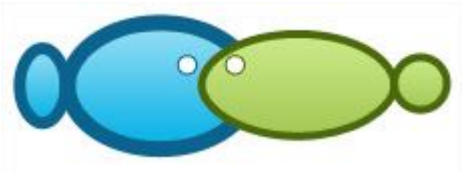

# Cooperative or individually? Impact of fishing expedition decision on income

[1,2]Dian Ayunita N.N. Dewi, [3]Deden D. Iskandar

[1] Graduate School of Economics, Doctoral Program, Faculty of Economics and Business, Diponegoro University, Semarang 50241, Indonesia; [2] Faculty of Fisheries and Marine Sciences, Diponegoro University, Semarang 50275, Indonesia; [3] Economics Department, Faculty of Economics and Business, Diponegoro University, Semarang 50275, Indonesia. Corresponding author: D. A. N. N. Dewi, dianayunita_nnd@live.undip.ac.id

**Abstract**. Mini purse seine fishers in Pekalongan, Indonesia, regularly face the following fishing decision: whether they set fishing expeditions cooperatively or individually. This study aimed to determine the effect of the decision of fishing fleets on income, and to examine the impact of fishing season on income. The relationship between the two factors and their role in income along fishing operations was also determined. Fishing income was compared from two different options of fishing expeditions and divided into two different categories: fishing income from fishing cooperatively (A) and fishing individually (B). This study involved 964 units income per trip. Fishing season was divided into low and peak seasons as the total mini purse seiner expedition activities. Fishing income analysis from two decision options implied that decision to set fishing individually resulted in higher income than cooperative fishing fleet. The decision to set fishing expedition individually allows skipper to find perfect fishing grounds and aggregate small pelagic fish compared with fishing cooperativelly. Fishing season also affects income and the two factors are related to mini purse seiner income. Result of this study provide insight into fishing decisions faced by mini purse seiner fishers at Pekalongan, Indonesia.
**Key Words**: fishing decision, fishing season, income, mini purse seiners, Indonesia.

**Introduction**. Fishers' income depend on fishing target, total amount, and prices. Fishing master or skipper capability to find exact fishing ground also affects fishing income (Gatewood 1983; Durrenberger & Pálsson 1986; Bjarnason & Thorlindsson 1993). Information about fish schooling or shoaling position and fishing gear that targets schooling fish is valuable for the success of a fishing operation (Gatewood 1984). Nonetheless, uncertain conditions on the sea also haunt fishing masters or skippers along their fishing trips. Their decision to set fishing trips involves a great risk as they may encounter failure during fishing operations. To diminish the fail risks, some fishers cooperate with one another and share information about an appropriate fishing ground of fishing target. They may also decide to leave a fishing port and set fishing together or individually. This type of interaction is considered cooperative. According to the International Cooperative Alliance cited by Doragawa (2005), cooperative definition is an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs. Cooperative interactions are recognized as an important instrument for socio-economics improvement for the community (Emana 2009). Cooperation in a society benefits economic development with enlightened community to grow together. Cooperatives can be characterized by dual attributes: economic and social attributes (Liang et al 2015).

Fishing expedition patterns between individual vessels can vary. The differences may be caused by different technical characteristics, experience, knowledge, and responses to large uncertainty (Hermansen & Eide 2012). People are rational and try to maximize their satisfaction by gaining more of whatever goods or services they desire, as assumed in utility theory (Branch et al 2006). The level to which vessels and skippers each determine fishing catching power has been a topic of contention by researchers (i.e. Pálsson & Durrenberger 1982, 1990; Durrenberger & Pálsson 1986; Gatewood 1983,

1984; Bjarnason & Thorlindsson 1993; Oliveira et al 2016). Behavior among fishermen is difficult to classify accurately. According to Branch et al (2006) fishers' behavior can be categorized into risk-loving and risk-averse. In addition, fishermen may appear to be risk-loving but are actually just making bad decisions when given poor information or during unlucky situations. Risk-averse fishermen are much more common than risk-loving fishermen among the same fishery. Fishermen who choose to set fishing expeditions together may be categorized as risk-averse but may be considered risk-loving when fishing alone (Branch et al 2006).

Studies about fishing income and its factors were conducted by Russel & Alexander (1996), Squires & Kirkley (1999), Eggert & Lokina (2007), Jabri et al (2013), and Hammarlund (2018). Many factors can influence fishing income. Previous studies highlighted the skipper's skill, number of crew members, fishing trip and target behavior as factors that affect fishing income. Indonesia has different regulations for fishing. There is no quota for fishing days and fish catching amounts. However, the limitation of Total Allowable Catch (TAC) allows the optimum fishing catches in 11 Indonesian Sea Water Management Areas (Minister of Marine Affairs and Fisheries 2016a). The natural limitation for fishermen is their fishing vessel capacity. The "race to fish" condition in common properties such as fisheries is not a good practice and leads to poor fish quality (Fujita et al 2004). The present study focused on mini purse seiners with fishing base at Pekalongan's fishing port. Moreover, the fishermen operated fishing gear in Pekalongan sea waters located in Indonesian Sea Water Management Area 712 or Java Sea. Mini purse seiners at the fishing port of Pekalongan has increased by about 10% units since 2005-2014 (Pekalongan Fishing Port 2015). Fishing interactions by sharing information of pelagic fish fishing grounds among mini purse seine fishers have also been reported in Pekalongan, Indonesia. This cooperative interaction is an optional decision for mini purse seiner fishing fleets when they are going to set fishing expeditions. Cooperative as a social capital plays a crucial role in social capital's development (Melece 2013). Social capital relates to the available resources in network communities, in which mutual support, reciprocity, cohesion and trust are shared values (Melece 2013; Cloete 2014; Akahoshi & Binotto 2016). Fishers' cooperative behavior is a special condition in what is otherwise a highly competitive situation (Gatewood 1984). Small groups of skippers cope with the general competition to share information during fishing season periods. Information is limited in volition and purpose (Gatewood 1984). Fishing season may be the particular reason for a skipper to set a fishing expedition because of the small pelagic fishing targets during different period across the sea water territory. Fishing season also provides an option for fishers to set fishing expeditions and fisher' need to achieve desired utility in economic return. In Indonesia, the fishing season is affected by monsoon winds that can bring strong tidal waves and affect aquatic productivity (Gaol et al 2012; Kunarso et al 2017).

This study aimed to answer wether a significant difference exists between the incomes of fishing fleets who set fishing expedition cooperatively and that of individual fishing fleets. It then leads to investigate the income of mini purse seiner fishers in different fishing seasons. Moreover, the interaction between fishing decision and fishing season and its effect on revenue were analyzed. Thus, the study objectives were to determine the effect of decision of fishing fleets on income, examine fishing season effects on revenue, and analyze the plausibility of an interaction between the two factors and its effect on income along fishing operations.

## Method

***Descriptions of the study***. This section presents the method used to determine mini purse seine income in Pekalongan from decision options to fish and the effects of fishing season effects on income. Income is from fish gained from selling captured fish products. Gross income from commercial fishing refers to the total amount received from catching, taking, harvesting, cultivating, or farming fish, shellfish, crustacean, sponges, seaweeds, or other aquatic forms of animal or vegetable life, as well as money from patronage dividends and fuel tax credits and refunds (Internal Revenue Services 2018). This study

used fishing gross income from catching fishes. To compare fishing income from two different options of fishing expeditions, the researcher selected mini purse seine fishing vessels from daily reports of Pekalongan's fishing port daily based on the study criteria. After the selection process, all the mini purse seiners were divided into two different categories: fishing vessels who decide to set fishing expedition cooperatively (A) and fishing fleets who fish individually (B). The criteria for A category were as follows: leave the fishing port at the same date and have same fishing days in their trips. The criteria for B category were as follows: leave the fishing port in different dates and different fishing days with other fishing vessels or leave the fishing port at the same date but have different fishing days from other fishing vessels (stay shorter or longer).

***Data type***. Data about fishing date, fishing days, and income were compiled from secondary data. Secondary data were obtained from the daily records of Pekalongan's fishing port in 2016. Here, the authors selected fishing fleets and categorized them into income decision groups. Income data from the compilation process revealed 964 unit income per trip from 52 fishing vessels. Fishing vessel capacity ranged from 13 GT (gross tonnage) to 30 GT. Fishing season was used as a fixed factor to identify the effect on fishing revenue. Fishing season was divided into two categories: low and peak seasons. Fishing season category was identified from fishing activity reports from Pekalongan's fishing port rather than monsoon winds. Monsoon winds are caused by changing patterns in Indonesia's climate. In this paper, low season describes few vessels sailing the sea, whereas peak season refers to months when fishing fleets set numerous expeditions. The peak season encompasses April, May, June, October, November, and December. By contrast, the low season comprises January, February, March, July, August, and September.

***Statistical analysis***. The objectives were analyzed by two-factor ANOVA. Fishing decision and fishing season were used as independent variables. The assumption for two-factor ANOVA is that both categories maintain the same normality, independence and equality in variance. This assumption was tested by Levene's test of equality of error variances. Interaction between fishing decision and fishing season and its effect on the revenue of fishing among fishing vessels were analyzed in this study. The following hypotheses were tested:

- $H_{01}$: all the fishing decisions in fishing expeditions have equal income;
- $H_{02}$: all fishing seasons in fishing trips have equal income;
- $H_{03}$: fishing decision and fishing season have no interaction effect on income.

**Results and Discussion**. Purse seiners with float rope length ≥ 300 m and mesh size of 1 inch in Indonesia are called mini purse seiners. This type of fishing gear pursues schooling fish and functions with a fishing aggregating device (FAD) or lamps. It operates in shallow water along the regency sea water teritory (12-24 nautical miles) (Minister of Marine Affairs and Fisheries 2016b). Its fishing target is small pelagic fish. Fishing days vary from 1 day to 10 days. Fishing vessels with size 13-20 GT usually fish from 1 day, whereas fishing days of vessels from 21 GT to 30 GT ranged from 3 days to 10 days. According to fishing port data records, the fishing target of mini purse seiners can be identified by the major fish captured. Species that were mostly captured by mini purse seiners in Pekalongan were scads (*Decapterus* sp.). The other fishing target were Indian oil sardine (*Sardinella longiceps*), Indian mackerel (*Rastrelliger kanagurta*), Indo-Pacific king mackerel (*Scomberomorus guttatus*), mackerel tuna (*Euthynnus affinis*), and black pomfret (*Parastromateus niger*).

The influence of decision fishing trips on income, both in low and peak season was the main research object of this study. From data records of mini purse seiners' fishing activities were statistically summarized. The peak season yielded 643 trips, whereas the low season total trips reported 321 trips. The maximum fishing income in low season was 68,318,175 IDR, whereas that in peak season was 53,549,629 IDR (Table 1). Vessel size ranged from 13 GT to 30 GT. In general, the individual fishing decision produced higher income than cooperative fishing. Income variations in fishing fleets were high due to the

wide range of vessel size (from 13 to 30 GT). Low income was gained by smaller fishing fleets (13-25 GT) and large vessels had bigger capacity and higher gross income than small vessels. Fishing composition also varies for every fishing vessel.

Table 1

Summary of statistical results

| | | *Obsv.* | *Mean* | *SD* | *Min* | *Max* |
|---|---|---|---|---|---|---|
| Low season | Income A in IDR per trip | 215 | 51676502.33 | 45245122.61 | 47684515.28 | 55668489.37 |
| | Income B in IDR per trip | 106 | 62632849.06 | 41641560.00 | 56947522.42 | 68318175.69 |
| Peak season | Income A in IDR per trip | 463 | 38219701.94 | 35727095.42 | 35499395.33 | 40940008.56 |
| | Income B in IDR per trip | 180 | 49186761.11 | 29956331.43 | 44823892.83 | 53549629.39 |
| | Vessel | 52* | 26.65** | 4.586** | 13** | 30** |

* Total of fishing vessel observation units; ** Vessel size (GT).

The assumptions for two-factor ANOVA of both categories are the same normality, independence and equality in variance (Table 2). The average fishing revenue from individual fishing decision is higher than cooperative fishing during low and peak seasons. A comparison of income generated from both fishing decision categories demonstrated that the null hypothesis could not be proven correctly. This result was verified by two-factor ANOVA (Table 3). Thus, decision to set fishing together leads to smaller income than solitary fishing. The analysis of fishing income from the two decision options implies that fishing individually gains a higher income than cooperative fishing. The decision to set fishing expeditions individually enables skipper to find perfect fishing grounds and aggregate large amounts of small pelagic fish compared with cooperative fishing. In cooperative fishing the yield is distributed among the group, so the fishing income is small. The fishing decision made by the skippers depends if they are risk-loving or risk-averse. The skippers can also become risk-loving or risk-averse depending on the information they receive from another skipper. When they regard information as poor, they may decide to set a fishing expedition individually. Fishing season also affects revenue. Two-factor ANOVA of fishing season revealed statistically significant effects on revenue (Table 3). Fishing in different seasons (low and peak) leads to different average income. Fishing income during the peak season is smaller than that during the low season. Revenue from fishing is also affected by the fish prices every season. During the low season, fish prices substantially rise due to market demand.

Table 2

Levene's test of equality of error variances (dependent variable: income)

| *F* | *df1* | *df2* | *Sig.* |
|---|---|---|---|
| 213.382 | 5 | 1543 | 0.000 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

Table 3

Two-factor ANOVA test result (dependent variable: income)

| *Source* | *df* | *F* | *Sig.* |
|---|---|---|---|
| Corrected model | 5 | 186.429 | 0.000 |
| Intercept | 1 | 1555.951 | 0.000 |
| Decision | 2 | 433.222 | 0.000 |
| Fishing season | 1 | 28.456 | 0.000 |
| Decision * Fishing season | 2 | 7.689 | 0.000 |
| Error | 1543 | | |
| Total | 1549 | | |
| Corrected total | 1548 | | |

During the low season, 25 vessels from 52 samples decided to postpone their fishing expeditions Table 4). The number of cooperative fishing trip in the low season was 215 trips, but that in the peak season was 463 trips. By contrast, individual fishing trips in the low season amounted to 106, whereas those in the peak season reached 180 fishing trips (Table 5). Monthly fishing trip with cooperatives varied from one to 13 times per month. The highest number of cooperative fishing trips occured in March (low season), May, and May (peak season). In July 2016, only four trips of cooperative vessels were operated for fishing (low season). Meanwhile, December recorded 39 trips of cooperative vessels went fishing. That was the lowest fishing trips number with cooperative decision both in low and peak season (Tables 4 and 5).

Table 4

Fishing trips patterns of mini purse seiners during low season in 2016

| *Vessel* | *Jan* | | *Feb* | | *Mar* | | *Jul* | | *Aug* | | *Sep* | | *Total trips per vessel* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Coop* | *Indiv* | *Coop* | *Indiv* | *Coop* | *Indiv* | *Coop* | *Indiv* | *Coop* | *Indiv* | *Coop* | *Indiv* | |
| 1 | | 4 | 2 | 1 | | 4 | 1 | | | | | | 12 |
| 2 | 3 | 1 | 1 | | 2 | 1 | | | | | | | 8 |
| 3 | 4 | 1 | 1 | | 4 | | | | 1 | 2 | | | 13 |
| 4 | 2 | | 1 | 1 | 2 | 2 | | | | | | | 8 |
| 5 | 4 | 1 | 2 | | 2 | 2 | | | | | | | 11 |
| 6 | 1 | 1 | | | | | | | | | | | 2 |
| 7 | 1 | 3 | 3 | | 5 | | | | | | | | 12 |
| 8 | 3 | 1 | 2 | 1 | 2 | | | | | | | | 9 |
| 9 | 1 | 2 | 3 | | 2 | 2 | 1 | | 1 | | | | 12 |
| 10 | 2 | 1 | | 2 | 2 | 1 | | | | 2 | | 2 | 12 |
| 11 | 1 | 1 | 3 | | 2 | 1 | | 1 | | | | | 9 |
| 12 | 2 | 1 | 2 | 1 | 2 | 1 | | | | | | | 9 |
| 13 | 3 | 1 | 2 | 1 | 3 | | | 1 | | | | | 11 |
| 14 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | | | | 12 |
| 15 | 4 | 2 | 2 | 1 | 1 | | | | | | | | 10 |
| 16 | 4 | | 1 | 1 | 3 | 1 | | | | | | | 10 |
| 17 | 3 | | 1 | | 3 | 2 | | 1 | | | | | 10 |
| 18 | 1 | 1 | 0 | 1 | | | | | | | | | 3 |
| 19 | 2 | | 1 | 1 | 1 | 2 | | 2 | | | | | 9 |
| 20 | 1 | 1 | 2 | | 3 | | | | | | | | 7 |
| 21 | 1 | 1 | | | | 2 | | | | | | | 4 |
| 22 | 1 | 2 | 1 | 2 | 4 | 1 | | 2 | | 1 | | | 14 |
| 23 | 1 | 2 | 1 | 1 | 2 | 1 | | | | | | | 8 |
| 24 | | 2 | 1 | 1 | 2 | | 1 | 2 | 2 | 2 | | 2 | 15 |
| 25 | 1 | | | | 2 | | | | | | | | 3 |
| 26 | | 2 | 1 | 1 | 1 | 2 | | | | | | 1 | 8 |
| 27 | | 1 | | | 3 | 1 | | | | | | | 5 |
| 28 | | | | | 2 | 2 | | | | | | | 4 |
| 29 | | | | | 1 | 1 | | | | | | | 2 |
| 30 | | | | | 1 | | | | | | 5 | | 6 |
| 31 | | | | | 2 | | | | | | | | 2 |
| 32 | | | | | 2 | | | | | | 11 | | 13 |
| 33 | | | | | 1 | | | | 2 | 1 | 5 | 1 | 10 |
| 34 | | | | | 2 | | | | 4 | 1 | 12 | | 19 |
| 35 | | | | | | | | | 3 | | 11 | | 14 |
| 36 | | | | | | | | | 2 | | 3 | | 5 |
| *Total trips per month* | 48 | 34 | 34 | 17 | 66 | 30 | 4 | 10 | 16 | 9 | 47 | 6 | |

Table 5

Fishing trips patterns for mini purse seiners during peak season in 2016

| Vessel | Apr | | May | | Jun | | Oct | | Nov | | Dec | | Total trips per vessel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coop | Indiv | Coop | Indiv | Coop | Indiv | Coop | Indiv | Coop | Indiv | Coop | Indiv | |
| 1 | 3 | | 3 | | 1 | 2 | 1 | | 2 | 2 | 3 | | 17 |
| 2 | 2 | 2 | 2 | | | | | | 1 | | 1 | 1 | 9 |
| 3 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | | 2 | 17 |
| 4 | 1 | 2 | 2 | | 1 | 2 | 3 | | 1 | 2 | 3 | | 17 |
| 5 | 1 | 2 | 1 | 2 | 1 | | 1 | 1 | 2 | 4 | 3 | 1 | 19 |
| 6 | 1 | | | | | | | | | | | | 1 |
| 7 | 3 | 2 | 2 | 1 | 2 | 1 | | | 1 | 4 | 3 | | 19 |
| 8 | 3 | | 2 | 1 | 1 | 2 | | | 1 | | | | 10 |
| 9 | 2 | 2 | 2 | | 1 | | 1 | | | | | | 8 |
| 10 | 2 | 1 | 3 | | 3 | 1 | | | 1 | | | | 11 |
| 11 | 5 | 1 | 3 | | | 3 | | | | 1 | 1 | 1 | 15 |
| 12 | 1 | 2 | 3 | | 2 | 1 | 3 | | 3 | 1 | 1 | 1 | 18 |
| 13 | 2 | 1 | 1 | 1 | | 2 | | | 2 | 2 | 2 | 2 | 15 |
| 14 | 1 | | 1 | | 2 | 1 | | | | | 1 | | 6 |
| 15 | 2 | 1 | | | | 1 | | | | | 1 | | 5 |
| 16 | 2 | 1 | 4 | | 2 | 1 | | | 2 | | 2 | 1 | 15 |
| 17 | 2 | | 1 | 1 | 1 | | 2 | | | | | | 7 |
| 18 | | | | | | | | | | | | | 0 |
| 19 | 1 | | | 1 | | 1 | | | 2 | | 2 | 1 | 8 |
| 20 | 2 | | 1 | 1 | 3 | 1 | 1 | 1 | | 1 | | | 11 |
| 21 | 4 | 1 | 1 | 3 | 3 | 3 | | | | | | 2 | 17 |
| 22 | | | | | | | | | | | | | 0 |
| 23 | 2 | 1 | 3 | 1 | 3 | | | 2 | | 3 | 1 | | 16 |
| 24 | 1 | 2 | 2 | | 2 | 1 | 2 | 1 | 2 | 2 | 2 | | 17 |
| 25 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 3 | 1 | 1 | 18 |
| 26 | 1 | | 4 | 3 | 2 | | 3 | 2 | 2 | 2 | 1 | 1 | 21 |
| 27 | 2 | | 2 | | 2 | 2 | 2 | 1 | 2 | | 1 | | 14 |
| 28 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 16 |
| 29 | 2 | 2 | 3 | 1 | 2 | 2 | | 1 | 1 | 3 | 3 | 1 | 21 |
| 30 | | | | | 1 | | 3 | | 2 | | 1 | 2 | 9 |
| 31 | 3 | 1 | | | 1 | | 6 | | 4 | | | | 15 |
| 32 | 1 | 1 | 3 | 1 | 1 | 1 | | | | | | | 8 |
| 33 | 11 | | 4 | 2 | 3 | | 12 | 1 | 9 | | | | 42 |
| 34 | 13 | | 7 | 1 | 5 | | | | | | | | 26 |
| 35 | 12 | | 9 | 1 | 1 | | 4 | 2 | | | | | 29 |
| 36 | 10 | | 9 | | 3 | | 7 | | 9 | 2 | | | 40 |
| 37 | 8 | 1 | 2 | | 3 | | | | 1 | | | | 15 |
| 38 | 3 | | 2 | 1 | 1 | 1 | 2 | | 2 | | 1 | | 13 |
| 39 | 3 | 2 | 6 | 1 | | | | | | | | | 12 |
| 40 | 1 | 1 | 3 | | | 1 | | | 2 | | 2 | 1 | 11 |
| 41 | 2 | | 2 | | 2 | | | 1 | | | | | 7 |
| 42 | | | 2 | 1 | 1 | 1 | 1 | | | 1 | | | 7 |
| 43 | | | 2 | | | | | | 1 | | | 2 | 5 |
| 44 | | | | 1 | | | | | 2 | 1 | 1 | 1 | 6 |
| 45 | | | 1 | | | 1 | | | | | | | 2 |
| 46 | | | 2 | 1 | | | | | | | | | 3 |
| 47 | | | 1 | 1 | | | | | | | | | 2 |
| 48 | | | | 3 | 3 | 1 | | | | | | | 7 |
| 49 | | | 1 | 1 | | | | | | | | | 2 |
| 50 | | | | | 3 | 1 | | | | | | | 4 |
| 51 | | | | | 3 | 1 | | | | | | | 4 |
| 52 | | | | | 3 | | | | 2 | 1 | | | 6 |
| Total trips per month | 122 | 32 | 106 | 34 | 73 | 39 | 60 | 16 | 63 | 37 | 39 | 22 | |

This decision to fishing individually is connected with utility maximization to congregate more fish to catch. During the low fishing season, this situation is more uncertain to find fishing target than the peak season. Otherwise, in the peak season, fishers prefer to set cooperative fishing expeditions because fish targets are abundant. Moreover, their fishing capacity is limited. For fishers or skippers, information about perfect fishing grounds is not crucial during low season. As long as they can catch fish and return to the fishing base, they can still yield profit. Racing for fishing is a rational action of fishers or skippers. Rational action does not imply self-interest. There's nothing irrational about sharing for others, believing in fairness, or sacrificing for a social ideal (Gintis 2009). And this characteristic explains why the fishers cooperate with one another and set fishing expeditions together. They act rationally to gain income for their fishing activities by making sound decisions during every expedition.

**Conclusions**. Analysis of fishing income from two options to set a fishing expedition revealed significant results. Income from group B (individual decision) was a significantly different from income of group A (cooperative decision). Meanwhile, fishing season also influences fishing revenue due to interaction between fishing decision and fishing season. This study demontrates that decisions made by mini purse seiner fishers during every fishing season can impact their income. The decision to fish cooperatively in low season leads to a low yield of fish caught. By contrast, fishing individually provides an opportunity to collect more fish.

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Authors:
Dian Ayunita Nugraheni Nurmala Dewi, Graduate School of Economics, Doctoral Program, Faculty of Economics and Business, Diponegoro University, Jl. Erlangga Tengah Semarang-50241, Indonesia; Faculty of Fisheries and Marine Sciences, Jl. Prof. Soedharto SH., Tembalang, Semarang 50275, Indonesia, e-mail: dianayunita_nnd@live.undip.ac.id
Deden Dinar Iskandar, Economics Department, Faculty of Economics and Business, Diponegoro University, Jl. Prof. Soedharto, SH., Tembalang, Semarang-50275, Indonesia, e-mail: deden.dinar@gmail.com

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