Comparison Between Fish-Catching Techniques with Purse Seine Fishing Equipment in Japan and Indonesia

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Abstract. Japan is a country that has highly developed marine fishery resources. In the field of fisheries, Indonesia is still very behind compared to Japan. One of the factors related to Indonesia being lagging behind Japan in the fisheries sector lies in the fishing technique using the purse seine fishing gear. There are several conditions related to fishing gear in Indonesia, such as: simple navigation and fishing gear, almost 80% of fishing gear operation still uses human power with manual steering systems and fishing operations in Indonesia which can take some time weeks or even months. This has an impact on the less than optimal fish catch. Indonesia is still very far from being able to catch up with the technology owned by Japan, especially in the operation of purse seine fishing gear. The purpose of this study was to determine and explain the purse seine fishing gear and to know the similarities and differences between fishing techniques and purse seine fishing gear in Japan and Indonesia. This study used a qualitative approach with literature review to collect data and make observations directly into the field, namely in Indonesia, especially on the Tri Mina Barokah Ship, Juwana area, Pati Regency and in Japan especially the Yamasen Ship, Choshi area, Chiba Prefecture. The results of the study that show the most significant difference between fishing techniques in Indonesia and in Japan are the number of vessels and fishing aids used. In Indonesia, fishing is still using 1 unit of ship which has a function as fish finder, net carrier and fish catcher, besides that the fishing aid used is still very simple. In Japan, 4 vessels are engaged in fishing (honsen, tansakusen, unpansen, recko boat) and are equipped with sophisticated and modern fishing tools.

1. Introduction

Indonesia is an archipelago country that has the biggest natural resources in marine especially in fisheries. As one of the pillars that support economy of nation, national fishery has other aim such as to: accomplish targeted production, provide national fish need, export fish to other countries and provide workforce/labour. Adequate available means and infrastructures in catching fish are totally required in order to increase fast of: production growth, fishermen and units of fish-catching vessel year over year. There are many ways to get fast and excellent caught-fish result. One of them is to amplify speed of the fish-catching vessel by upgrading the power, adding number of vessel engine or augmenting purse seine net size. In Asia, Japan is very advanced in fish-catching technology.

According to FAO (Food and Agriculture Organization), in 1988 total caught-fish quantity of Japan reached 12 tons or 13% of total world caught-fish number. Not only are the Japanese fish-catching armadas operating in their own water territory but they are also operating even until Pacific Ocean, Indian Ocean and other international water areas. Indonesian fishermen only operate by using one unit of vessel while in Japan they at least operate 2 units of vessels, even more, most fishermen there
use 4 units of vessels altogether to catch fish, therefore it is very likely that fish-catching result in Japan is more dominant than in Indonesia. In addition to using fish-catching equipment, geographical location of Japanese fishing area is exceedingly supporting because fish-catching area is only 20 miles from the shore.

In Japan, most of the operations of purse seine use 4 units of vessels consisting of fishnet vessel (honsen), fish-searching vessel (tansakusen), caught-fish storing vessel (unpansen) and assisting vessel (recko boat). Every vessel is equipped with navigation tool based on type of the vessel, while purse seine fishing vessels in Indonesia mostly just use one vessel in addition to functioning as net vessel, also as caught-fish storing vessel. In operating fish-catching purse seine in Indonesia, almost 80% of them use human labour; this is totally opposite with operation in Japan. In Indonesia purse seine fishing vessel facility along with navigation tool used is not as complete as in Japan. Japanese vessels have complete navigation tool like navigating ability to monitor: wind direction, sea water currents, near water depth, vessel position; and every crew has each bed, whereas in Indonesia purse seine fishing vessel all beds are put together, navigation tool is limited and steering gear is still manual. During its operation to catch fish, purse seine fishing vessel in Japan can always returns to harbour every day, in contrast in Indonesia it will take weeks or even months to do so. This condition can affect fish-catching process speed and also the caught fish quality. If the fishing vessel is able to return to harbour everyday the caught fish will be fresher compared to those put in the vessel storage by weeks or months because the fishing time takes weekly or monthly.

2. Literature Review

2.1 Catching Device of Purse Seine

Purse seine is fish-catching device that is categorized into group of surrounding net equipped with wrinkle cord and ring to draw together the bottom during operation. The ring has double function as moving area of ring cord and as the sinker. Until now purse seine is still the most productive fish-catching device to get small pelagic fish. Role of net to the caught fish is to contain the fish so they cannot escape the capturing net when it is encircling the fish. Initially purse seine was used in Rhode Island water area to catch menhaden (brevootia tyrannus). Then purse seine was patented under the name of Berent Velder from Bergen in Norway on March 12, 1859. [10].

In Indonesia purse seine or ‘pukat cincin’ in Indonesia language initially was introduced in northern java coast by Sea Fishery Research Institute (Lembaga Penelitian Perikanan Laut-LPPL) in 1970 in cooperation with fishery businessman by the name of Djajuri in Batang and it worked very well. Soon afterward in 1973-1974 this device was implemented in Muncar, Banyuwangi Regency, Central Java and since then it has been developing fast till now. At the beginning during its growing process in Muncar there was social conflict between traditional fishermen and fishermen using purse seine, but in the long run this fish-catching method was accepted by traditional fishermen [5].

2.2 Type of Purse Seine

Various purse seines are developed in order to be in line with the fishermen need and use [1]. Generally, purse seines are categorized based on: mesh basic design, species of fish to catch, number of vessel used during the operation, and fishing time operated.

- Based on mesh basic design, purse seine size is divided into: square, trapezium and two symmetrical indentations.
- Based on species of fish captured by purse seine, the fish are divided into: purse seine sardines, purse seine tuna, purse seine seed mackerel, purse seine Indian mackerel, etc.
- Based on number of vessels used during operation, they are divided into: two-boat system purse seine and one-boat system purse seine.
- Based on operating time, they are divided into: daylight purse seine and night time purse seine.

Based on the dimension, purse seines are divided into:
3. Result and Discussion

3.1 Fish-Catching Technique with Purse Seine catching device in Indonesia and Japan

a. Area and Time of Catching

In Indonesia, catching fish using purse equipment is carried out in the night time (between sunset/dusk to sunrise) that is between 9 pm to 3 am in the morning; however, there is also purse seine operated in daytime. By and large, in Indonesia the process setting or net deploying is done twice a day that is during dusk and morning to dawn, but on certain condition volume of catching can be reduced or increased, yet it can also be no setting or no net deploying due to weather condition such as high sea wave or bad weather. Most of purse seine vessels in Indonesia during the fish-catching process take 1 month to 2 months to do so depending on condition of fish, season and weather. Areas of catching fish cover Java Sea, Natuna islands, Karimata strait, Makassar, Kangean islands, Masalembo and Bawean Island. In determining fishing ground, fishermen refer to moving cycle of little pelagic fish in water area of Natuna islands, Karimata strait, Java sea and Makassar strait which naturally can alter and swift based on seasonal change [6].

In Japan, areas of catching fish in Japan are divided into Sea of Japan (Nihonkai) and Pacific Ocean (Taiheiyo). In most cases, fishermen in Pacifc Ocean (Taiheiyo) tend to use purse seine. Season will determine the location of the fish because pelagic fish tend to be in between cold current (oyashio) and warm current (kuroshio). Catching zone can change based on natural condition but in general it will not be so significantly different than information about catching situation in water area explained above. Fish-catching time in Japan also depends on captured fish species and catching duration. Local government has decided the duration and frequency of catching. Concerning the duration, frequency of net setting can be one time to twice. Most fish-catch activity using purse seine in Japan is carried out in one day. For example, if fishermen and the vessels leave in the early evening, they will come back to the harbour around 2 o’clock in the morning, and if they leave midnight, they will come back around 5 o’clock in the morning, that’s why caught fish using purse seine in Japan are very fresh [4].

b. Dimension of Purse Seine Catching Device

Dimension of purse seine in Indonesia is determined by its length that is from one wing to the other wing and its width that is distance between upper rope and lower rope (in meter). Width or height of purse seine in backward trapezium is measured at center part or the one that makes the pouch/bag [7].

In Japan, minimum of purse seine net depends on vessel condition that will bring or operate that net. Several factors that affect dimension of purse seine catching device are: purse seine net minimum length is 15 meters of vessel length; net minimum depth depends on length of purse seine net; length and bunt minimum depth is equal to length of vessel; while selection of net mesh size depends on size and type of captured fish.

c. Type of Purse Seine

In Indonesia, generally, mini purse seine consists of vessel, catching device that is net and its part, also special lifeboat for purse seine with light supporting device and supporting device combination of light and Fishing Aggregating Device (FAD). Vessel used during purse seine operation is teak (tectona grandis) based motor boat with length of 12-20 m,
breadth of 3.5 m, Depth of 1.2 – 1.5 m and Gross Tonnage (GT) is 10 – 20 GT. Net of purse seine has material of polyamide with average length of 500 – 700 m and width of 45 – 50 m, net mesh is 1 – 2 inch. Lifeboat with length of 4 – 6 m, breadth of 0.5 – 0.9 m and Depth of 0.5 m is specifically dedicated to purse seine with light supporting device and combination between light and FAD. Fish-catching operation using purse seine usually takes one day. It is equipped with fish-catching supporting device such as fishing aggregating device for daylight catching activity and light for nigh time catching activity. Vessel used is equipped with attached motor with 25-36 horsepower engine. Usually 12 to 16 people as vessel crews are needed. Other than mini purse seine, there is also big purse seine which the catching zone is water area much further away that goes from Java Sea to Malacca strait. In order to do this, bigger vessel with 160-250 horsepower engine is required. For Large purse seine is purse seine that essentially has length more than 600 m. One of the examples of large purse seine is Cakalang purse seine. This seine has length approximately 1.000 meters and width 60-70 meters, its mesh net is variably from 1 inch for net that can function as bunt and 4 inches at the outermost part. Method of operation of both large purse seine and small/mini purse seine principally is similar [4].

Type of purse seine used in Japan mostly is purse seine one-boat system so called in Japanese isomaki and two-boat system is nisomaki. Isomaki is fish-catching vessel with purse seine catching device that during its operation is operated by 1 unit of net vessel while nisomaki is operated by 2 units of net vessels. In Japan, purse seine can be categorized into: One-Boat Horse Sardine Purse Seine, Two-Boat Sardine Purse Seine, One-Boat Horse Mackerel and Mackerel Purse Seine, Two-Boat Horse Mackerel and Mackerel Purse Seine, One-Boat Skipjack and Tuna Purse Seine, Two-Boat skipjack and Tuna Purse Seine [4].

d. Supporting Catching Device that is used
As for supporting devices used to operate purse seine in Indonesia catching device are: fishing aggregating device to attract school of fish to gather around it so they can be easily captured; roller to function as device to drag purse line during catching fish placed at left or right hull of the vessel where hauling is being processed; lifeboat is a small vessel without independent moving engine but will be dragged by the main vessel to and from fishing ground. It is equipped with a paddle/oar and a pressurized paraffin lamp; Spade as helping device to move captured fish from capturing device to vessel deck, this spade is made from nylon material whereas the grip and diameter are made of wood or rattan material; and light as helping device to lure or entice fish interest to gather underneath the light. Types of light used are pressurized paraffin lamp, neon lamp and mercury lamp [9].

Supporting catching device of Japan purse seine are power block, net hauler, pass winch, side roller, light, spade, supporting vessel. Main supporting devices used in Japan are: power block that is main part that functions to drag the net to the vessel which the working process has to be simultaneously working with net hauler. This net hauler has same function with power block to drag the net; pass winch that is main part to function to drag purse line and side roller that is a supporting device used to drag the net when it makes the pouch designed to facilitate the fishermen to spend less energy when dragging quickly the net into the vessel [4].

e. Catching Method and Catching Technique
Purse seine vessels in Indonesia mostly use method of chasing after school of fish, therefore it can be done in night time and daytime by encircling the aggregate of fish with big net. Catching technique in Indonesia water area even though has used purse seine vessel but the supporting device used is still very rudimentary and during the setting and hauling, it tends to use human labour.

Purse Seine vessel in Japan during its operation to catch fish mostly has implemented method of chasing school of fish, it can be done both in the night and daylight. Technically what has been done in Japan is same with what has been done in Indonesia. What is more
superior in Japan is only supporting devices that are used which are net setting, net hauling and handling the captured fish [4].

\textbf{f. Type of Captured Fish}

Types of fish caught in Indonesia water area by using purse seine catching device are: seed mackerel, yellow tail scads, horse/jack mackerel, Sardine/Phil card, narrow-barred Spanish mackerel. The fish that are the destination for catching purse seine nets are pelagic fish that are clustered and close to sea level [3]. If the fish have not been collected in a catchable area or beyond the ability to catch the net, efforts must be made to ensure that the fish come together by using light, FADs, floating raft, and others [8].

Types of fish captured using purse seine supporting device in Japan water areas are: Mackerel (Masaba), Dotted Mackerel (Goma saba), Sardine (Iwashi), Dotted Sardine (Miwashi), Pointy mouth Sardine (Katakuchi washi), Horse Mackerel (Aji), Squids (Ika), Pikes (Sanma) [4].

\textbf{g. Operating Vessel}

Purse seine fishing armada generally is operated by individual business using wood-made hull. Machines that are used vary with 20-360 horsepower engine depending on the vessel size and fish-catching area. Most of purse seine vessels in Indonesia use one vessel that has various functions as fish-searching vessel, fish-catching vessel and caught fish-storing vessel. Small purse seine vessel (10-30 GT) has 20 horsepower engine which operates on one-day fishing time. Medium size purse seine vessel (30-50 GT) has 120 horsepower engine which uses operating time based on how many days per trip like 7-20 days per trip. Big size purse seine vessel (30-50 GT and 100-130 GT) has 120-360 horsepower engine which uses catching time operation based on days like 10-40 days per trip [5].

Based on function, purse seine vessels in Japan consist of:

a. Net vessel (Honsen) is a main vessel to carry purse seine net and to function as fish-searching vessel equipped with navigation tool more advanced than other vessel and also functions as fish-storing vessel. This is carried out if unpansen cannot store fish anymore due to overcapacity.

b. Vessel for searching fish (Tansakusen) is a vessel that functions as fish-searching vessel where a school of fish is located, also to function to drag left hull of net vessel (honsen) during dragging the net and lifting up the fish out of the sea so the vessel is still balanced and has stable distance with fish-storing vessel (unpansen). This vessel is designed to have speed faster than other vessel that is around 15-20 knot and has storing power of 70 GT.

c. Vessel for storing fish (unpansen) is vessel to store and bring captured fish. Vessel for storing fish tends to have bigger size than other vessels. Unpansen used in Japan has storing capacity of 300-400 GT with speed of 15-18 knot. Maximum capacity of unpassen to store fish is 300 tons.

d. Helping vessel (Recko boat) is a vessel to function to set net from honsen during catching operation and also to drag unpansen from left hull during dragging up captured fish.

\textbf{3.2 Comparison between fish-catching technique in Japan and Indonesia}

Similarity between fish catching technique in Japan and Indonesia is both catch pelagic fish by using technique of encircling school of fish with big net. Type and material of purse seine catching device used has similar net mesh because it has been fitted with targeted pelagic fish. The smaller fish to capture the smaller the net mesh is. Fish-catching time for pelagic fish in Indonesia and Japan is carried out mostly in the night and early morning to dawn [2].

Actually there is not much different between Japanese and Indonesia regarding the process of handling fish. In Japan in handling captured fish, the fish mixed with ice will be put in the vessel and then they will be brought to the harbour unloading and be sent to the next consumer, meaning the fish are very fresh. Meanwhile in Indonesia the captured fish will be put in storing room for 1
week to 4 weeks because the fishing ground is far away so the fish will be returning to the harbour after the ship returns to the original harbour.

On the whole, the difference between fish-catching technique using purse seine in Japan and Indonesia is on vessel type and supporting device that is used. In Indonesia, material of vessel is wood while in Japan mostly is made of stainless steel which has been equipped with sophisticated tools. In Japan, fish catching is carried out by several vessels that have each individual function in one team and are equipped with modern supporting device while in Indonesia it is carried out by only one vessel and only equipped with simple supporting device. During full moon, Purse seine vessel in Indonesia cannot do catching because it is still uses light supporting device and fish aggregating device to gather fish. Light that is used to gather fish cannot function during full moon because the light will be biased by moonlight. In Japan full moon doesn’t affect the fish-catching activity, because the catching system is carried out by chasing and searching a school of fish [4].

Table 1. Similarities and differences between fish-catching technique in Japan and Indonesia.

| Item                  | Purse Seine in Japan | Purse Seine in Indonesia |
|-----------------------|----------------------|--------------------------|
| Purse seine vessel    | Net Vessel           | O                        |
|                       | Fish-Searching Vessel| O                        |
|                       | Fish-Storing Vessel  | O                        |
|                       | Helping Vessel       | X                        |
|                       | Recko Boat           | X                        |
| Supporting catching device | Fishing Aggregating Device (FAD) | X    |
|                       | Roller               | O                        |
|                       | Supporting Vessel    | O                        |
|                       | Spade                | O                        |
|                       | Light                | O                        |
|                       | Power Block          | O                        |
|                       | Net Hauler           | O                        |
|                       | Pass winch           | O                        |
|                       | Side Roller          | O                        |

Conclusion
Fish-catching method using purse seine carried out in Japan and Indonesia has similar method order but different in fish-catching technique due to number of vessels and supporting device used. From above table we can see that number of vessel and supporting catching device used have significant differences. Those differences affect the fish-catching process. Number of armadas consisting of 4 vessels will be faster to locate school of fish and sophisticated supporting catching device will facilitate process of net deployment, net dragging and handling captured fish.

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