

The economic impact of the “cantrang” prohibition in the northern Java Sea, Indonesia

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Abstract. The present study aimed to compare the economic impact of “cantrang” to other environmental-friendly fishing gears on the northern Java Sea. The study was conducted in the Provinces of Banten, West Java, Central Java and East Java. The type of data used are primary and secondary data where primary data collection was carried out by conducting interviews with key informants using questionnaire, interview, field observations and focused group discussions. The results showed that “cantrang” gear provides a higher level of profit compared to other fishing gears. Based on the analysis of investment criteria, “cantrang” has better criteria than “multi-monofilament gill net” gear operated in Pandeglang and Indramayu, West Java and “purse seine” gear operated in Rembang and Lamongan, East Java. The amount of profit sharing received by danish seiner was higher than the district minimum wage on each research location. Therefore, danish seiner are reluctant to switch from “danish seine” to another fishing gear, and challenge the prohibition policy issued by government. In order to encourage danish seiner for switching to more environmental-friendly gear, the policy have to address the welfare of danish seiner first before applying substituted gear to maintain the sustainability of fish resources.

Key Words: demersal, fisheries policy, fishing gear, financial analysis, welfare.

Introduction. Cantrang is a danish seine net in accordance with the Indonesian National Standard (SNI) 01-7236-2006, but fishermen on the north coast of Java, it has been modified to have the ability for a higher catch (Sasmita et al 2012). Fishers of northern Java Sea facing continuous pressure by the government to replace the “cantrang” fishing gear with the more environmental- friendly gear as a condition to get a fishing permit. To accelerate the replacement process, the government will not award permits to vessel owners who refuse to replace their “cantrang” to environmental-friendly fishing gear. Fact in the field is that fishers still operate “cantrang” behind the tight control of the law enforcers and organizingly unwilling to replace the gear. The main reason is that the replacement of fishing gear will cause a significant decrease in catchment which will finally reduce income.

Out of eleven fishery management areas in Indonesia, one of the areas is Fisheries Management Area (FMA) 712 on Northern of Java. Dominant fishers that stay in northern of Java Island traditionally operate “cantrang” gear, but since 2015 the gear is totally banned through the enactment of Ministry of Marine and Fisheries Decree Number 2/2015 (MoMAF 2015) on the prohibition of trawls and seine net in FMA’s in Indonesia. The prohibition is part of government effort on addressing the problem of the unfriendly gear such as trawl and modified seine net that targeting demersal fish that has been fully exploited (Aji et al 2013). Therefore, strict supervision is needed because the number of fishing gear has increased by 300.08% from 2000 to 2012 or increasing 14.65% year⁻¹ (Table 1).

Table 1

Number of “cantrang” operated in Indonesian waters in 2000–2012 (MoMAF 2014)

<i>Year</i>	<i>Total (Units)</i>	<i>Change (%)</i>
2000	7,109	-
2001	10,314	45.08
2002	17,005	64.87
2003	17,893	5.22
2004	23,445	31.03
2005	22,763	-2.91
2006	23,784	4.49
2007	26,208	10.19
2008	26,820	2.34
2009	28,372	5.79
2010	19,726	-30.47
2011	23,683	20.06
2012	28,442	20.09
Average change year ⁻¹		14.65

Ministry of Marine and Fisheries Decree Number 50/2017 shows that the potential of fish resources in the FMA 712 is about 1,341,632 tons year⁻¹ while the Total Allowable Catch (TAC) is 1,073,306 tons year⁻¹ (MoMAF 2017a). Estimated potential, TAC, utilization rates and status of fish resources in FMA 712 of the Republic of Indonesia are presented in Table 2.

Table 2

Estimated potential, TAC, utilization rates and status of fish resources in FMA 712 of the Republic of Indonesia (MoMAF 2017a)

<i>Targeted resource</i>	<i>Potential (tons year⁻¹)</i>	<i>TAC (tons year⁻¹)</i>	<i>Utilization rate</i>	<i>Status</i>
Small pelagic	364,663	291,730	0.38	M
Big pelagic	72,812	58,250	0.63	F
Demersal	657,525	526,020	0.83	F
Coral fish	29,951	23,961	1.22	O
Shrimp (penaeid)	57,965	46,372	1.11	O
Lobster	989	791	1.36	O
Crab	7,664	6,131	0.70	F
Swimming crab	23,508	18,806	0.65	F
Squid	126,554	101,244	2.02	O
Total	1,341,632	1,073,305	0.99	F

Description of utilization rate (E):

- E < 0.5 - Moderate (M), fishing effort allow to increase;
- 0.5 ≤ E < 1 - Fully exploited (F), fishing effort is maintained with strict monitoring;
- ≥ 1 - Over exploited (O), fishing effort have to be reduced.

Table 2 shows that only the small pelagic category is in moderate status so the fishing efforts can be increased. Big pelagic, demersal fish, crabs, and swimming crabs have fully exploitation status so there should be no increase in fishing effort. Reef fish, shrimp, lobster, and squid have overexploited status so there must be a reduction in fishing effort. The status of capture fisheries in FMA 712 encourages the government to issue a regulation of the Ministry of Marine and Fisheries decree No. 2/2015 to prohibit the operation of “trawls” and “cantrang” (MoMAF 2015). In the implementation level, the danish seiner’s resistance to regulation of the Ministry of Marine and Fisheries decree No. 2/2015 drive vertical disagreement to central government and horizontal differentiation with fishers other than fisherman of cantrang. Ermawati & Zuliyati (2015), revealed a regulation of the Ministry of Marine and Fisheries decree No. 2/2015 to prohibit the

operation of "trawls" and "cantrang" resulting in unemployment, decreased welfare, and crime. In addition, in a review, academics at Brawijaya University added that the ban on trawlers and trawlers on the North Coast of Java had resulted in a 30% reduction in catches (Sukandar et al 2015). However, the two studies did not reveal the potential of fisheries, the number of permitted fishing efforts, optimal utilization and welfare of fishermen. Demersal fisheries are short-lived fisheries which if not utilized will die naturally (Budiman 2006; Ernawati 2007). According to Haynes et al (1986), fisheries resource management can increase benefits for fisheries actors in three ways. First, increasing output by managing fish stocks at the maximum fishing conditions in the long run, second decreasing the unit cost of catching by reducing competition between fishing actors, third, increasing profits per unit of output produced. Therefore, demersal fisheries must still be utilized and managed optimally because if left unchecked, demersal fisheries that die naturally become a cost of sacrifice for a lost asset.

Fisheries economic literature highlights many economic problems arising in fisheries such as decreases in fish stocks, loss of fisheries rent, increases in fishing costs and asset rigidity (Dupont 1988; Clark & Munro 1975). According to regional economic growth theory, the impact of changes in the fisheries sector is not limited to the fisheries sector itself. The impact of these policies can extend to other economic sectors (Stanley 2003; Letson & Milon 2002). The policy of limiting the number of ships that can operate causes two types of injustice in fisheries:

1. Intergenerational injustice arising where the current generation bears costs while future generations of fishermen benefit from the regulation (Sumaila & Walters 2006)
2. Intergenerational injustice occurs if the regulation reduces employment opportunities for some fishermen. Affected fishermen cannot easily obtain alternative employment.

Anderson (1985) has shown that fisheries management with restrictions on fishing permits can generate rent for fisheries resources in commercial fisheries. Meanwhile, if it only limits the number of main inputs in capturing there will be an increase in business costs. If there is a reduction in the amount of fishing effort for fisheries, benefits will be obtained by switching the use of assets, through other uses. Loss of rent (rent dissipation) is the difference in resource rent that is obtained when there is a policy of limiting capture efforts with the maximum potential rent in conditions without a policy. The reasons for the loss of rent are:

1. Capital stuffing or input substitution that occurs when fishermen try to increase their catches by using more inputs.
2. Over-use of the fleet, several facts show that permits overfishing were permitted from optimal conditions.
3. The use of heterogeneous types of ships, which allows the operation of ships with low efficiency.

Asano et al (2016) identified the source of rent loss in fisheries with a limited entry policy. Asano et al (2016) concluded that limited entry does not cause capital stuffing as long as there are no restrictions on the number of days at sea and there is no incentive to invest excessively in using fisheries technology. The loss of rent and overfishing is entirely due to the excess number of fishing days.

MoMAF (2017b) considers that the policy has a significant effect in reducing the number of fishing efforts in Indonesia. The policy is a form of government intervention in managing fisheries resources. In the long term, if fishing effort limitations can be implemented effectively, fish resources will recover and fish stocks will increase so fishers will return to prosperity because more fish can be caught. According to Haynes et al (1986), the management of fisheries resources will improve the benefits for fishers in three ways: Firstly, managing fisheries at Maximum Sustainable Yield (MSY); Secondly, reduce the cost per unit effort by reducing competition between fishers; and Thirdly, increase the profit per unit of fish catch.

Dahuri (CNN Indonesia 2016) stated that since the policies have been implemented, the production of fish catches dropped dramatically, the fishers complain of reduced income and livelihood loss. Fish processing companies in some regions also lose benefits because they could not get a sufficient raw material because some fishing vessels could not get permission to operate. According to danish seiner, before

implementing the policy, the government should make an alternative first and the policies is only aimed at safeguarding nature without considering economic problems and the welfare of fishers. On the implementing level, the policy of “cantrang” gear ban causing a variety of perspectives both in terms of the sustainability of fishery resources and in terms of the welfare of society. Under these conditions, it is necessary to assess the economic impact of prohibition of “cantrang” on the northern of Java Sea. Therefore, the present study aimed to compare the economic impact of “cantrang” to other environmental-friendly fishing gears on the northern Java Sea

Material and Method

Description of the study sites and research time. Research locations were in Northern of Java where “cantrang” fishing is operated. The administrative area covering FMA 712 are Banten Province, West Java Province, Central Java Province and East Java (Figure 1). Research time comprised 4 months, from April 2018 to July 2018.

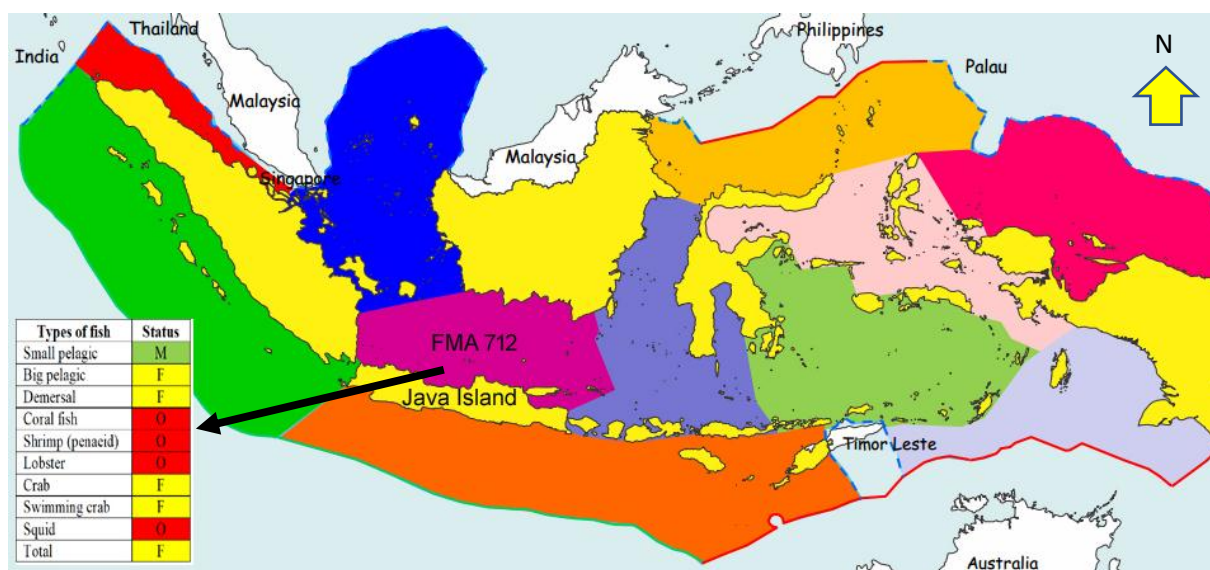


Figure 1. The research location in FMA 712.

Types of data. Data used in this research was primary data and secondary data. Primary data was collected from the interview with danish seine and other fishing gear users. Secondary data was collected from the fishing port, office of marine and fisheries on each province in Northern Java, Ministry of Marine and Fisheries, and from the Central Bureau of Statistics.

Economic analysis. The economic analysis in this research used two approaches: qualitative and quantitative. The qualitative analysis was used to get information about the operationalization of fishing gear: fishing ground, kind of fish captured, number of fishers each vessel, number of effort and size of the vessel. Quantitative analysis was used to get financial feasibility of Net Present Value (NPV), Net Benefit Cost Ratio (Net B/C), Internal Rate of Return (IRR) (Gittinger 1986).

a.) Net Present Value (NPV)

The NPV shows the profit that will be gained during the life of the investment or the amount of the value of the cash flow at the present time minus the costs incurred during a certain time. The formula used in the NPV calculation is:

$$NPV = \sum_{t=0}^n \frac{B_t - C_t}{(1 + i)^t}$$

Where:

- B_t - Benefit year-t (USD)
- C_t - Cost year-t (USD)
- n - project age (year)
- i - Discount rate (%)
- t - Period (year)

Investment assessment in the NPV method, namely:

1. NPV > 0 means that the business is financially feasible because the profits obtained are higher than the costs.
2. NPV = 0, means financially the business is in a break-even condition because the profits obtained are equal to the costs incurred.
3. NPV < 0 means that the business is not financially feasible because the profits obtained are less than the cost/not enough to cover the costs incurred.

b.) Net Benefit Cost Ratio (Net B/C)

Net B/C ratio indicates the value of additional profits at every increase in the cost of one unit of currency. If the value of Net B/C < 1, the business is not feasible but if the value of Net B/C > 1, the business is feasible (Gittinger 1986). The formula used is:

$$\text{Net B/C} = \frac{\sum_{t=0}^n \frac{B_t - C_t}{(1+i)^t} \text{ for } B_t - C_t > 0}{\sum_{t=0}^n \frac{B_t - C_t}{(1+i)^t} \text{ for } B_t - C_t < 0}$$

Where:

- Net B/C - Benefit-cost ratio
- B_t - Revenue obtained in year -t (USD)
- C_t - Costs incurred in year t (USD)
- n - Project age (Year)
- i - Interest rate (%)
- t - Period (Year).

c.) Internal Rate of Return (IRR)

The Internal Rate of Return is the average level of annual internal profits expressed in percent units. If the IRR > interest rate then the business is feasible. In contrary if the IRR < interest rate, the business is not feasible. The formula used in calculating the IRR is:

$$\text{IRR} = i_1 + \left| \frac{\text{NPV}_1}{\text{NPV}_1 - \text{NPV}_2} \right| (i_1 - i_2)$$

Where:

- NPV1 - Positive NPV (USD)
- NPV2 - Negative NPV (USD)
- i₁ - The interest rate that results in a positive NPV (%)
- i₂ - The interest rate that results in a negative NPV (%)

Results

State economic losses due to operationalization of "cantrang". The Ministry of Marine and Fisheries renewed regulations prohibiting fishing gear which was previously the Ministry of Marine and Fisheries decree No. 2/2015 (MoMAF 2015) into Ministry of Marine and Fisheries decree No. 71/2016 (MoMAF 2016). In this regulation, there is a clause added where "cantrang" fishing vessels are only allowed to operate on Line II of FMA 712 which is 4-12 nautical miles from the shoreline.

"Kompas" Daily (2018) has reported that there are 336 "cantrang" vessels in Rembang with 259 vessel's tonnage of >30 GT (Gross Tonnage) and as many as 77 vessel's tonnage of <30 GT. Out of the 77 vessels, 75% have been marked-down. If there is a "cantrang" vessel-owner who has difficulty replacing the "cantrang" with an environmental-friendly fishing gear due to the high cost, the government will assist them to get the capital facilities.

MoMaF (2017b) shows species targeted by "cantrang" as 51% from 9 species and bycatch as 49% from 16 species (the dominant species is Common Ponyfish, *Leiognathus equulus*). Species target as raw material for *Surimi* and bycatch used as fish flour. "Cantrang" catches is not selective, it is causing stock depletion or reduction in fish resource stocks; furthermore the catch will decrease. Regional license for "cantrang" vessels with a size of <30 GT but on the average on the field is >85 GT. There is a decrease in the size of the vessel's GT (marked-down) which results in that of large vessels being able to obtain permits and operate in 4-12 miles of water. Fish resources in the Java Sea waters are declined due to the density of fishing activities that use "cantrang" gear. Most of the >30 GT "cantrang" owners do not pay Non-Tax State Revenue and get subsidized fuel that should be for small scale fishers (Table 3).

Table 3

State losses due to marked-down of "cantrang" vessels (MoMaF 2017b)

<i>State losses</i>	<i>2015 (USD)</i>	<i>2016 (USD)</i>
Non-Tax State Revenue	23.46 M	39.34 M
Non-targeted of fuel subsidy	20.00 M	25.07 M
Depletion of fish resources	702.14 M	876.43 M
Total	745.60 M	940.84 M

MoMaF (2017b) stated that the economic losses caused by the operation of "cantrang" in Indonesia in 2015 amounted to 745.60 M and in 2016 amounted to 940.84 M. The biggest loss was due to the depletion of fisheries resources. If this is allowed then the state losses caused by the depletion of fisheries resources in the long term will be even higher.

Since 2013, MoMaF no longer listed "cantrang" data concerning production, effort, and vessels operating on the Indonesian statistics. This is because "cantrang" has been already considered as an illegal fishing gear (Nababan et al 2018).

Comparison of investment, operational costs, revenues and profit of "cantrang" and non-prohibited fishing gears in Northern of Java. Figure 2 shows the comparison of investment, operational costs, revenues and profit in capture fisheries activities (using "cantrang") and non-prohibited gears (gill net, purse-seine and handline) in Banten, West Java, Central Java, and East Java. "Cantrang" capture fisheries and "gill net" in Banten (Pandeglang) shows a very significant difference in revenues and profits. Investment in Banten (Pandeglang) for "cantrang" was 22.64 M USD and "gill net" was 14.70 M USD. The revenue from "cantrang" was 157.14 M USD year⁻¹ and from "gill net" was 17.14 M USD year⁻¹ while the profit of "cantrang" was 104.29 M USD year⁻¹ and "gill net" was 13.79 M USD year⁻¹. The operational cost of the "cantrang" was 50.34 M USD year⁻¹ and "gill net" was 8.57 M USD year⁻¹.

For capture fisheries in West Java (Indramayu), "gill net" is substitution for "cantrang" so that the investment value used for ships is considered equal to 4.74 M USD. Operational costs for "cantrang" are 4.71 M USD year⁻¹ and "gill net" is 1.43 M USD year⁻¹. Annual revenue from "cantrang" fishing equipment is 11.00 M USD and "gill net" is 60.71 M USD. Annual revenue for "cantrang" is 411.00 M USD and "gill net" 6.07 M USD while annual profits for "cantrang" is 5.02 M USD and "gill net" 3.38 M USD.

For capture fisheries in Central Java (Rembang) the investment of a "cantrang" business amounting to 33.64 M USD while the "purse-seine" vessel reaches 5 times higher costs than the investment of "cantrang", which is 158.57 M USD. The operational cost of "cantrang" was 68.57 M USD and "purse-seine" was 90.00 M USD year⁻¹. Annual

revenue for "cantrang" was 137.14 M USD and "purse-seine" was 128.57 M USD. The annual profit for "cantrang" was 68.56 M USD and "purse-seine" was 51.43 M USD. The difference between the two fishing gears in Central Java (Rembang) is quite significant, for "purse-seine" fisheries takes greater investment and operational costs but giving smaller profits compared to "cantrang".

For capture fisheries in East Java (Lamongan), investment of "cantrang" business involved 58.57 M USD while "longline" fishing business amounted to 25.39 M USD. Operational costs year⁻¹ of "cantrang" amounted to 90 M USD and "longline" fishing line of 27.07 M USD. Annual revenue for "cantrang" was 205.71 M USD and "longline" fishing 85.71 M USD. The annual profit for "cantrang" was 120.00 M USD and "longline" fishing 60.00 M USD.

The results of business analysis based on investment, operational costs, revenue and profits per year indicate that the "cantrang" providing higher profits than non-prohibited fishing gears.

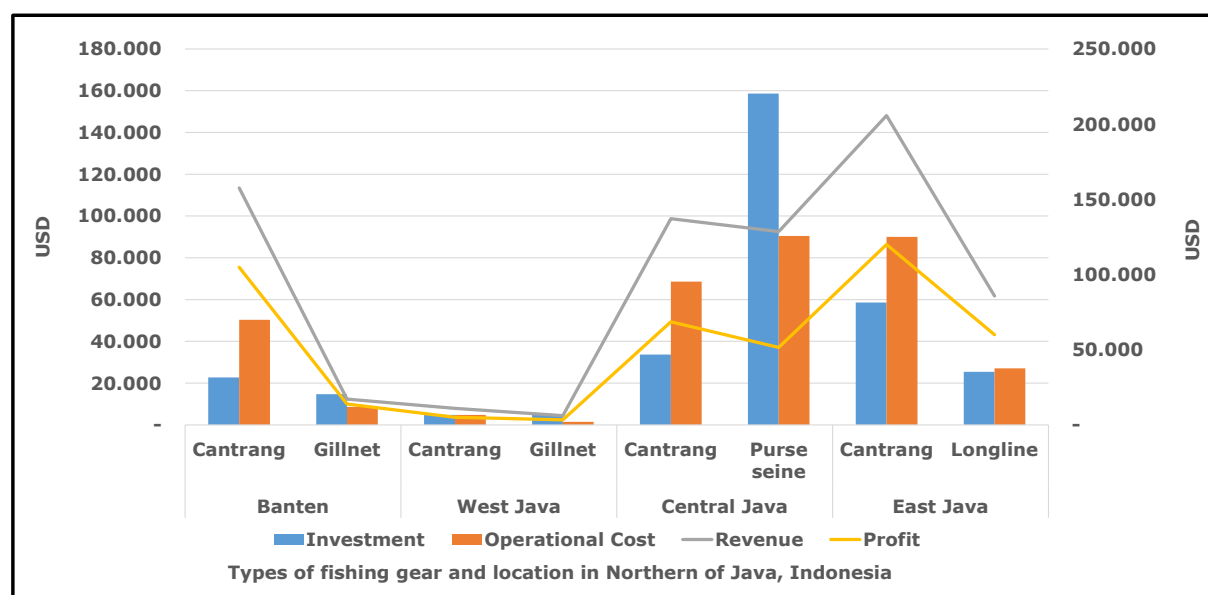


Figure 2. Investment, operational cost, revenue and profit each year of capture fisheries in Northern Java (Source: primary data processed 2018).

Comparison financial analysis of "cantrang" and non-prohibited fishing gears in Northern Java. The financial analysis consists of the analysis of R/C Ratio, PP, ROI, NPV, Net B/C, IRR (Gittinger 1986). In general, Table 4 shows that both fishing vessels with "cantrang" or non-prohibited fishing gears are feasible to be carried out financially as fishery business.

Table 4
Comparison financial analysis of "cantrang" and non-prohibited fishing gear in Northern Java

Information	Banten		West Java		Central Java		East Java	
	"Cantrang"	Gill net	"Cantrang"	Gill net	"Cantrang"	Purse seine	"Cantrang"	Long line
R/C	2.99	1.63	1.84	2.25	1.4	1.54	2.28	3.17
PP	0.22	1.06	0.94	1.40	1.06	1.94	0.72	0.61
ROI	4.63	0.94	1.06	0.71	3.05	0.81	3.51	3.38
NPV (M USD)	720.73	35.29	32.75	22.52	197.29	86.93	664.89	359.67
Net B/C	32.82	3.40	7.90	5.75	5.67	1.55	12.35	15.18
IRR (%)	467.00	51.00	118.00	85.00	58.99	5.31	162.10	190.23

Source: primary data processed (2018).

For capture fisheries in Banten, West Java and Central Java shows that the overall financial value (R/C, ROI, NPV, Net B/C) of "cantrang" fisheries is higher than "gill net"

fisheries. Payback period (PP) of “cantrang” is also shorter than “gill net”. This is different from the fishery business in East Java, the “cantrang” gear produces financial value (R/C, Net B/C, and IRR) which is lower than “longline”. The “cantrang” payback period is also longer than the “longline” as indicates that “longline” fishing gear is financially more feasible than “cantrang”.

Comparison of wages received by fishers to provincial minimum wages regime.

Circular Letter of the Ministry of Manpower Number B.337/M.NAKER/PHIISK-WAGES/X/2017 (MoMP 2017) stated that Provincial Minimum Wage (PMW) and Regency/Municipality Minimum Wage (RMMW) rates in thirty four provinces in Indonesia is determined by the Governor in each Province and applied to all formal sectors. PMW is the minimum income received by every individual and can be used as a benchmark of prosperity of the citizens. This income comparison is to see the ratio between state determined PMW and fisher’s income. When the ratio is <1 then the fishers’s income are under PMW (insufficient), when the ratio =1 means that the fishers's income are equal to PMW (borderline), and when the ratio is >1 means that the income of fishers is higher than PMW (above sufficient).

In term of working structure in fishery, generally there are three level of division of works on the fishing vessel: owner, captain, and labor. To see the income distribution, see Table 5 that shows the income of labor fishers is the smallest compared to captains and owners. Meanwhile the biggest income is obtained by owners. On all type of gears, either prohibited or non-prohibited, this disparity occurs. On each region on the northern Java Sea, “cantrang” fishery business gives the highest income compared to all other non-prohibited gear, distributedly on labor fishers, captains and owners. The labor fishers's income in the “gill net” fishery (in Banten and West Java) and “purse seine” fisheries (in Central Java) has a ratio less than 1. Meanwhile the labor fishers’s income in “longline” fisheries (in East Java) has a ratio of more than 1. The ratio of fishers's income to provincial minimum wages is presented in Table 5.

Table 5

The ratio of fishers's income to provincial minimum wages (PMW)

Variables	Banten PMW 168.11 USD		West Java PMW 140.02 USD		Central Java PMW 109.64 USD		East Java PMW 132.22 USD	
	Cantrang	Gillnet	Cantrang	Gillnet	Cantrang	Purse seine	Cantrang	Longline
Labor fishers	1.71	0.53	1.02	0.55	1.80	0.98	2.22	2.27
Fishing vessel captain	4.12	0.70	1.02	0.55	5.39	1.95	3.30	3.03
Fishing vessel owner	20.49	2.12	2.04	3.32	23.36	18.57	35.85	14.37

Source: primary and secondary data processed (2018).

Discussion. According to MoMaF (2017b), “cantrang” capture fisheries is a business that caused a loss of state revenue of 745.60 M USD in 2015 and 940.84 M USD in 2016. However the results of business analysis calculations show that the substitute fishing gear (non-prohibited fishing gear) is not better than “cantrang”. The results of the calculation of financial analysis also have a smaller feasibility than “cantrang” except for “longline” fisheries in East Java. The results of the calculation of wages compared to PMW, the substitute also produce low income which mean reduces fisher’s welfare. Rejection of the regulation of the Ministerial Decree No. 71/2016 (MoMAF 2016) by danish seiner is basically reasonable because the law create a deteriorating impact on the welfare of fishers.

Conclusions. The “cantrang” capture fisheries causing state losses due to marked-down where the state loses revenue tax and spending on fuel subsidies for “cantrang” fishing vessels. In addition, “cantrang” capture fisheries causing depletion of fisheries resources. To balance between the environmental consideration and social-economic challenge on the grass root level, the prohibition of “cantrang” fishing gear should be complemented by a fishing gear replacement policy that does not reduce the welfare of fishers before

taking substitute fishing gear. This is to avoid rejection from “cantrang” capture fishers while the fisheries resources remain sustainable.

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