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Sustainable Fisheries Adaptation of *Terubok* Coastal Area in Sarawak, Malaysia

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Abstract

Sustainable ways of fishing has been applied worldwide as the population of fish is decreasing due to heavy fishing and overexploitation. The famous fish in Sarawak, Tropical shad *Tenualosa* which locally known as *ikan terubok* (*Terubok* fish) is also experiencing a

major decline in its population. Therefore, the goal of this study is to investigate the most preferable ways to increase the number of *Terubok* population in Sarawak. This study reveals that, the regulation factor is the most preferable ways in increasing the number of *Terubok* population followed by conservation and economics factor. Besides, the willingness to accept (WTA) estimation by using Contingent Valuation Method (CVM) shows that the average amount of compensation that will be given to the *Terubok* fisherman in order to conserve the *Terubok* populations is RM 301.08.

Keywords: sustainable fishing, willingness to accept, contingent valuation method, tropical shad *Tenualosa* (*Terubok)*

1. Introduction

The tropical shad of the Clupidae family is an important estuarine fish for both cultural and commercial needs and these species are unique as they are protandrous hermaphrodite (Blaber *et al.*, 1996). In the Sarawak River, there are two types of *Tenualosa* or locally known as *ikan Terubok that* can be found which are *Tenualosa toli* and *Tenualosa macura.* As claimed by Rajali (1991), *Tenualosa toli* can be found at the river estuary of Batang Lupar, Batang Saribas, Batang Lassa and Batang Sadong whereas *Tenualosa macura* can be found at Sebuyau, Batang Sadong, Batang Saribas and Batang Lassa. Blaber, Milton, Chenery & Fry (2003) stated that both *toli* and *macura* have a great cultural significance in Sarawak and commercially fished for their eggs which can be sold at a very high price. However, the *Tenualosa* species is suffering from a major decline due to heavy fishing and overexploitation since 1980's (Rahim *et al.*, 2014). Therefore, the Enforcement and Licensing Unit (ELU) of Sarawak had come out with a program called Close Season Program (CSP) in 2007 until 2012. The main goal of this program is to ensure the *Terubok* population can be increased.

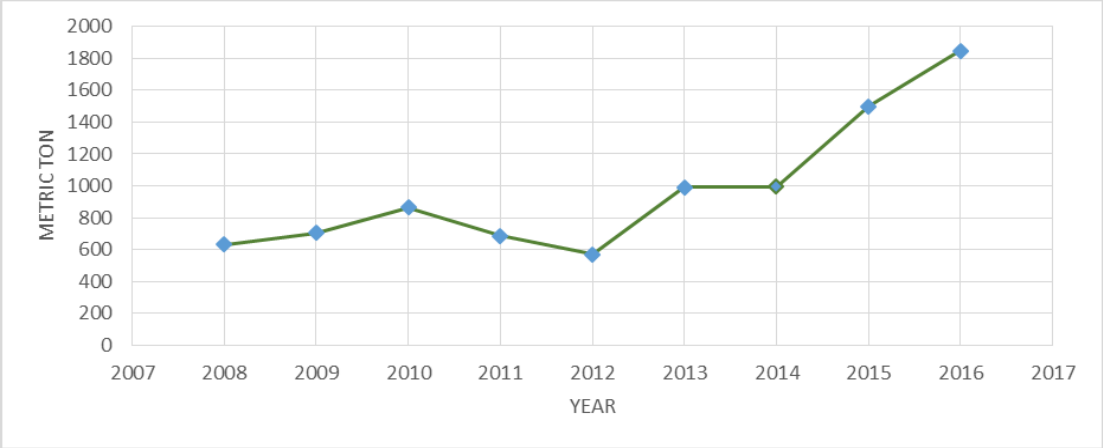

Figure 1. Total Landing of Tenualosa Macura and Tenualosa Toli

Source: Department of Fisheries Malaysia (2017)

As shown in Figure 1, the trend of *toli* and *macura's* total landing is stable during CSP as the population is well sustained and monitored by fisheries department. However, the total landing of toli and macura had increased drastically after the CSP ended in 2012. This indicates that the *Terubok* population is increasing during CSP and it shows that this program

is a success in increasing the number of *Terubok*. It is worrying that if the total landing of both *Tenualosa* increasing from year to year, it will diminish the number of *Terubok's* population. Therefore, it is crucial to have an effective conservation approach to sustain and protect these species such as to have a sustainable ways of fishing *Terubok*.

The terms sustainable is defined as meeting individual's needs without affecting the ability of the future generations to meet their own needs (Mason, 2018). In short, sustainable refers to conserving an ecological balance in order to avoid the reduction of natural resources. Meanwhile, sustainability is known as maintaining a stock size above some minimum safe level (Gudmundsson & Wessells, 2000). The issues that lead to the overexploitation of the natural resources such as *Terubok* can be overcome by having a sustainable fisheries management as well as promoting sustainability to people. Therefore it is important to promote a sustainable ways of fishing in order to allow the population of the fish is in their golden era as well as providing a profitable fishery industry for the fisherman.

Sustainable ways of fishing has been widely used to ensure that the fish population can be sustained and maintained for the use of the future generation. In the study of Grafton *et al.* (2006), the researchers highlighted four main driver in promoting sustainable ways of fishing which are appropriate fisher incentives, more public research, effective oversight and monitoring by the responsible body. On top of that, an appropriate regulations and regular enforcement should be implemented besides the incentives for the fishers in order to support a sustainable fishery (Conrad & Danoff-Burg, 2011). Ezhim & Asogwa (2018) added that the regulations have to be simple and understandable by the fishers so that it is easier for them to act upon the sustainable ways of fishing

2. Study Area

This study is conducted in a few division in Sarawak which consist of Terubok fisherman. The core Terubok areas are selected as the study area as suggested by the Sarawak Inland Fisheries Centre. For that reason, this study will be carried out at Batang Lupar, Lingga in Sri Aman division, Batang Lassa, Daro in Mukah division and Batang Sadong, Ladong in Samarahan division.

Figure 2. Core *Terubok* Areas in Sarawak

Source: Google Maps (2018)

The data for the *Terubok* fisherman is provided by the Sarawak Inland Fisheries Centre and there are 250 respondents that has been interviewed which consist only the *Terubok* fisherman at the core terubok areas.

3. Questionnaire Design

The data is collected by using questionnaire to obtain the *Terubok's* fisherman WTA amount. The questionnaire is designed in Malay language as it is easier for the fisherman to understand it. A total of 250 questionnaire were issued and only 200 questionnaire were valid for estimation. This study employed stratified sampling as the target respondents are only the *Terubok* fisherman that is monitored by the Sarawak Inland Fisheries and areas of sampling are conducted at the core *Terubok* areas.

In order to estimate the fisherman's WTA, the questionnaire will be divided into three sections. Section I will be on the attitudinal questions where the information collected is used to measure a particular attributes of a products or services. In short, it is a measure on how the consumer feels about something. In this case, the attitudinal questions are presented to the fisherman in order to identify their opinion on *Terubok*.

In Section II, the contingent valuation questions which is the hypothetical scenario will be presented. The fisherman will be given a scenario that explains the current situation of *Terubok* and the *Terubok's* fisherman will be ask on their WTA amount with different amount of bids in different questionnaire. On top of that, the fisherman will also be asked on their maximum amount of WTA that they desire considering their income that they earn every month.

Lastly in Section III is the sociodemographic questions which is a common sections in any survey. It is important to include this section as it is important to identify the respondents information and details to ensure that the study are reaching out for the exact target audience.

4. Statistical Analysis Methods

4.1 Exploratory Factor Analysis (EFA)

The level of confidence of EFA on the data can be determine by using Kaiser-Meyer-Olkin (KMO) and Bartlett sphericity test (Hair, Black, Babin, Anderson & Tatham, 2005). The KMO test presents the normalized value which is between 0 to 1.0. If the value of KMO is less than 0.5, it indicates the factor analysis method is not suitable for data processing. On the other hand, if the value of KMO is above 0.5, the method is adequate for data processing by using factor analysis method (Kaiser, 1974). Besides, Bartlett sphericity test is based on the chisquare distribution and the null hypothesis for the test is there is no correlation between the variables. The data is not suitable for factor analysis as the significance level is greater than 0.10, hence, the null hypothesis cannot be rejected (Gorsuch, 1973).The application of factor analysis is widely used in conducting research which for example in a study by Christensen & Raakjær (2006) they employ factor analysis to analyse the differences in the tactical decisions of fisherman. Other than that, the factor analysis is used a study by Bewal, Bewal & Al Jabri (2015) to estimate the training needs by the fisherman at Banitah coast in

Oman. Factor analysis is a technique used to group similar variables which is presented in the attitudinal question into dimensions (Fabrigar, Wegener, MacCallum & Strahan, 1999). Usually, this analysis is employed to identify the factors that may be used to represent the relationship among the interrelated variables and also explains the pattern of correlation within the observed variable in a Likert-scale (George & Mallery, 2010). For the purpose of this study, Exploratory Factor Analysis (EFA) is conducted to identify in what way the Likert scale variable is related and grouped to form a construct (Maciel *et al.*, 2013). The goal of conducting EFA is to reduce the number of observed variable which is not related to explain the components as latent construct (Bewal, Bewal & Al Jabri, 2015). EFA is conducted on 22 items of interest in identifying the major variables which explains the WTA of the *Terubok's* fisherman.

4.2 Reliability Test

On top of that, reliability test is used to describe the overall consistency of a measure. The reliability coefficient that is shown by the Cronbach's Alpha indicates how well the items are correlated in a set of question (Sekaran & Bougie, 2016). The higher the coefficient of the Cronbach's alpha it indicates the higher internal consistency of reliability.

4.3 Contingent Valuation Method (CVM)

In order to estimate the willingness to accept (WTA), contingent valuation method (CVM) are often used as the method to measure the welfare losses and gained (Brown & Gregory, 1999). Since CVM is classified under Stated Preferences approach, therefore it is used to gain the information of their preferences by doing the hypothetical payment scenarios and this information is then used to produce the monetary values of people's WTA. WTA can be defined as the minimum amount of compensation that will be given to the community for the changes that might affect them (Haneman, 1991; Shogren & Hayes, 1997).

5. Results and Discussion

5.1 Sociodemographic of the Respondents

From the results, it shows that 97.5% of male are involved in the fishing activity compared to only 2.5% of female. The average age for the respondents is 51 years while the mean of the household size is seven. In average, the respondents had become *Terubok* fisherman for almost 24 years. Majority of the respondents are consist of Melanau with percentage of 49% followed by Melayu and Iban with 36.5% and 12.5% respectively. Chinese and Lunbawang are the minority with 1.5% and 0.5% correspondingly. Most of the respondents had primary education by 45%, 28% of them had no formal education, 28% had attend secondary school and only 1% had a diploma. Besides, 48% of the respondents had earned income range between RM500 to RM 1000 per month while 42% had earned less than RM 500. Only 10% of the respondents had earned income more than RM 1000 per month.

The logit model is used to estimate the goodness-of-fit indicated by the coefficient of determination (R^2) of 0.232. This indicates that, about 23 percent of the variation in the dependent variable is explained by the variations in the independent variables.

5.2 Exploratory Factor Analysis (EFA) and Reliability Test

The Kaiser–Meyer–Olkin (KMO) Measure of Sampling Adequacy is 0.708. This indicates that factor analysis is suitable to be used for data processing. According to Kaiser (1974), 0.708 is middling level of inter correlations among the items. Likewise, Bartlett's test of sphericity showed that there is a correlation between the variable since the level of significant is less than 0.10. The EFA is done over the 22 items of the Likert scale variable to identify the categories that belongs to the items. The factors along with their given names, items that belongs to each of the factor and their Cronbach's alpha scores are presented in Table 1. Based on the coefficient of Cronbach's alpha presented in Table 1, there are 3 aspect that are reliable in promoting sustainable Terubok fisheries which is regulation, conservation and economics. The closer Cronbach's alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale (Zickmund, 2003). According to the rule of thumb, regulation aspect has a very good strength of association. The frequency of each item in factor 1 is presented in Figure 3 to 6.

Table 1. Factor Analysis and Reliability Test Results

Factor 1: Regulations

No	Item
1	By limiting the **catching season**, it can control and conserve the population of the *Terubok* fish in the Sarawak River
2	By imposing a quarantine **fishing quota** can control and conserve the population of the *Terubok* fish in the Sarawak River
3	By **limiting capture days** it can control and conserve the population of *Terubok* fish in the Sarawak River.
4	By **limiting the use of catching tools** can control and conserve the population of the *Terubok* fish in the Sarawak River
Cronbach's Alpha	**0.853**

Factor 2: Conservation

No	Item
1	The *Terubok* population is conserved to ensure that **future generations** can enjoy Sarawak's *Terubok*
2	The *Terubok* population is conserved so that it will ensure **long-term fishery resources**
Cronbach's Alpha	**0.714**

Factor 3: Economics

No	Item
1	The *Terubok* fish can **increase the people's love** for Sarawak
2	The *Terubok* fish can **provide economic benefits** to Sarawak
3	By preserving the stock of *Terubok* fish, it can provide **income to fishermen** in the future
4	By preserving the stock of *Terubok* it can ensure the **continuity** of fishing for the **next generation**
5	*Terubok* is a natural source of storage for future use
Cronbach's Alpha	**0.672**

The item in Factor 1 which is regulation is further discussed as the Cronbach's Alpha is 0.853 which indicates that the factor is the most reliable factor that may affect the willingness to accept compensation by the *Terubok's* fisherman.

Item 1: By limiting the **catching season**, it can control and conserve the population of the *Terubok* in the Sarawak River

Figure 3 shows the frequency distribution of item 1. It shows that 91 respondents which is equivalent to 45.5 percent agreed that the catching season limitation may help in controlling and conserving the *Terubok* population whereby 30.5 percent of the respondents disagree on the regulations.

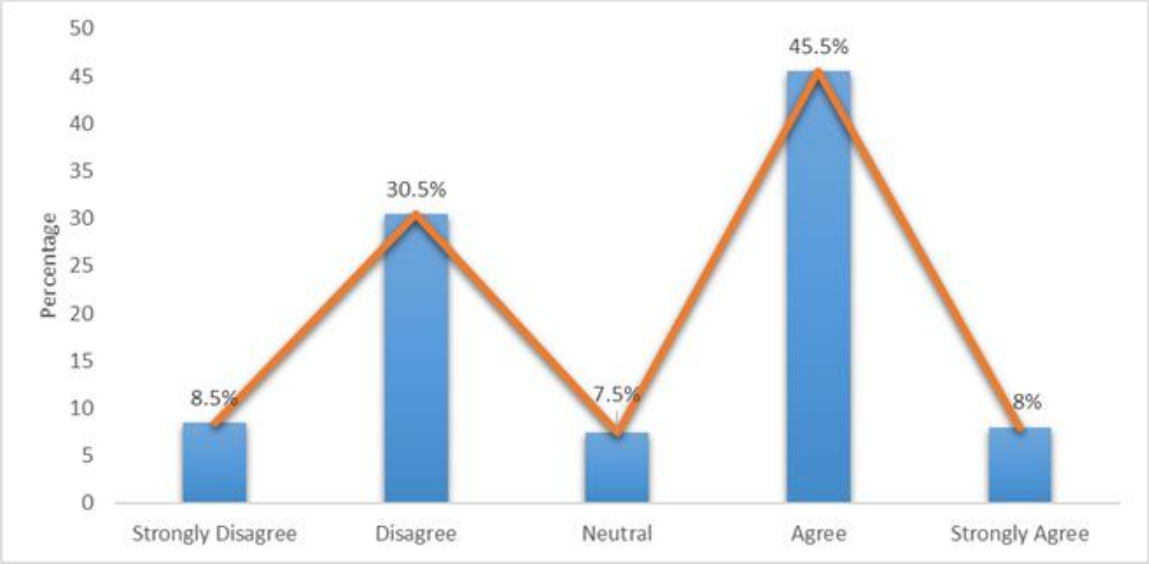

Figure 3. Frequency Distribution of Catching Season Response

Item 2: By imposing a **fishing quota** can control and conserve the population of the *Terubok* in the Sarawak River

Figure 4 shows the frequency distribution of item 2. It shows that 79 respondents which is equivalent to 39.5 percent agreed that the imposing a fishing quota may help in controlling and conserving the *Terubok* population whereby 32.5 percent of the respondents disagree on the regulations. 15 respondents agreed that the fishing quota may help in conserving the *Terubok* population compared to 19 respondents who strongly disagree.

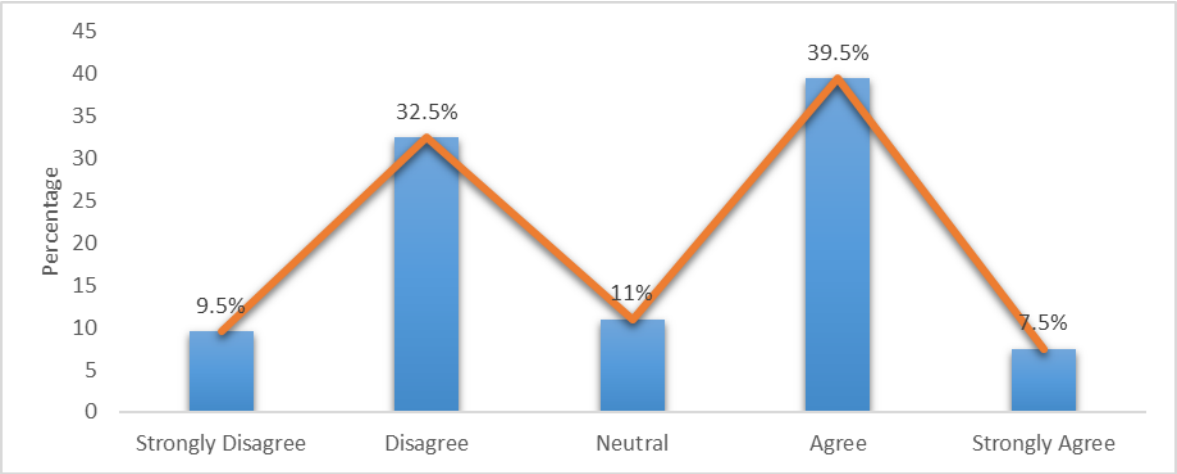

Figure 4. Frequency Distribution of Fishing Quota Response

Item 3: By **limiting capture days** it can control and conserve the population of *Terubok* in the Sarawak River

Figure 5 shows the frequency distribution of item 3. The results shows that 43.5 percent of the respondents agreed that the *Terubok* population can be conserved by limiting capture days of *Terubok* whereas 29 percent of the respondents disagreed. 18 of the respondents is neither agreed no disagreed on the regulations. On top of that, 10.5 percent of the respondents strongly disagree that the limitation of *Terubok* capturing days can control the *Terubok* population and at the same time it can be conserved. However, 16 respondent strongly agree on the regulation.

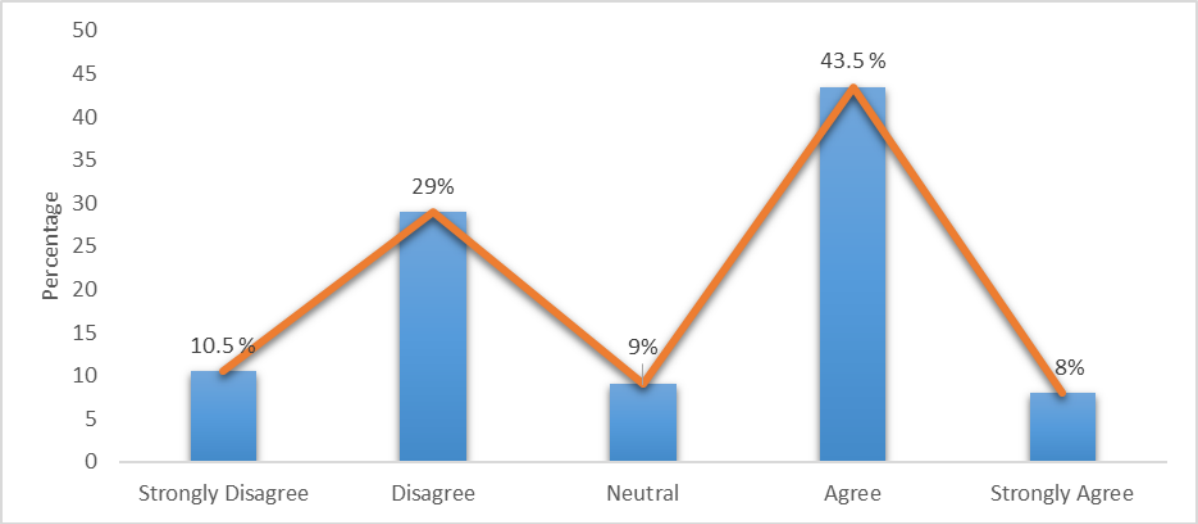

Figure 5. Frequency Distribution Limiting Capture Days Response

Item 4: By **limiting the use of catching tools** can control and conserve the population of the *Terubok* fish in the Sarawak River

Figure 6 shows that 5.5 percent of the respondents strongly disagree that the catching tools may help in controlling and conserving the *Terubok* population while 21.5 percent disagree

on the matter. However, the results shows that 88 out of 200 respondents agree that the catching tools used by the fisherman can help to control and conserve the population of *Terubok* in the Sarawak River. Meanwhile 16.5 percent of the respondents strongly agree that the catching tools can control and conserve *Terubok* population.

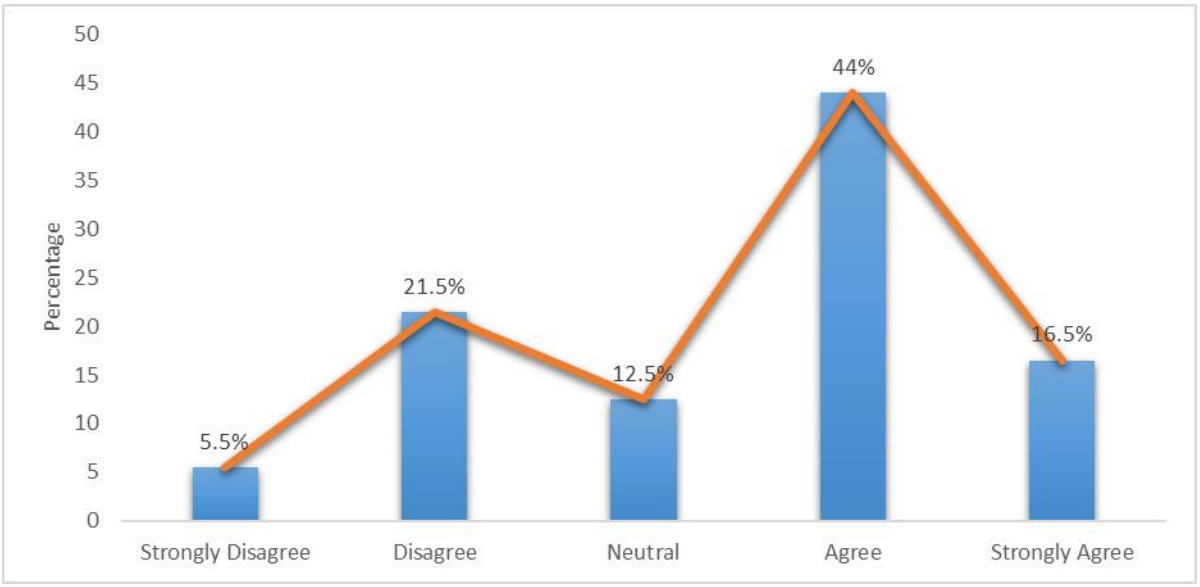

Figure 6. Frequency Distribution Catching Tools Limitations

5.3 Contingent Valuation Method (CVM)

The CVM results shows that the mean value of WTA is RM 301.08 which means that in average the compensation that is received by the *Terubok* fisherman is RM 301.08 in order to enhance the sustainability of *Terubok* as well as to conserve the population. The total value of WTA for 200 fisherman is RM 60,216 and the maximum amount of WTA by the fisherman is RM 822.89.

6. Conclusion and Recommendation

The species of *Tenualosa toli* and *Tenualosa macura* is an important marine creatures to Sarawak as it is a source of income for the nation. However, the major decline in the population due to heavy fishing and overexploitation is worrying if there is no proper ways to curb this problem. Among the three aspect that had been tested, regulation aspect seems to be reliable in order to maintain the sustainability of *Terubok* as well as to conserve the population for the next generation. Therefore, factor analysis result shows that 91 respondents which is equivalent to 45.5 percent agreed that limiting the *Terubok's* catching season may help in controlling and conserving the population of *Terubok* as well as to enhance the sustainability of the population. The compensation that the *Terubok*'s fisherman will receive per month is RM 301.08 on average and the maximum amount of compensation is RM 822.89.

The fisheries department of Sarawak need to take into account the regulation aspect that may help in improving the long-term sustainability of *Terubok* in Sarawak. Besides, the department need to educate the fisherman on the regulation that had been outline by

conducting a training program on the sustainable ways of catching *Terubok* so that the fisherman will have a clear idea on it. On top of that, the department can produce a schedule for each of the fisherman on the allowed days of capturing *Terubok* during the season. The fishing quota of *Terubok* should also be emphasized other than limiting the catching tools used to catch *Terubok* in order to sustain the population as well as to promote the sustainable ways of fishing. Furthermore, the awareness of the *Terubok* fishers on the importance of sustainable fishing should also be increase so that the long-tern sustainability of *Terubok* can be achieved.

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