Do fishers need to diversify their source of income? A special reference in vulnerable fishers of Cilacap Waters, Indonesia

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Abstract. The purpose of this study is to analyze the effects of the variables of age, education, catch, and the number of family dependents, both together and separately, in diversified business activities of small-scale fishers in Cilacap. The study also aims to analyze the differences between the household incomes of the fishers who only fishing and the fishers who do diversification (processing). The used sampling method is simple random sampling. The total number of respondents = 60. In total, 41 respondents are fishers who simply live from fishing and 19 respondents are fishers who fish and perform diversification. The research used the analytic method called logistic regression. Based on the results of the logistic regression, we concluded that the variables of age, education, catch, and the number of family dependents together and separately result in a significantly positive sign toward the diversification of fishing. Fishers are still highly dependent on the catches of local fish stocks, with the contribution of utilization up to 68% of annual income. Fishers who choose to not diversify are mostly less educated, are not at a productive age, catch very little and have a small number of family dependents. It becomes necessary to strengthen institutional fishers and fisheries management resources/community-based co-management. To enhance the role of local institutions, priority programs should be implemented that provide training towards fish processing business diversification and form a joint venture for fisher's wives' groups.

Key Words: fisheries management resources, income diversification, small scale fisheries, institutional fishers, co-management.

Introduction. Indonesia is a maritime country that has 17,508 islands and a coastline of approximately 81,000 km. The total area of Indonesian waters reaches 75% of the entire region. This vast sea area has led the economic activity of many residents directly and indirectly towards the utilization of marine resources (Brotosusilo et al 2016; Susilowati et al 2018).

Fishery resources can potentially be exploited to improve the life of fishers. However, there are many fishers who have not been able to improve and utilize their catch, which leads to their income not being adequate to fulfill their daily needs (Olale & Henson 2012a; Olale & Henson 2012b; Olale & Henson 2013). Based on data from the Ministry of Maritime Affairs and Fisheries in 2012, there were 7.87 million poor fishers in Indonesia, which is 25.14 percent of the nationwide number of poor people. Their average income is slightly more than 32.97 USD/month. In fact, it often occurs that the fisher's income at sea is not comparable to their necessary operating costs. These operational costs become a burden for these fishers (Kusnadi 2009).

When income becomes increasingly difficult for fishers to earn, the creation of income sources from alternative means is the answer to their survival. Illo & Polo (1990) concluded that in order for fishers to survive and increase their household income, more diverse strategies are needed other than relying solely on the catching sector. Good diversification, agribusiness in coastal areas, and coastal-marine tourism activities are opportunities that are still open to development. Diversification is needed so that the fishers do not rely solely on one type of income.

One of the efforts that have been made by fishers in Cilacap to optimize their income and increase their prosperity is to engage in diversification. In this case, fish is processed into salted fish (gesek). However, not all the fishers do this. Approximately 10% of the total fishers in the fish auction perform this diversification. In fact, some fish auctions do not apply diversification at all.

Furthermore, this processing activity is not the fisher's main job. Many factors influence diversification both internally and externally. The lack of capital, skills and knowledge and erratic weather reduce the possibilities to perform diversification. In Kenya, education levels, access to credit and membership in an organization are key factors that determine the behavior of income diversification of fishers (Olale & Henson 2012a; Olale & Henson 2012b; Olale & Henson 2013).

Based on the above, it is necessary to assess the income of fishers based on whether they engage in diversification. Then, it is also necessary to study the factors that influence the fisher's behavior to engage in diversification in Cilacap, which include age, education, catch, and the number of dependents. Finally, we can obtain the appropriate empowerment strategies that can be used as policy to improve the living standards of fishers.

Material and Method. The method utilized in this study was survey method using direct interviews. The sample consisted of a group of 60 respondents (fishers) from the fish auction of Sidakaya in Cilacap. In total, 41 respondents were fishers who fishing at sea and 19 respondents were fishers who fishing and are engage in diversification.

A logit regression model was used to analyze the data. The model specifies that the dependent variable is a dichotomous or qualitative variable, and the independent variable can be either a quantitative variable or a qualitative variable (dummy). Mathematically, logit regression models can be written as follows (De Janvry & Sadoulet 2001; Lanjouw & Lanjouw 2001; Villarreal 2006; Abdulai & CroleRees 2001; Wouterse & Taylor 2008).

$$L(x) = ln\left(\frac{\pi(x)}{1-\pi(x)}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p$$

Based on a mathematical model, an econometric model can be formed as follows:

$$ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 \text{age} + \beta_2 \text{education} + \beta_3 \text{catch} + \beta_4 \text{ dependents} + e$$

Dependent variable:

P = proportion of fishers	=>	P = 1; fishers who fishing and diversify
		P = 0; fishers that only fishing

Independent variable:

Age (x1)	=>	Young age: ≤ 40 years old (comparison)
		Old age: > 41 years old
Education (x2)	=>	Low education: ≤ 6 years (comparison)
		High education: > 7 years
Catch (x3)	=>	Few results: ≤ 500 kg (comparison)
		Many results: > 501 kg
The number of dependents (x4)	=>	Few: ≤ 3 people (comparison)
		Many: > 4 people

Significance testing models and parameters:
Test of the entire model (G Test);
Wald Test: tests of significance of each parameter;
Test of Reduction Model.

Results and Discussion. There were four independent variables in this study, including age (years), education (years), the catch (kg) by counting the total number of catches during 2017, and the number of dependents in the home unit. The dependent variable in this study was the diversification of value 0 and 1, where 0 was for fishers who were not engaged in diversification and 1 was for fishers who were engaged in diversification.

The feasibility of the model is tested by assessing the overall fit of the model to the data. The hypothesis that was used to assess the model's fit is as follows:

H0>0.05: hypothesized model did not fit to the data.

H1< 0.05: hypothesized model fit the data.

By looking at the statistical value, -2 Log L could determine whether including additional variables into the model would significantly improve the model's fit. The difference -2 Log L for the model with constants only and -2 Log L for models with both constants and variables were distributed as X2 to df (difference df (n-k) for the second model). Based on the output from using the software Statistical Package for Social Sciences (SPSS) version 17.0, the binary logistical regression analysis showed the difference of -2 Log L amounted to 40.633 with df = 4 (59-55), and the figure is statistically significant. This means that the null hypothesis was rejected and the model was fit to the data.

Qualification Test with Negelkerke's R Square. Negelkerke's value R^2 could be interpreted as the value of R^2 in multiple regressions. Based on Table 1, the SPSS output value of Cox and Snell's R Square was 0.492 and Negelkerke's R2 value was 0.690. This means that 69.0% of the variability of the dependent variable could be explained by the variability of independent variables. The remaining 31.0% was explained by other variables that were not included in the model. These variables include the weather, free time for fishing, tastes/behavior, and others (but not examined in the present study).

Table 1

Qualification test with Negelkerke's R square

Value of -2 Log likelihood	*Value of Cox & Snell R Square*	*Value of Nagelkerke R Square*
34.287	0.492	0.690

According to Hamzens (2007), the main obstacle faced by small fishers in catching fish is unfavorable weather. If the weather is unfavorable, the number of catches decreases. In addition to delaying the departure to sea, there is no good solution to overcome unfavorable weather. The Indonesian Greenaction Forum/GEF Small Grants Programme in 2014 has charted the adaptation of fisheries to climate change and variability in Cilacap waters based on the effects of El Nino and La Nina as global phenomena that affect the rainfall in this region of Indonesia (Climate Change Center 2014).

According the Hamzens (2007), the spare time of fishers if they do not go to sea can be used in various ways. Rismayani (2012) denotes the allocation of free time for fishers when not fishing as 35.61% sleep, 19.13% other, 18.15% watching TV, 7.39% farming, 4.73% rest, 4.01% meals, 3.98% worship, 3.41% net repair, 2.27% communal work, 1.01% seeking improvements and 0.35% travel to their house.

Prihandoko et al (2012) has estimated the behavior accurately using the perspective of planned behavior theory for artisanal fishers in Indonesia. This theory can be used to examine the intentions and behaviors of artisanal fishers. The coefficient determination from the variables attitudes, subjective norms, and perceived behavioral control against the intention to behave was at the level of 64%. A subsequent finding for the coefficient determination of behavioral variables indicates a level of 47%, so the influence of other variables that had been not observed was at level of 53%. In other words, no conclusions can be made regarding fisher's behavioral intentions.

Qualification test with Hosmer and Lemeshow's Goodness of fit test. If the value of Hosmer and Lemeshow's Goodness of Fit statistics were equal to or less than 0.05, the null hypothesis was rejected, which meant there were significant differences between the models with the observations value. Therefore, the goodness of fit model was not good because the model could not predict the value of observations. If the statistical value of Hosmer and Lemeshow's Goodness of Fit is greater than 0.05, then the Null Hypothesis H0 was accepted, which means that the model was able to predict the values of observation or the models fit with the data observations.

In Table 2, the SPSS output on the display showed the statistical value of Hosmer and Lemeshow's Goodness of Fit of 8.823 with a p value of 0.357. This value was well above 0.05, so it could be concluded that the Null Hypothesis was received, which meant that the model was able to predict the observed values.

Table 2

Qualification test with Hosmer and Lemeshow's goodness of fit test

Value of Chi-square	*Degree of Freedom (Df)*	*Significance*
8.823	8	0.357

Qualification test with classification table. Based on Table 3, classification was calculated using the estimated value of the true (correct) and wrong (incorrect). In the column, there were two predicted values of the dependent variable. A value of 1 indicated diversification and 0 was no diversification, whereas in the line indicated the actual observed values of the dependent variables 1 and 0. A perfect model of all cases would be on the diagonal, with a prediction accuracy rate of 100%. The SPSS results showed that the prediction accuracy of this model was at 86.7%.

Table 3

Qualification test with classification table

Respondents		*Predicted*		
		Doing diversification		*Percentage prediction accuracy*
		0.00	1.00	
Doing diversification	0.00	38	3	92.7
	1.00	5	14	73.7
Total percentage	-	-	-	86.7

Parameter estimation and its interpretation. Maximum estimation of parameters could be viewed on the display outputs of the results of the logistical regression estimation. Based on estimation in Table 4, the logistic regression (logit) could be expressed as follows:

$$ln\left(\frac{\mathrm{p}}{1-\mathrm{p}}\right) = -25.186 + 0.188\ \mathrm{X1} + 0.895\ \mathrm{X2} + 0.09\ \mathrm{X3} + 1.461\ \mathrm{X4}$$

Table 4

Value of parameter estimation

Specification	*Coefficient (B)*	*Standard error*	*T-Value (Wald)*	*Degree of freedom (Df)*	*Sig.*	*Probability (Exp(B))*
Age (X1)	0.188	0.098	3.678	1	0.055	1.207
Education (X2)	0.895	0.367	5.960	1	0.015	2.447
Catch (X3)	0.009	0.003	10.908	1	0.001	1.009
Dependents no. (X4)	1.461	0.584	6.249	1	0.012	4.310
Constants	-25.186	8.303	9.201	1	0.002	0.000

Sig. – significance.

The significance in the Table 4 showed the effect of each independent variable on the dependent variable. The independent variables in this study would have a significant effect if their significance value (Sig.) was less than 0.05 and 0.1.

For the independent variables, the probability of significant age was 0.055. The probability of education was 0.015. The probability of significant catch was 0.01. The probability of number of dependents was 0.012. From the logistic regression equation, it could be seen that the log of the odds fishers to diversify is positively related to the age of fishers, the level of education of fishers, catches and the number of dependents.

Any increase in age while the other variables were constant would raise the log of the odds fishers to diversify by 0.188. If age and other variables were held constant, an increase in education would raise the log of the odds of fishers to diversify by 0.895. If age and other variables were held constant, an increase of catch size would raise the log of the odds fishers to diversify by 0.009. Furthermore, if age and other variables were held constant, an increase of number of dependents would increase the log of the odds fishers to diversify by 1.461.

The relationship between the odds and the independent variables are described below. The risk odds are the ratio between the probability of an occurrence and no occurrence of an event. The interpretation of coefficients in the regression model was any increase in the unit of the independent variables that would result in the risk of Y = 1 exp (B) times greater.

Age variable. The independent variable age has a positive and significant influence of 0.188, which meant that older fishers had a higher probability to diversify their business. With an Exp (B) of 1.207, older fishers were 1.207 times more likely to diversify than younger fishers. In terms of age, it could be concluded that the fishers who do diversify were the 41 to 50-year-old fishers.

In Table 5, it could be seen from the results of the cross-tab that, at ≤30 years old, only 1 fishers diversified, while the other 14 did not. In the 31 to 40 years old fishers, 4 fishers diversified while 18 did not. Finally, with the fishers 41 to 50 years old, 14 fishers diversified while 9 did not.

According to Simanjuntak (1985), the working performance of older people decreased because of their age. When the fishers got older, their physical abilities to fish decreased, and this reduced their catch and ultimately lowered their income level. Business diversification is one solution that can overcome this loss. Older fishers also are less able to diversify into the agricultural business, so they prefer to diversify by utilizing existing resources, such as processing fish into salted fish (gesek).

Table 5

Value of Cross-tab (age * diversification)

Age category	*Diversification*		*Total*
	No diversification	*Diversification*	
<= 30	14	1	15
31 – 40	18	4	22
41 – 50	9	14	23
Total	41	19	60

Education variable. The education variable gave a positive and significant effect of 0.895, which meant that fishers with higher education levels, such as middle and high school, had a high probability of business diversification. The Exp (B) showed a figure of 2.447, which meant that middle and high school educated fishers were 2.447 times more likely to diversify than less educated fishers (primary school).

In Table 6, the results of cross tabulation (cross-tab) showed that 1 fisher who did not attend school did not diversify his business. Then, there were 2 primary school educated fishers who diversified and 17 who did not. There were 4 middle school educated fishers who diversified and 18 who did not. Finally, there were 13 high school educated fishers who diversified and 5 that did not.

Table 6

Value of cross-tab (education * diversification)

Education	*Diversification*		*Total*
	No diversification	*Diversification*	
Not attend school	1	0	1
Primary school	17	2	19
Middle school	18	4	22
High school	5	13	18
Total	41	19	60

These results occurred because the educated fishers with skills and higher consciousness continued to increase their income compared to the fishers with lower education. With higher awareness and skills, fishers would try to innovate with their catch. When the price of fish in auctions was relatively cheap the results changed. This created innovation by fishers processing fish into salted fish to give an added value to their production.

Catch variable. Like the previous two variables, catch also had a positive and significant effect of 0.09, with an Exp (B) of 1.009. This situation meant that fishers with more catches (>501 kg) were more likely to diversify, as opposed to fishers with catches under 500 kg.

In Table 7, on the cross-tab results, we see that there were 6 fishers with catches less than or equal to 300 kg who did not diversify. With the fishers who had catches of between 301-600 kg, 3 fishers diversified and 21 fishers did not. With the fishers with 601-900 kg catches, 2 fishers diversified and 12 fishers did not. Finally, with the fishers with catches of ≥901 kg, 14 fishers diversified and 2 fishers did not.

Table 7

Value of cross-tab (catch x diversification)

Catch (kg)	*Diversification*		*Total*
	No diversification	*Diversification*	
≤300	6	0	6
301 - 600	21	3	24
601 - 900	12	2	14
≥ 901	2	14	16
Total	41	19	60

Having more catches would mean more innovation by fishers would provide more additional value to the catch. They could diversify with salted fish processing so that they did not only depend on the price of raw fish. This is very advisable because when the result of fish catches is abundant, the auction prices decline.

Number of dependents variable. The number of dependents variable has a positive and significant impact on diversification. The fishers who have more dependents felt they had enough free time to do the processing and preferred diversifying.

In Table 8, the results can be seen in the cross-tabulations (Cross-tab). There were five fishers who did not have dependents, and they did not diversify. With the fishers who had one child/dependent, there were four fishers that did not diversify and five fishers who did. Then, with the fishers who had two children/dependents, five fishers diversified and twenty-three fishers did not. With the fishers who had three children/dependents, there were five fishers who diversified and eight fishers that did not. Finally, with the fishers who had four children/dependents, four fishers diversified and one fisher did not.

Table 8

Value of cross-tab (number of the dependents x diversification)

Number of the dependents	*Diversification*		*Total*
	No diversification	*Diversification*	
Did not have dependents	5	0	5
One child	4	5	9
Two children	23	5	28
Three children	8	5	13
Four children	1	4	5
Total	41	19	60

Research that was conducted by Roosganda (2007) stated that diversification is an effort to earn extra income to meet daily needs and support dependents. The increasing numbers of dependents meant diversification was more likely. This would motivate the fishers to work harder for additional income for their family.

Based on the elaboration above, it was found that partially, age, education, catch, and the number of dependents influenced business diversification. Then, together, the variables of age, education, catch, and the number of dependents provided a significant effect on the diversification of fisher's efforts. In Table 9, the income of fishers from diversification provides them with greater incomes.

The condition of marine capture fisheries in the north of Central Java and Cilacap are already experiencing overfishing (Pomeroy 2012; Suharno et al 2016; Suharno et al 2017b; and Suharno et al 2017a). The state of marine resources is increasingly degraded, characterized by declining fish stocks, and the activity of the fishing community should limit exploiting the sea (Pomeroy 2012; Perret & Yuerlita 2014; Stoop et al 2016).

According to Dasgupta (1993), diversification becomes a more attractive choice when resource degradation worsens. Some parties supported this hypothesis by Dasgupta (Reardon & Vosti 1995; Forsyth et al 1998; Swinton et al 2003; Ellis & Allison 2004; Barbier 2010; Suharno & Widayati 2015; Stoop et al 2016), but the level of diversification of the small-scale fisheries sector was still low and has not been able to eliminate saturation in exploited marine conditions. The fishing communities in the study sample are still highly dependent on local fish stocks, with the contribution of utilization up to 68% of annual income. This dependence will continue to put pressure on marine resources. Without access options in other sectors becoming more attractive (Carter & Barrett 2006; Carter et al 2007), this might pose a real danger for the community to fall into the poverty-environment trap. The research findings indicate that the limited degree of diversification comes from the lack of effective institutions to manage local institutions, and the limited access for most of the sample to have another more attractive option. Low levels of income diversification belong mostly to fishers with productive ages.

One way to reduce the degradation is to diversify the income and develop other activities outside the fishing sector (Perret & Yuerlita 2014; Finkbeiner 2015; Stoop et al 2016). According Stoop et al (2016), a higher level of income diversification usually occurs in areas where natural resource degradation is more severe.

Analysis of studies confirms the importance of education in order to increase the interest of fishers in diversification, with the higher levels of education leading to higher degrees of income diversification. In our sample, 44% of respondents who did not diversify only completed a middle school education. Similarly, 44% of those who did not diversify are in the productive age range of 31-40 years. Additionally, 51% of those who did not diversify had catches of between 301-600 kg. Finally, 56 % of those who did not diversify had 2 dependents. It can be concluded that the fishers who choose not to diversify are mostly poorly educated, of productive age, possess a relatively smaller total catch, and a have a small number of family dependents.

When linked with the future, the study also looks at more in-depth ways to cut resource degradation through education in schools (Stoop et al 2016). So far, government support means that young people of compulsory school age must complete a minimum of 12 years. Degradation that occurs continuously on fish stocks and declining incomes in the fisheries sector will reduce the attractiveness of the sector and will make parents more eager to support their children with a minimum of 12 years of compulsory school.

Linked to poverty, the rural poor are concentrated in less developed regions and have a long history (Barbier 2010). The poverty-environment trap, with a variety of complex and unique phenomena, should be immediately terminated as a way of realizing empowerment of the poor. Empowering fishers must be comprehensive and include the following strategies: (1) be locally based, involving local natural and human resources that can be enjoyed by the local community; (2) improve the welfare (emphasize the welfare of society and not an increase in production); (3) be based on partnership (mutual partnership between the locals can open up access to technology, markets, knowledge, capital, better management, and socially broader business; (4) use holistic/multiple aspects (development reaches all aspects, every local resource is noteworthy and utilized); and (5) practice sustainability (of the construction itself, covering economic and social aspects) (Ministry of Maritime Affairs and Fisheries 2003).

Table 9

The results of the specific income diversification

Income criteria of fishers (USD)	*No diversification*	*Diversification*
< 658.75	7	0
658.76 – 1,317.39	20	11
1,317.40 – 1,976.08	10	2
1,976.09 – 2,634.66	3	3
2,634.67 – 3,293.32	1	1
3,293.33 – 3,951.98	0	2
3,951.99 – 4,610.47	0	0
> 4,610.48	0	0
Total	41	19
Minimal	287.24	658.69
Maximal	3,152.19	3,299.62
Average	1,201.06	1,377.32
Standard deviation	598.50	964.56

Sources: Primary data processed, 2017.

Conclusions. Age, education, catch, and the number of dependents give positive effects, significant impacts, and influence the diversification of the fishers in the Cilacap regency. Fishers who have diversified with products such as salted fish have an average income of 1,377.32 USD/year. The fishers who do not diversify have average annual income of 1,201.06 USD.

Program developments that lead to increased income diversification for community-based fishers should include, among others: 1) development of access to capital through the allocation of government funds and access to larger loans from banks; 2) development of technology and business-scale fisheries; 3) development of market access through wider access of the catch and the improvement of the development of market access for poor fishers; 4) institutional strengthening of fishers through the action of social solidarity and collectivity of society into groups (national and local governments positioned as a manager to provide insight, knowledge and skills, and education management of fishing effort), which will encourage social capital fishers independence and social and economic strength; 5) resource management community-based fisheries through accommodation community involvement in the management of resource based fisheries participation. A central element of co-management (co-management is a partnership between government, communities and other resource users) implementing a concept where the various interested parties (stakeholders) agree to share management roles, rights and responsibilities on natural resources, with the primary goal of being more precise, efficient, equitable and even; and 6) the development of facilities and infrastructure to support fishing efforts.

To enhance the role of local institutions, there are two priority programs that can be implemented. The first priority program provides training in diversified fish processing, and the second forms a group of joint ventures for the fishers's wives. Since economic activities in the village are still individual, there is no joint venture of fishing communities. Employment that occurs is between superiors and subordinates, or the owner of the boat with a fishing boat worker’s sharing system. When workers do not go to sea fishing, the boat owners also do not get revenue.

The first priority should be to provide diversification and skill training to members of the group. Without the skills of each member of the group, the business activities would be performed in vain. This type of training depends on the interest of each member and the availability of natural resources. Examples of appropriate skills training would be turning fish processing into products with added value, such as smoked fish, salted fish, and milkfish from the catch of local fishers. Forming a group of joint ventures for the fishers's wives is an effort that is also realistic for the wives of fishers who do not have steady jobs. Conducting joint ventures would provide jobs to help supplement family incomes. The business activities could be done in groups, with these activities including process-based foods such fish nuggets and shredded fish.

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