these materials can enter Makassar City waters. Destructive fishing activities, especially in Makassar City waters, still exist around Lanjukang and Langkai islands. However, that only happens in the peak of the wet season when the fishermen can't get into their usual fishing ground, usually in December-January. It needs public awareness and cooperation with the government to overcome destructive fishing activity. The open-closed system initiated by Lanjukang and Langkai islands people can be an excellent example to be developed and applied to other Makassar City islands.

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Conflict of interest. The authors declare that there is no conflict of interest.

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Authors:

Fadly Fadly, Fisheries Science, School Of Postgraduate, Indonesia Muslim University, Urip Sumoharjo Street No. 225, Panakukang, Makassar, Indonesia, e-mail: fadly91@gmail.com

Muhammad Kasnir, Fisheries Science, School Of Postgraduate, Indonesia Muslim University, Urip Sumoharjo Street No. 225, Panakukang, Makassar, Indonesia, e-mail: muh_kasnir@yahoo.co.id

Asbar Asbar, Fisheries Science, School Of Postgraduate, Indonesia Muslim University, Urip Sumoharjo Street No. 225, Panakukang, Makassar, Indonesia, e-mail: asbar_umi1964@yahoo.com

Ihsan Ihsan, Fisheries Science, School Of Postgraduate, Indonesia Muslim University, Urip Sumoharjo Street No. 225, Panakukang, Makassar, Indonesia, e-mail: ihsan.ihsan@umi.ac.id

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