Assessment of Surface Push Net (Sondong) as Eco Friendly Fishing Gear

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Abstract. Sondong is a type of push net fishing gear that is operated in the water surface. This gear captured one type of fish only namely Stolephorus sp. To understand the eco-friendly level of this gear, a study has been conducted in August 2018 in the Akar Strait Village, Meranti Regency, Riau Province. To check the eco-friendliness of this gear, the characteristics of this gear is compared to five [1] namely the selectivity level; do not cause habitat damage; high quality fish produced; low bycatch and discard and do not harm the protected fish species. This study was conducted through direct observation in the field and interviewing the fishermen. Technical, environmental and financial data were descriptively analyzed. Based on data obtained, it can be concluded the surface push net is a very environmental friendly gear as it perfectly meets all five basic ecofriendly criteria. In financial term, the use of this gear might be continued because it provides benefits for fishermen as well as quickly return the business capital.

1. Introduction
In general, push net includes a fishing gear that is prohibited from operation by the government through [2] which states that this fishing gear is not selective and environmentally damaging. However, there is one case of push net found in Akar Strait Village that has the same general construction of the bottom push net, but this push net is operated on the surface and it captures a single species, Stolephorus sp only. This gear known as sondong and so far there is no information on the environmental friendly level of this gear. To understand whether this gear can be categorized as environmental friendly gear, a study is needed to be conducted. The eco friendliness status of the gear can be used as basic information to design a policy of the operation of the gear in the future.

Through this research, the technical feasibility of the sondong push net was analyzed base on 5 basic ecofriendly criteria of Code of Conduct for Responsible Fisheries (CCRF) issued by [1]. The financial feasibility of this fishing gear is studied to ensure the sustainability of the related fisheries business.

2. Methods
This research was conducted on August 2019 in the waters of Selat Akar Village, Putri Puyu District, Meranti Islands Regency, Riau Province (Figure 1).
The tools used in this study are camera, a meter and work sheet. Data were obtained by investigating the sondong push net operated in the Selat Akar Village waters. Questionnaires were distributed among the fishermen in order to get information on the fishermen perception toward the 5 basic ecofriendly criteria issued by [1]. The technical data of the surface push net were obtained by observing the gear in the field and then compared it with data obtained from reference.

The primary data collected in this study are including the technical aspects related to push net unit such as: size and number of the push net in this area, general construction of the push net, including material, size, knot type and operation method, season and operation area, composition of catch, main and by catch, number of trips per season, number of catches/unit/trip. While the financial analysis observed includes: operational costs; supply costs, the catch price/kg, fishermen's income per trip and investment cost per fishing device. Five basic criteria [1] used to assess the ecofriendliness of the sondong push net are as follows:

a) The fishing gear must have high selectivity;
b) The fishing gear used does not damage the habitat, dwelling and breeding of fish and other organisms.
c) Produce good quality fish.
d) Minimum wasted catches;
e) Not capturing a protected or endangered species

The fishermen perception obtained through the questionnaires were then scored following [3]:
- Score 0-5, very environmental unfriendly
- Score 6-12, is not environmental friendly
- Score 13-15, environmental friendly
- Score 16-20, is very environmental friendly

The financial analysis was done by analyzing the business and investment efforts in the field, including operating income and analysis of revenue cost ratio.

2.1 Payback Period (PP) and Return of Investment (ROI) analysis

The formula used for analyzing the business income:

\[ \pi = TR - TC \]

Note:
- \( \pi \) = Profit
- \( TR \) = Total Revenue
- \( TC \) = Total Cost

Criteria:
• If the total income > total cost, the business is categorized as profitable and worth to be continued.
• If total income = total cost, the business is categorized as not profitable, but it is no loss (just achieve the break even point).
• If the total income > total cost, the business is categorized as loss and it is not worth to be continued.

2.2 Revenue - Cost ratio analysis
The formulas used is:
\[
\frac{R}{C} = \frac{TR}{TC}
\]

Note:
\(\pi\) = Profit
\(TR\) = Total Revenue
\(TC\) = Total Cost
\(C\) = Cost
\(R\) = Revenue

Criteria:
• If \(R/C > 1\), the business activity is profitable and the business is deserved to be continued.
• If \(R/C < 1\), the business activity is loss and it is not worth to be continued.
• If \(R/C = 1\), the business activity does not provide any profit nor loss (just in the break even point).

2.3 Payback Period analysis
The formula used to analyze the payback period is following [4]:

\[
PP = \frac{1}{\pi} \times 1\text{ year}
\]

Description:
\(PP\) = payback period
\(i\) = investments issued
\(\pi\) = profit

Criteria:
• If the payback period is shorter than the maximum payback period, then the effort is said to be worth continuing.

2.4 Return on investment (ROI)
The measurement model used is an analysis of the return on investment (ROI). Calculation of ROI is done to determine the amount of profit earned compared to the amount of investment invested [5].
The formulas used are:

\[
ROI = \frac{\pi}{I} \times 100\%
\]

Note:
\(ROI\) = Return of Investment
\(\pi\) = Profit
\(I\) = investment

3. Results
Sondong fishing gear presence in the Selat Akar Village has an unique catches and technique of operation, this fishing gear is operated on the surface and the catch is anchovies (Stolephorus sp).
The number of surface push net boat that land their catch in the Selat Akar Village is 20 units. The technical aspects of surface push net compare with the bottom push net gear are presented in Table 1.
Table 1. Construction and material of the surface’s and the bottom’s push nets (sondong)

| No | Component          | Surface Sondong | Bottom Sondong | Unit          |
|----|--------------------|-----------------|----------------|--------------|
| 1  | Bag/Color          | blue            | black          |              |
|    | a. Bag number      | 2 (midship)     | 1 (bow)        | unit         |
|    | i. Bag consists of | 7 (ms=0.5 cm)   | 10             | m            |
|    | - Part I           | 150 (ms=2.8) cm |                |              |
|    | - Part II          | 350 (ms=2) cm   |                |              |
|    | - Part III         | 300 (ms=1.3) cm |                |              |
|    | - Cod end          | 200 (ms=0.7) cm |                |              |

The material used and the construction of the surface’s and bottom’s push nets are not much different. The only difference in the construction of those gear is the use of 2 bags mounted in the left and right side of the ship in the surface push net, while in the bottom’s push net there is a bag only mounted in the bow of the ship.

Table 2. Method and operation time of surface’s and bottom’s push net

| No | Variable                     | Surface Push net | Bottom push net | Unit |
|----|------------------------------|------------------|-----------------|------|
| 1  | Operation method             |                  |                 |      |
|    | a. Operation layer           | Sweep the surface, 1-2 m depth | Sweep the bottom |      |
|    | a. Hauling frequency         | 3-6              | 10-15           | Times /day |
|    | b. Operation Duration        | 1-2              | 0.3-0.5         | Hour/hauling |
|    | c. Trip/day                  | 1                | 1               |      |
|    | d. Catching time             | Up to midday     | Morning to midday |      |
|    | e. Number of fishermen that use the sondong | 2-3 | 2-3 | man |
| 2  | Catches                      |                  |                 |      |
|    | a. Main Catches              | Anchovy (Stolephorus sp) | Red shrimp (Paneus Indicus) |      |
|    | b. By catches                |                  | White shrimp (Paneus marguensis) |      |
|    |                               |                  | Yellow Shrimp (Paneus sp.) |      |
|    |                               |                  | Clupeiformes (Ilisha elongata) |      |
|    |                               |                  | Daggertooth pike conger (Muraenesox cinereus) |      |
|    |                               |                  | Stingray fish (Trygon sp) |      |
|    |                               |                  | Threadfin (Polynemus sp.) |      |
|    |                               |                  | Flathead grey mullet (Mugil cephalus) |      |
|    |                               |                  | Pama croakerPama croaker (Otolithoides pana) |      |

| Amount of catches | 101.16 | 101.16 |
| Shrimp (200); fishes (50) |

| 3  | Fishing ground (depth)   | 3-6   | 1.5-4  | m     |

*Bottom pushnet (sondong) : [6]*
The basic operation system of the surface’s as well as the bottom’s push nets are similar. The bags that are mounted to the ship were drag along as the ship running. The water as well as the fish entering the bag and as the water escape, the fish was trapped in the bag. The surface’s push net is commonly operated in the area far from the shore line, while the bottom’s push net are push to the bottom of the in shallow water, coastal water during low tide. The operation time of surface’s push net was around 6 hours (morning to noon), while the bottom’s push net was operating during the low tide.

In Malacca Strait waters is distinguished into two seasons, namely West Season (low catch season) which occurs in December, January and February and Eastern Season (peak season) which occurs in June, July and August [7]. As the environmental condition is fluctuated due to the season, the catch of the sondong was also various, there were “low season”, “moderate season” and “peak season” of fish catch.

3.1 Surface’s Sondong fishing gear operation
The surface’s push net was set by tied up the tip of the bag’s mouth to the lower part of the ship’s foot on the left and right sides of the deck. The push net was then lowered up to ±1-2 m depth and all parts of the bag are immersed and fill by sea waters and it forms a pouch. As the ship moving, the mouth of the bag face the water and it is dragged toward the targeted species (Figure 1).

![Figure 1. The surface’s push net (sondong) set in boat](image)

Note :
- a: Push net foot; b. Push net Frame; c. Push net Bag; d. Push net fleet
  - (i) The bags that are identic in size and shape [8]
  - (ii) Front view of surface’s push net gear [9]

4. Discussion
The target catch of the push net fishing gear in the Selat Akar Village is anchovies (*Stelephorus* sp, Clupeidae). The amount of dry and wet anchovy catch per day is presented in Figure 2. This gear catch a single species only and there is no discard nor bycatch.
Environmental Friendly Level of the surface’s push net (sondong)

According to [10] the environmental-friendly fishing technology is the technology used to catch fish without affecting the quality of the environment. The operation of this type of fishing gear may maintain the sustainable fisheries capture in accordance with the provisions of responsible fisheries implementation and to protect fish resources. The environmental friendly fishing gear can be studied from the perspective of fishing gear construction, fishing gear operation, types of fish caught as well as fishing ground. The data of fishermen perspective toward the surface’s push net is presented in Table 3.

Table 3. Fishermen perspective toward the surface’s push net

| No | Criteria                                           | Respondents | Sum of Score |
|----|----------------------------------------------------|-------------|--------------|
|    |                                                    | 1 | 2 | 3 | 4 | 5 |               |
| 1  | Has high selectivity                              | 4 | 4 | 4 | 4 | 4 | 20             |
| 2  | Does not damage the habitat                       | 4 | 4 | 4 | 4 | 4 | 20             |
| 3  | Produce high quality / good quality fish           | 4 | 4 | 4 | 4 | 4 | 20             |
| 4  | Low of By-catch and Discard                       | 4 | 4 | 4 | 4 | 4 | 20             |
| 5  | Does not endanger protected fish species           | 4 | 4 | 4 | 4 | 4 | 20             |
|    | **Total**                                          | 4 | 4 | 4 | 4 | 4 | 100            |
|    | **Average**                                        |             |             |             |               | 20             |

Source: Primary data, interviewing 5 respondents

Data presented in Table 4 shown that all respondent have positive perspective toward the surface’s push net operation, as all of them provide maximum value (4) for all criteria. All respondents agree that the gear has high selectivity in catching the fish, which is the targeted species, *Stolephorus* sp only. The operation of the gear does not damage the environment, provide high quality fish, almost do not captured bycatch and discard (less than 3 species) and also do not catch any endangered species. These facts indicate that the operation of the surface’s push net does not have any negative impact toward the environment and it may be categorized as environmental friendly gear.

Based on the criteria of environmental friendly fishing gear, the bottom’s push net is categorized as environmental friendly gear as their score are between 10-18 [11]. The average score of the bottom’s push net gear presence in the UPT Fishery Port was 18.3. Unfortunately, this gear is secondly common gear in the UPT Fishery Port of Riau Province [12].
The operation of this push net has been banned according to [2]. This prohibition is enforced because the bottom’s push net has very low selectivity. The use of relatively small mesh size and the operation of the gear that touch the bottom causes many types of shrimp and fish were caught and most of the catches are young fishes. The more young fishes caught means that there will be a threat to the sustainability of the species and will negatively impact the declining of fish stock. Bottom’s push net operation may damage the bottom area of the waters and it is classified as not environmental friendly fishing gear.

The financial analysis is conducted in order to understand the whether the fishery business in the Selat Akar Village is qualified or not qualified to be conducted. The analysis conducted including the profit, cost and payback period analyses. A business may be qualifies based on important factors such as the investment and production costs. These costs consist of fixed costs and variable costs (fixed cost) that are considered as periodical cost with constant or fixed cost and it is not affected by the business processes. While the variable cost is the nominal amount that always fluctuate and is strongly influenced by the amount of productivity generated in a business [13]. The investments of the sondong fishermen in the Selat Akar Village is presented in Table 4.

**Table 4. Surface push net Bussiness Investment**

| No. | Investment Costs | Prices | Unit | Total   |
|-----|------------------|--------|------|---------|
| 1   | Fleet            | 50.000.000 | 1    | 50.000.000 |
| 2   | Sondong Bag      | 2.000.000  | 2    | 4.000.000   |
| 3   | Machine          | 35.000.000 | 1    | 35.000.000  |
| 4   | Boiling Pot      | 380.000   | 2    | 760.000     |

**Table 5. Fixed costs Investment Depreciation**

| No. | Fixed Costs (Depreciation) | Economic Value (Year) | Cost/ Year   |
|-----|-----------------------------|-----------------------|--------------|
| 1   | Fleet                       | 8                     | 6.250.000    |
| 2   | Sondong Bag                 | 2                     | 2.000.000    |
| 3   | Machine                     | 8                     | 4.375.000    |
| 4   | Boiling Pot                 | 3                     | 253.333      |

**Table 6. Maintenance costs**

| No. | Maintenance | Time Period | Cost/Year (Rp) |
|-----|-------------|-------------|----------------|
| 1   | Fleet       | 1           | 2.000.000      |
| 2   | Sondong Bag | 2           | 200.000        |
| 3   | Machine     | 2           | 1.500.000      |
| 4   | Boiling Pot | 2           | -              |

Total Cost = Fixed costs + Maintenance costs = Rp. 12,878,333 + Rp. 3,700,000 = Rp. 16,578,333
Table 7. Variable costs

| No. | Kind of needs  | Needs /day | Price | Costs /day | Total costs/9 days |
|-----|----------------|------------|-------|------------|--------------------|
| 1   | Fuel (Solar)   | 50 liter   | 6,750 | 337,500    | 3,037,500          |
| 2   | Gas            | 2 cylinders | 190,000 | 380,000    | 3,420,000          |
| 3   | Salt           | 1 sack     | 65,000 | 65,000     | 585,000            |
| 4   | Logistic       | -          | 50,000 | 50,000     | 450,000            |
| 5   | Fishermen’s wages | 2   | 75,000 | 150,000    | 1,350,000          |
| 6   | Lubricating Oil| 18 liter/3 months | 850,000 | -         | -                  |

Sum = 8,842,500

Total Cost = FC + VC
= Rp.16,778,333 + Rp. 8,842,500
= Rp. 25,620,833

4.1 Gross Income
There is 15-20 trips of sondong gear operation/ month. This gear is operated during high tide. As they they do a “one day fishing trip”, they may do the fishing maximum 20 days/ month. Other 10 days the fishermen stay at their home and repairing their boats or push nets (Table 8).

Table 8. Amount of daily catch and fish prices by season

| No | Season                | Kind of catches | Amount of Catches (kg) | Price (Rp) |
|----|-----------------------|-----------------|-----------------------|------------|
| 1  | Peak Season April – June (Stelephorus sp) | 50              | 35,000                |
| 2  | Moderate season July-November (Stelephorus sp) | 25              | 50,000                |
| 3  | Low Season December-March (Stelephorus sp) | 15              | 65,000                |

Source : Primary Data

Based on interview with the push net fishermen in the Selat Akar Village, there are 3 fishing seasons that was categorized based on the amount of catches, namely: the peak season (high amount of catch) , moderate season and low fishing season (low amount of catch). The fishermen do not operate the gear during the low season.

4.2 Business Analysis
Business analysis is carried out to determine the success that has been achieved during the fishery business. The business analysis of the surface’s push net fishermen is presented in Table 9.

Table 9. Results of Business Analysis on surface push net Unit

| Aspects of Business Analysis | Results |
|-----------------------------|---------|
| Total Revenue (Rp)          | 45,520,000 |
| Total Expenditure (Rp)      | 25,620,833  |
| Profit (Rp)                 | 19,899,167  |
| Revenue-Cost Ratio (R/C)    | 1,776     |
| Payback Period (year)       | 4,51      |
| Return On Investment (%)    | 0,22      |

The value of R/C > 1, indicates that the business analysis of the push net benefits for each fisherman, as the total revenue earned is greater than the total expenditure, while the time of capital return is fast and the business is feasible to be developed in the future.
5. Conclusions and Recommendation

5.1. Conclusion

Based on the construction aspect and the operation method, the surface’s push net gear presence in the Selat Akar Village is categorized as environmental friendly gear. This gear catch a single type of fish only, which is anchovies (Stolephorus sp), there are no by-catches and discard. The characteristics of this gear perfectly meets 5 environmental friendliness criteria issued by [1].

Results of the business analyses indicate that surface’s push net operation is worth to be continued as it is able to return the business capital in short time. Based on the financial aspect of the fishery business, surface’s push net operation is categorized as profitable businesses for fishermen.

5.2. Recommendation

The surface sondong fishing gear used by the Selat Akar Village fishermen provide profits even though the operation is morning to midday only. There is a possibility to operate the gear from morning to afternoon.

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