

IMPACT OF FISHING GEARS ON CATCH COMPOSITION AND VOLUME OF CATCH BY SPECIES IN GILI SULAT-GILI LAWANG, INDONESIA

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Abstract: This study aims to analyse the impact of different fishing gear on the catch composition and volume of catch by species in Gili Sulat–Gili Lawang, Indonesia. Primary data obtained through face-to-face interviews which was conducted in four villages (i.e., Sugian, Dadap, Belanting, and Labuhan Pandan village) around Gili Sulat-Gili Lawang was used in this study. Data was collected from 85 respondents, which was divided by proportion technique and a descriptive analysis was followed to analyse the data. The results showed that, 29 species of fish were recorded in the catches. The handline showed the highest catch composition (21 species), followed by longline (19 species), gillnet (18 species), cast net (13 species), speargun (9 species), fishing rod and trolling line (7 species each), and scoop net (1 species). The heaviest fish catch was achieved with a longline (3,785.25 kg), followed by gillnet (3,272 kg), handline (2,958 kg), cast net (2,462 kg), trolling line (773 kg), spear gun (237.50 kg), fishing rod (71 kg), and scoop nets (45 kg).

Keywords: Catch composition, relative abundance, fishing gear, catch volume, fisherman.

Introduction

Gili Sulat-Gili Lawang is among the regions in Indonesia with abundant marine resources and the many of the people in the area work as fishermen. They use different types of fishing gear to catch fish. According to Damayanti *et al.* (2022), most of the fishermen in this area use hand lines, gill nets, spear guns, and lift nets. In general, differences in fishing gear will result in differences in catch composition and catch volume by species. As highlighted by Rubel *et al.* (2014), catch composition is the variety of fish that fishermen catch, and it is mainly influenced by the type of fishing gear used. As evidence, previous studies have found that catch composition varies between different types of gillnets (Cerbule *et al.*, 2022), type of nets (Sarker *et al.*, 2008), or between types of fishing gears (Rubel *et al.*, 2014). For example, hand line predominantly catches trevally, cakefish, grouper, squid, and mackerel (Shadiqin *et al.*, 2018). Meanwhile, gill nets predominantly catch, bullet tuna (*Auxis rochei*), blackmouth catshark (*Galeus melastomus*), blue whiting (*Micromesistius poutassou*), and small-spotted catshark (*Scyliorhinus canicula*) (Santos *et al.*, 2002).

More interestingly, Santos *et al.* (2002) pointed out that there is a difference in catch composition between gillnets and longlines, where gillnets can catch more types of species than the longline. However, the longline can catch more commercially valuable fish species than the gillnet. The different catch compositions of different fishing gear are mostly due to different operating styles and the way each fishing gear catches fish. For instance, a bottom gill net (i.e., a passive fishing gear) that is placed for a set amount of time on the seafloor and is used to catch fish that swim through it (Matrutty *et al.*, 2023). In other words, a gill net can catch any fish that swims into it. Meanwhile, a longline is a single mainline of monofilament nylon with baited hooks that is buoyed in a horizontal position and often anchored (Samoilys *et al.*, 2011) and targets sharks and tuna (Bromhead *et al.*, 2012). Handlines are a kind of selective fishing gear and there is a waiting period involved in the capture process (Haris *et al.*, 2023).

Despite prior evidence, some literature has shown that there were differences in catch

volumes by species with different fishing gear. As revealed by previous studies, the volume of catch by species is different between gillnet, longline, and beach seine (Munubi & Nyakibinda, 2020), trap, gillnet, beach seine, handline, and speargun (McClanahan & Mangi, 2004), and lift nets, gill nets, hooks, and hand lines (Ahmed & Hambrey, 2005). Based on the above situation, this study aims to examine the effect of the different fishing gear on catch composition and catch volume by species in Gili Sulat-Gili Lawang, Indonesia.

Materials and Methods

This investigation was completed in about four months (i.e., June to September 2023) in four villages around Gili Sulat-Gili Lawang, Indonesia namely Sugian (8°21'01"S 116°41'18"E), Dadap (8°21'21"S 116°42'59"E), Belanting (8°18'58"S 116°35'48"E), and Labuhan Pandan (8°24'42"S 116°40'00"E) (Figure 1). Gili Sulat and Gili Lawang are two small islands that are included in the Sambelia village area, along with East Lombok and West Nusa Tenggara, Indonesia. These islands

are located in the east of the northern part of Lombok island bordering the sea with the Alas Strait, which separates Lombok island from Sumbawa island.

The data for this study was obtained from primary sources through face-to-face interviews and field observation. Face-to-face interviews were chosen as a method to collect the data because the interviewer can explain the question in a more comprehensive manner so that the respondent can answer clearly (Schröder, 2016). To prepare the questionnaire, this study adopted the questionnaires from Gravestock *et al.* (2008), Rahim *et al.* (2018), Nursyazwin and Zein (2019), and Sukono *et al.* (2021).

The Slovin formula was used to determine the study's sample size (n). Due to the total population size (N) of fishermen in four villages around Gili Sulat-Gili Lawang being 426, using a 10% margin of error, the respondents of this research were 85 fishermen. The number of fishermen was obtained from statistical data of the community based on jobs on each village website (Sugian village government, 2023; Dadap village government, 2023; Belanting

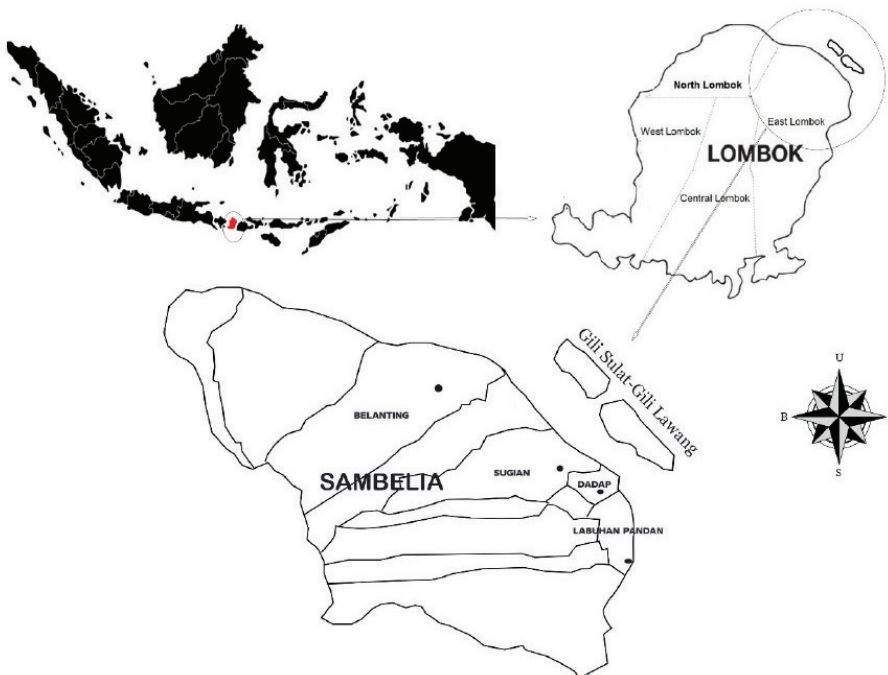


Figure 1: Map showing study area in the Gili Sulat-Gili Lawang

village government, 2023) and the Labuan Pandan fisherman group profile (Indonesia Ministry of Marine Affairs and Fisheries, 2020). The respondents were divided by proportion for each village, namely Sugian (22), Belanting (5), Dadap (15), and Labuan Pandan (43). Respondents with more than one year of fishing experience were selected at random.

Descriptive analysis was used to analyse catch composition and catch volume by species for the different fishing gear. This method was also applied by Suharyanto *et al.* (2020), Aprilla *et al.* (2021), and Amponsah and Amarquaye (2021) in describing the volume of catch and catch composition in fisheries management area (FMA) 716, in Indonesia, Banda Aceh, and Ghana, respectively. Prior to this analysis, the volume of catch by species was calculated based on the formula proposed by Krebs (1989). The relative abundance formula was:

$$\text{Relative abundance \%} = (ni/N) \times 100 \quad (1)$$

where:

ni = the number of individuals of the species

N = the total number of individuals of fish caught

Results and Discussion

Type and Characteristic of Fishing Gears Used

Eight types of fishing equipment were found to be used by the fishermen in Gili Sulat-Gili Lawang, as shown in Table 1. A fisherman normally used more than one type of fishing gear in a single trip. The fishing gear most used by fishermen was the handlines, followed by gillnets, longlines, cast nets, trolling lines, spearguns, scoop nets, and fishing rods. Cast nets, gill nets, trolling lines, handlines, and longlines were predominantly found to have a total length greater than 50 m, while scoop nets and spearguns were found to have a total length below 50 m. On the other hand, the dominant mesh sizes in the net (cast net, gillnet, and scoop net) used by fishermen were 2 inch or below and the number of hooks was 20 or below (i.e., fishing rods, handlines, trolling lines, and longlines).

Table 1: Types and characteristics of fishing gears used by fisherman in Gili Sulat-Gili Lawang, Indonesia

Characteristic	Type of Fishing Gear																
	Cast Nets		Fishing Rod		Gill Net		Hand-line		Longline		Scoop Nets		Spear Gun		Trolling Line		
	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	
Total Length (m)	≤50	1	6	1	50	4	14	1	2	0	0	3	100	4	100	0	0
	> 50	15	94	1	50	25	86	56	98	27	100	0	0	0	0	10	100
Height (m)	≤50	7	44	-	-	7	24	-	-	-	3	100	-	-	-	-	-
	> 50	9	56	-	-	22	76	-	-	-	0	0	-	-	-	-	-
Mesh (inch)	≤2	15	94	-	-	25	86	-	-	-	2	67	-	-	-	-	-
	>2	1	6	-	-	4	14	-	-	-	1	33	-	-	-	-	-
Size (No.)	≤20	-	-	2	100	-	-	57	100	27	100	-	-	-	-	10	100
	>20	-	-	0	0	-	-	0	0	0	0	-	-	-	-	0	0

Note: f = frequency, % = percentage

Catch Composition

The composition of the catch using various type of fishing gears is shown in Table 2. Generally, 29 fish species were recorded by the 85 fishermen in Gili Sulat-Gili Lawang. Handlines had the highest catch composition (21 species), followed by longlines (19 species), gillnets (18 species), cast nets (13 species), spearguns (9 species), fishing rods and trolling lines (7 species each), and scoop nets (1 species).

The differences in catch composition by fishing gears may occur due to the handline used for hook and bait, which can be adjusted to target the type of fish to be caught. More interestingly, the size of the hook greatly affected the catch composition size as well as the rates of catch of reef fish (Patterson *et al.*, 2012). Handlines can optimise exploitation patterns and greatly boost capture efficiency by using more hooks and bait (Herrmann *et al.*, 2018). Furthermore, handlines have the capacity to capture a greater range of fish species, irrespective of their harvest efficiency, across various trophic levels and functional groups (Humphries *et al.*, 2019).

In the context of volume of catch, longline records the highest catch (3,785.25 kg), followed by gillnet (3,272 kg), handline (2,958 kg), cast net (2,462 kg), trolling line (773 kg), spear gun (237.50 kg), fishing rod (71 kg), and scoop nets (45 kg). The highest volume of catch by longline may be due to the operation used. He (2010) stated that the longline could target a wide range of species, from bottom-dwelling flatfish to highly migratory tuna including bigeye, yellowfin, and albacore. In other words, it could be anchored on the seafloor or set to drift in the water currents.

On the other hand, the gill net was found to be the second most used gear for catching fish. Based on Naesje *et al.* (2004), compared to other gears, the gill nets are capable of catching a greater variety of fish by body length classes. The handline is the third most effective method for catching fish. This finding is in line with previous studies, Agustina *et al.* (2019), who found that fishermen in Perairan Sendang Biru mostly caught more fish when using handlines

because of its operating mechanism. When operating this fishing gear, fishermen could use many type of handlines with different functions. For example, tuna handlines could focus on targeting tuna and so on.

It is interesting to note that different fishing gear types can catch different species. The largest catch by the longline was the bigeye tuna (1,585 kg), followed by shark (900 kg). For the gill net and cast net, the heaviest catch was mackerel tuna (1,192.50 kg and 1,088.75 kg) and sardine (913.50 kg and 835 kg), respectively. Conversely, handline and trolling line were able to catch mackerel tuna (830.50 kg and 365 kg) and bigeye tuna (415 kg and 287.50 kg), respectively. On the other hand, the spear gun was able to catch emperor fish (60 kg), followed by squid (55 kg). In addition, fishing rods were highly capable at catching skipjack tuna (15 kg), followed by emperor fish (11 kg). However, scoop nets were unfortunately only able to catch anchovies (45 kg). This finding is in line with previous studies where bigeye tuna was the most often caught with longlines, the next most caught type of fish is the longnose lancet fish and blue shark (Bigelow *et al.*, 2012). While longlines mostly catch sharks (Bromhead *et al.*, 2012) and gillnets mostly catch mackerel tuna (Rofiqo *et al.*, 2019). By contrast, gillnets mostly caught sardines (Govender *et al.*, 2019) and handlines mostly caught tuna, skipjack, and mackerel tuna (Agustina *et al.*, 2019).

Overall, the most abundant species in Gili Sulat-Gili Lawang were mackerel tuna (3,917 kg), followed by bigeye tuna (2,287.5 kg) and sardine (1,788.5 kg). The finding is consistent with the findings of past studies by Dermawan *et al.* (2014), who found mackerel tuna, skipjack tuna, and tuna as the three dominant fish caught in East Lombok. With the water temperature ranging between 28°C and 28.5°C in Gili Sulat-Gili Lawang (Arifin & Yulianda, 2003), it may provide a suitable temperature for this species to thrive in. As pointed out by Shabrina *et al.* (2017), mackerel tuna lives in water temperature ranging between 28°C and 29°C.

Table 2: Catch composition by fishing gear in Gili Sulat-Gili Lawang, Indonesia

Species	Cast Net		Fishing Rod		Gill Net		Handline		Longline		Scoop Nets		Spear Gun		Trolling Line	
	Vc	Ra	Vc	Ra	Vc	Ra	Vc	Ra	Vc	Ra	Vc	Ra	Vc	Ra	Vc	Ra
Anchovy	-	-	-	-	-	-	-	-	-	-	45	100	-	-	-	-
Barracuda	7.5	0.30	7.5	10.56	0.5	0.02	49.5	1.67	35.0	0.92	-	-	-	-	-	-
Bigeye tuna	-	-	-	-	-	-	415.0	14.03	1585.0	41.87	-	-	-	-	287.5	37.19
Blackspot snapper	-	-	-	-	5.5	0.17	-	-	-	-	-	-	-	-	-	-
Blue sprat	-	-	-	-	97.5	2.98	67.5	2.28	15.0	0.40	-	-	-	-	-	-
Emperor fish	41.0	1.67	11.0	15.49	40.5	1.24	346.0	11.70	76.0	2.01	-	-	60.0	25.26	17.5	2.26
Giant trevally	15.0	0.61	-	-	12.5	0.38	61.5	2.08	51.0	1.35	-	-	10.0	4.21	-	-
Grouper	2.5	0.10	-	-	16.0	0.49	131.5	4.45	108.0	2.85	-	-	10.0	4.21	-	-
Largehead hairtail	-	-	-	-	-	-	-	-	2.5	0.07	-	-	-	-	-	-
Mackerel fish	50.0	2.03	-	-	458.5	14.01	184.0	6.22	17.5	0.46	-	-	7.5	3.16	25.0	3.23
Mackerel scad	296.0	12.02	-	-	379.0	11.58	63.5	2.15	57.5	1.52	-	-	-	-	10.0	1.29
Mackerel tuna	1088.8	44.22	10.0	14.08	1192.5	36.45	830.5	28.08	430.5	11.37	-	-	-	-	365.0	47.22
Mahi mahi	5.0	0.20	-	-	1.0	0.03	12.5	0.42	-	-	-	-	-	-	-	-
Marlin	-	-	10.0	14.08	-	-	70.0	2.37	95.5	2.52	-	-	-	-	-	-
Mulloway	-	-	-	-	-	-	-	-	8.5	0.22	-	-	-	-	-	-
Octopus	-	-	-	-	-	-	68.5	2.32	-	-	-	-	-	-	-	-
Parrot fish	-	-	-	-	-	-	-	-	-	-	-	-	15.0	6.32	-	-
Pompano	-	-	-	-	5.0	0.15	-	-	-	-	-	-	-	-	-	-
Rabbitfish	8.0	0.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sardine	835.0	33.92	-	-	913.5	27.92	40.0	1.35	-	-	-	-	-	-	-	-
Shark	85.0	3.45	-	-	100.0	3.06	50.0	1.69	900.0	23.78	-	-	-	-	-	-
Silver pomfret	-	-	-	-	-	-	-	-	7.5	0.20	-	-	-	-	-	-
Skipjack tuna	27.5	1.12	15.0	21.13	10.0	0.31	247.5	8.37	168.3	4.44	-	-	-	-	65.0	8.41
Snapper	-	-	-	-	7.0	0.21	43.5	1.47	-	-	-	-	15.0	6.32	-	-
Squid	0.8	0.03	-	-	2.5	0.08	38.5	1.30	15.0	0.40	-	-	55.0	23.16	-	-
Stingrays	-	-	10.0	14.08	16.0	0.49	105.0	3.55	125.0	3.30	-	-	15.0	6.32	-	-
Threadfin bream	-	-	7.5	10.56	14.5	0.44	36.0	1.22	-	-	-	-	-	-	-	-
Wolfherring	-	-	-	-	-	-	15.0	0.51	50.0	1.32	-	-	-	-	-	-
Yellowfin tuna	-	-	-	-	-	-	82.5	2.79	37.5	0.99	-	-	-	-	3.0	0.39

Note: Vc = average of catch (kg/trip), Ra = relative abundance (%)

Apart from that, as Gili Sulat-Gili Lawang is located near the coastal area and has an abundance of anchovies, it may provide enough food for mackerel tuna. As pointed out by a previous study, anchovies are the main food of mackerel tuna (Binsasi, 2020). Therefore, as the anchovies generally live in groups, use coastal areas to spawn, and raise their young (Wahyudewantoro & Haryono, 2011), which is similar to the coastal area of Gili Sulat-Gili Lawang, it may become a factor influencing the abundance of mackerel tuna in this area.

Conclusions

This study discovered that Gili Sulat-Gili Lawang, Indonesia used eight different type of fishing gears. All the types of fishing gear under review showed that the catch composition of fishermen in Gili Sulat-Gili Lawang was very diverse. Overall, fishermen recorded 29 species of fish in their catches. Handlines had the highest catch composition, followed by longlines, gillnets, cast nets, spearguns, fishing rods, trolling lines, and scoop nets. The bigeye tuna was the species most frequently caught by all the types of fishing gear under review. This was followed by mackerel tuna, emperor fish, skipjack tuna, and anchovies.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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