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Original Research Article

Effects of Land Reclamation Activities on Fish Catch Among Fishermen at Merambong Shoal, Johor

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Abstract: The fisheries community is a community that is highly dependent on the fisheries sector, and they usually live near the coastal area. However, land reclamation activities are conducted in the coastal area for development and urbanization due to the increasing population. Consequently, the land reclamation activities degraded the habitat of the fish and caused a decrease in their productivity. This study investigated the effects of land reclamation activities on fish catch among fishermen. Using convenience sampling, 79 fishermen in the Merambong Shoal were selected, and a structured questionnaire was constructed to get responses from these fishermen. Descriptive analysis, factor analysis, and multiple regression analysis were used to analyze the data. The study revealed that the number of trips, duration of fishermen to catch fish, distance of fishing ground from the coast, number of crew, and government incentives were the factors that affected the fish catch. These factors have significant relationships with the quantity of fish catch, which directly impacts income and, at the same time, affects livelihoods. The role of the government in increasing the monetary incentives and subsidies to improve the fishermen's fishing operations was highly recommended.

Keywords: fishermen; fish catch; land; reclamation; fishery community

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1. Introduction

Reclamation is conducted and has played a significant role in the urban development process in the coastal area in many parts of the world. Reclamation has become an effective method to overcome the land shortage problem due to the increasing number of people living in the coastal area and the development of the cities (Cipriani, 2022; Cui *et al.*, 2016; Zhang *et al.*, 2013). Reclamation in Malaysia started in the 18th century in Kedah for agricultural purposes when wet rice cultivation was introduced (Hisham & Ghazali, 2006). Besides

Kedah, states such as Penang, Melaka, and Labuan are pioneers of coastal land reclamation projects in Malaysia (Cipriani, 2022; Kaparawi & Abdul Latif, 1996).

According to Yusoff *et al.* (2006), about 76 coastline reclamation projects along the West coast of Peninsular Malaysia cover 97,000 ha. Many small-scale reclamation projects, such as Penang, Malacca, Labuan, Langkawi, and Kota Kinabalu, have been successfully implemented in several parts of the country, either as public or private sector projects. The purpose of land reclamation has changed and broadened into the planning and development of the country, especially in integrated rural communities. Moreover, coastal reclamation is conducted to retrieve the piece of land that was once destroyed by waves or abrasion, to develop a new area in coastal areas as a method to avoid abrasion, to provide an area for harbour and other public facilities, as well as mitigation effort for abrasion and recreational areas (Wagiu, 2011). For example, the reclamation was conducted in Terengganu, where beaches in Kuala Kemanan (Toriman, 2006), Dungun, Setiu, and Tanjung Gelam (Cipriani, 2022; David, 2016) were eroded and affected the safety of the community that is living the nearby area.

Alternatively, land reclamation activities are conducted for housing, industrial, and development. For example, a project under the Penang Development Corporation in Bayan Lepas, Penang, involved 500 ha of area reclaimed. Port Dickson, Negeri Sembilan, and Pulau Langkawi had reclaimed about 60 ha and 20 ha of the coastal area, respectively, for resort development. Another example of the development project is Bagan Datuk Water City in Perak, with 4,100 acres of development encircling commercial areas and educational and information technology hubs that can provide 30,000 job opportunities (WPS, 2018).

In Johor, especially, many development projects involve land reclamation activities, such as Danga Bay and Puteri Harbour. New reclamation projects started in Johor in mid-January 2014, and this development is a joint venture between Country Garden Group and Iskandar Esplanade Danga 88 Sdn. Bhd. (Williams, 2016). This development project was named Forest City and will act as key to the potential opening of international investment opportunities, which would propel Johor's economy as the central getaway in the South country. Four artificial islands consisting of apartment and villa housing, office buildings, parks, hotels, shopping malls, and international schools were planned to be built in the Tebrau Straits, off Mukim Tanjung Kupang, Gelang Patah, Johor. This project covers over 14 km^2 and involve a 20-year reclamation effort.

Land reclamation is said to positively impact coastal areas by improving the existing excess conditions for the public (Regional Coastal Plan, 2014). Unfortunately, land reclamation activities have caused permanent loss of natural habitat within the reclaimed areas. According to Naser (2015), reclamation has caused a reduction of the mangrove ecosystem and the destruction of seagrass beds. Moreover, reclamation materials and pollutants from reclamation activities were discharged into the sea, polluted the marine environment and caused undesirable effects on the capacity of fishery resources and the

aquaculture industry (Ge & Jun-Yan, 2011). The situation affects the fisheries' activities and simultaneously becomes problematic for the community that depends on the marine aquaculture industry as their source of income. For instance, fish farmers in Johor lost RM150,000 due to a probable 90% death of fish and fish fry (Yee, 2014). Accordingly, Saleh *et al.* (2016) stated that reclamation activities had caused a 50% decline in the fish and other marine commodities the fishermen catch before and after reclamation. Hence, according to (Kaparawi & Abdul Latif, 1996), coastal land reclamation projects can significantly impact the coastal environment, such as loss of mangroves and wetlands, damage to sensitive marine habitat, coastal erosion and impedance of hinterland drainage. This could further indicate that the project is not sustainable in an all-inclusive sense, even though it is claimed that the development is ecological. Hence, the main objective of this study was to investigate the effects of land reclamation activities on fish catch among fishermen.

2. Literature Review

2.1. Factors that Influence Fish Catch

Financial resources indicate the capability of the fishermen to afford fishing gear and other suitable gear that could improve their fish catch (Al Jabri *et al.*, 2013; Ramli, 2005). Financial resources can come from fishermen's savings or credit facilities. As stated by Mahmud *et al.* (2015), small-scale fishermen have limited financial resources, and the main sources of funds are their savings (Al Siyabi & Bose, 2018; Akanni, 2008). Furthermore, according to Ahsan *et al.* (2016), most fishermen need to borrow from different sources to buy suitable fishing gear due to a lack of credit facilities and savings. Clark *et al.* (2005) agreed that only a few financial institutions provide credit or loans to fishermen, and most banks avoid including fishermen in their credit loan schemes because it is considered too risky. For that reason, the fishermen's community still uses traditional fishing gear and poor-quality fishing materials (Tietze *et al.*, 2005).

The fisheries and the ecosystem have a stronger relationship than those in mainstream agriculture (FAO, 2009). This follows the report by Multi-Agency Brief (MAB, 2009). According to the report, the ecosystem's health and functioning are essential for fisheries' productivity as the ecosystem provides food and habitat for them. The fewer fishery resources will consequently limit the quantity of fish caught by fishermen (Ramli, 2005). Lalthanzara and Lalthanpuii (2010) also mentioned that the availability of fish affects the quantity of fish caught. The number of fish stocks may be affected by many types of disturbances. Cheong (2003) confirmed that such disturbances include technological advances in fishing, global regulations, land reclamation projects, and pollution that cause the decreasing number of fish resources.

A study on the impact of reclamation by Priyandes and Majid (2009) found that the productivity of fishery in Batam had significantly declined by 55%. Furthermore, some species of fish, such as Snapper, Grouper, and Shrimp, that have higher economic value in

the market are facing extinction due to deterioration of coral reef and water quality. This is an unfortunate situation caused by the reclamation projects in Batam. Subsequently, Xu *et al.* (2014) and Suo *et al.* (2015) concluded that the reduction in fish stocks was caused by the deterioration of the habitat due to reclamation activities, forcing the fish stocks to leave in search of a new habitat. Several studies (Hussin *et al.*, 2015; Hauzer *et al.*, 2013) also revealed that fish size and catch are declining, and it is expected to decrease further in the quantity of fish caught nationally within 10 to 20 years due to the reclamation activities.

Government incentives are essential for the fishermen to ensure the continuance and improvement of their source of livelihood. It is an incentive initiated by the government with subsidies or schemes to facilitate fishermen's fishing operations (Ali *et al.*, 2017). An ambiguous subsidy is provided to reduce the overexploitation of resources by payments to fishermen to stop fishing temporarily (Park, 2012; Sumaila *et al.*, 2012). The fishermen need Government support to successfully overcome the problems that arise at their fishing grounds so that they can accept any transformation or development in that area (Cipriani, 2022; Hussin *et al.*, 2015). Acquah and Abunyuwah (2011) revealed that government incentives are necessary for the fishermen to catch more fish.

Besides, a study conducted by Tzanatos *et al.* (2006) revealed that fishing operations had affected the quantity of fish catch. The fishermen's travel itinerary includes an hour and forty minutes to the fishing grounds, which are 20 km from shore. The fishermen are expected to spend more time and increase the number of trips in fishing to catch more fish if they want to improve their economic condition (Hill, 2005). It can be seen that the longer the fishermen spend their time in the ocean, the higher the chances they can catch much fish (Kasperski & Holland, 2012). Ironically, the fishermen could catch more fish if the distance they go to catch fish is further from the coast. This statement can be supported by Sampson (1991), who revealed that fishermen get access to larger fish densities with higher catch rates when they operate the vessels further from the coast, but it will use more fuel and time to travel. Additionally, due to coastal water that is usually overexploited and depleted, Akanni (2008) agreed that fishermen love to reach out far from the sea so that they can catch more fish.

Besides fishing operations, local ecosystem characteristics, crew skills, and fishing gear positively affected the fish catch. Abdul Hamid Jaafar and Siwar (2007) stated that the number of crews in a vessel and the operation cost per trip affect the number of total fish caught, with the high number of crew potentially increasing the quantity of fish caught. Similarly, Abd Kadir and Sohor (2009) revealed positive significant relationships between the crew numbers and the quantity of fish caught. On the contrary, Ùnal and Franquesa (2010) asserted that fishermen prefer to catch fish alone rather than employ crew due to lower fish catch that could jeopardize their income.

Numerous studies stated that fishing became the foremost job opportunity for the community that lives near the coastal areas, and most of them are full-time and experienced fishermen (Cipriani, 2022; Gonzalvo *et al.*, 2015; Kasperski & Holland, 2012; Sampono *et*

al., 2012). Equally important, experienced fishermen enable them to catch more fish when they can utilize their knowledge of fishing operations (Belwal *et al.*, 2012). Similarly, O'Neill *et al.* (2010) revealed that fishermen with more than five years of experience have at least 8% better average catch rates than fishermen with less than five years of experience. It could be said that older fishermen have more experience in catching fish and are more alert to the changes in their fishing grounds (Senapati & Gupta, 2015) and could alter their fishing behaviour to increase their total fish catch compared to the young fishermen (Lennox *et al.*, 2017).

3. Materials and Methods

3.1. Conceptual Framework

The conceptual framework in Figure 1 shows nine (9) independent variables were used to measure the quantity of fish caught by the fishermen. Based on the literature, these variables were used to understand the factors affecting fishermen's fish catch. The variables included experience (Abd Kadir & Sohor, 2009), number of trips (Steffe & Murphy, 2010), duration per trips (Lalthanzara & Lalthanpuii, 2010), distance to catch fish (Pitchaikani & Lipton, 2017), financial resources (Wasak, 2012), fishery resources (Suo *et al.*, 2015; Lalthanzara & Lalthanpuii, 2010), fishing grounds (Huong & Berkes, 2011), number of crew (Canbäck *et al.*, 2006) and government incentives (Acquah & Abunyuwah, 2011).

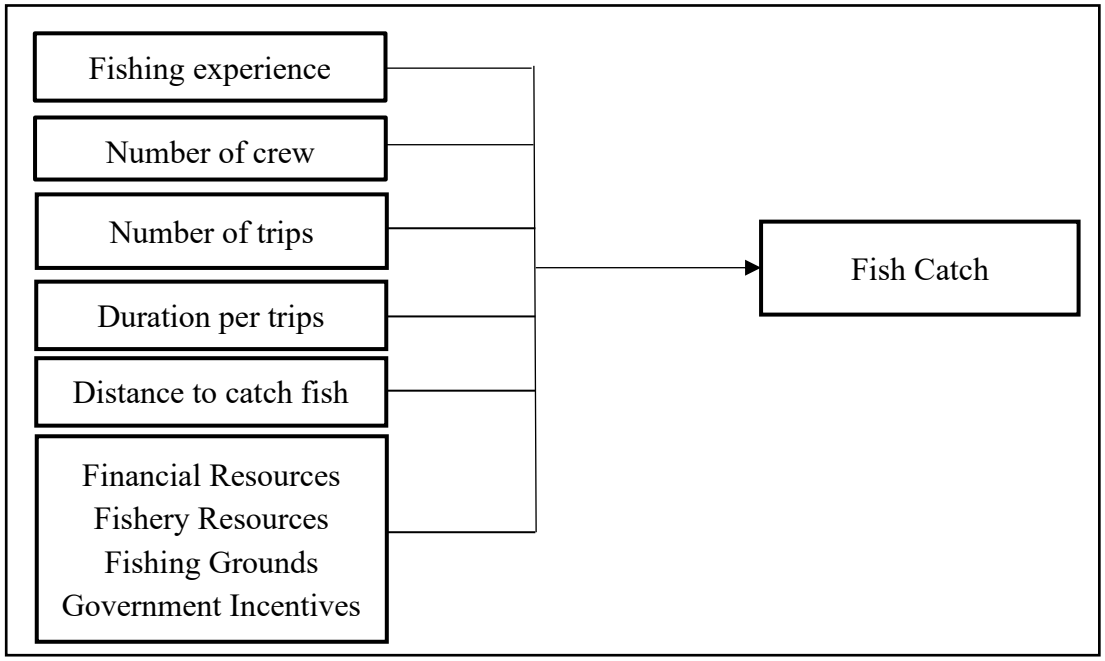

Figure 1. Conceptual Framework [Source: Adapted from Lalthanzara and Lalthanpuii (2010); Acquah and Abunyuwah (2011); Wasak (2012); Suo *et al.* (2015)]

The study was carried out at jetties near Merambong Shoal. It is in the Sungai Pulai Estuaries, near the Tanjung Kupang, Gelang Patah, and Johor. Johor Bahru is known as one of the fastest-growing cities after Kuala Lumpur. Hence, many developments have been carried out in this city. The newest development that is still in progress is Forest City. This development occurred near the Merambong Shoal. This research involved four jetties: Pendas Jetty, Kampung Pok Jetty, Sungai Che Manan Jetty, and Tanjung Adang Jetty, as stated in Figure 2.

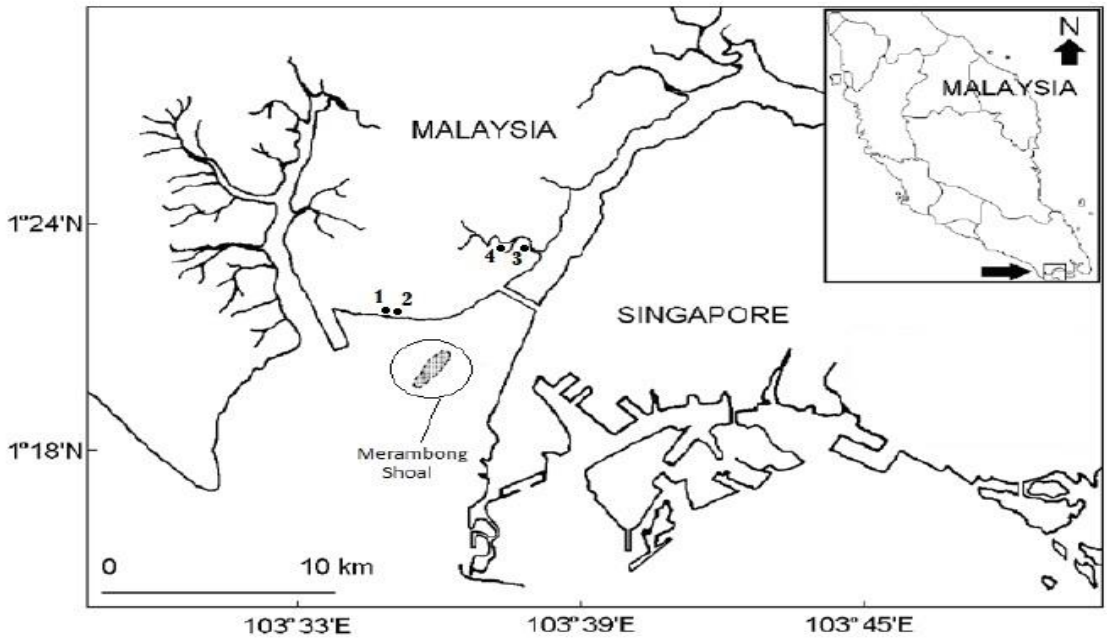

Figure 2. Location of the Jetties. **[**Source: Adapted and modified from Cob *et al.* (2012)]

According to the Department of Fisheries Gelang Patah, Johor, there are about 250 active fishermen in Tanjung Kupang, a sub-district of Gelang Patah. Using convenience sampling, the sample size involved 79 fishermen, representing 31% of the active fishermen. The sample size is consistent with similar studies by Agar and Shivlani (2016) and Muallil *et al.* (2013), who conducted their research with 25% to 35% of the total active fishermen. The list of sample sizes for each jetty is stated in Table 1. The data was collected around fishermen's landing sites, mostly while mending their nets or doing boat maintenance before or after going out to sea to minimize the disruption to their routines.

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Table 1. List of Sample Size and Jetty

Jetty	Number of Samples
Pendas Jetty	25
Kampung Pok Jetty	23
Sungai Che Manan Jetty	18
Tanjung Adang Jetty	13
Total	79

A structured questionnaire consisting of open-ended and close-ended questions was developed in Bahasa Melayu. A total of 79 fishermen were selected as respondents for this study. The questionnaire was divided into three (3) sections. Section A consisted of questions regarding fishermen's socio-demographic profiles. In this section, the questions were established to obtain information on age, gender, race, religion, level of education, marital status, family size, and involvement of the fishermen in the fishing industry. Section B was designed to gain insights regarding the fishing operations of the respondents. This part consisted of the number of workers (s), distance from the coast, fishing duration in hours, the number of fishing trips per month, and total fish catch per trip before and after reclamation. The questions about the factors that influence fishermen's fish catch were developed in Section C. A five-point Likert scale (interval scale) ranging from Strongly Disagree to Strongly Agree was used in section C. A Likert scale measures the extent to which a person agrees or disagrees with the statement where 1 = strongly disagree, 2 = disagree, 3 = natural/not sure, 4 = agree, and 5 = strongly agree.

The statistical analysis used to analyse the data includes descriptive analysis, factor analysis, and multiple linear regression analysis. Descriptive analysis was used to analyse the fishermen's socio-demographic profiles of fishing operations of fishermen and fish catch. Factor analysis acts as a data reduction technique, and the fundamental purpose of the analysis is to group all the correlated items and share prevalent variance. Eighteen items were used for the factor analysis in this study to identify the factors associated with the quantity of fish caught by the 79 fishermen. A multiple regression model was employed in this study to analyse factors that affect fish caught by fishermen in the study areas. In multiple regression analysis, several independent variables are combined to predict the value of dependent variables (Pallant, 2013; Tabachnick & Fidell, 2007). Various independent variables such as number of trips per month, duration per trip, distance to catch fish from the coast, fishing experience, number of crew, full-time fishermen, financial resources, fishery resources, size of fishing ground, and government incentives were used to predict values for the dependent variable which is the quantity of fish catch. In this study, factor scores calculated based on factor loadings of the factor analysis were used for the independent variables such as financial resources, fishery resources, size of fishing grounds, and government incentives. Multiple

linear regression was employed to identify the most influential factors affecting the fish fishermen caught.

The regression model used can be specified as follows:

$$Y= a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} \quad (1)$$

Where,
Y = Quantity of fish catch
a = intercept
$b_1, b_2, b_3, \dots, b_n$ = regression coefficient of independent variables
X_1 = Number of trips
X_2 = Duration per trips
X_3 = Distance from coast
X_4 = Fishing experience
X_5 = Number of crew
X_6 = Full time
X_7 = Financial resources
X_8 = Fishery resources
X_9 = Size of fishing ground
X_{10} = Government incentives

4. Results and Discussions

4.1. Socio-Demographic Profiles of Respondents

The socio-demographic profiles of the respondents are shown in Table 2. Most of the fishermen were male, which accounted for 91.1% (72), followed by females, which accounted for 8.9% (7). Most of the fishermen were Malay, which accounted for 93.7% (74), and the remaining were Chinese, which accounted for 6.3% (5). Meanwhile, about 26.6% of fishermen (21) belong to the age group of 41 to 50 years old, followed by 25.3% (20 fishermen) were from the age group of 51 to 60. The mean for the fishermen's age is 48.3 years.

Regarding education, the majority of respondents, 49.4% (39 fishermen), had gone through primary school, while 43% (34 fishermen) had only finished secondary school. Until now, aging fishermen with lower-level education are more common among small-scale fishermen (Guyader *et al.*, 2013; Battaglia *et al.*, 2010). The study also showed that 81% (64 fishermen) were married, and 15.2% (12) were single. The majority of the fishermen have a household size between 1 to 3, which accounted for 49.4% (39 fishermen), followed by 39.2% (31 fishermen) with household size between 4 to 6 and only 11.4% (9 fishermen) with household size between 7 to 9. Regarding fishing experience, 23% (18 fishermen) had between 11 and 20 years of experience, followed by 22% (17 fishermen) with equal or above

41 years of fishing experience. The mean for the fishing experience is 26.5 years. Lastly, 51 fishermen (65%) do not have workers on their boats.

Table 2. Socio-Demographic Profiles of Respondents

Item	Profile	Frequency (n)	Percentage (%)
Gender	Male	72	91.1
	Female	7	8.9
Race	Malay	74	93.7
	Chinese	5	6.3
Age	30 years and below	11	13.9
(Mean: 48.3)	31 – 40	13	16.5
	41 – 50	21	26.6
	51 – 60	20	25.3
	61 – 70	11	13.9
	71 years and above	3	3.8
Educational level	No formal education	5	6.3
	Primary school	39	49.4
	Secondary school	34	43.0
	Tertiary School	1	1.3
Marital Status	Married	64	81.0
	Single	12	15.2
	Widow/Widower	3	3.8
Household Size	1 – 3	39	49.4
	4 – 6	31	39.2
	7 – 9	9	11.4
Fishing experience	10 and below	16	20.3
(years)	11 – 20	18	22.8
	21 – 30	15	19.0
(Mean: 26.5)	31 – 40	13	16.4
	41 and above	17	21.5
Number of crew	None	51	65
	1	18	23
	2	8	10
	3	2	2

Note: n = 79

3.2. Factors Influencing Fish Catch among Fishermen

Factor analysis was employed in this study to identify the factors associated with the quantity of fish caught among 79 fishermen. The rotated component matrix of the survey data is shown in Table 3. Four factors were identified: financial resources, fishery resources,

fishing grounds, and government incentives. All four factors explained 63.44% of the variance in the data, which is considered an acceptable range according to Hair *et al.* (1998). All the factors were in the acceptable range of 0.5. Tabachnick and Fidell (2007) emphasized that a factor is considered reliable once it has at least three variables. In this study, one factor consisted of only two variables but was still considered reliable. Factors with only two variables were considered reliable when there was a high correlation between the variables with $r > 0.70$ and relatively uncorrelated with other variables (Yong & Pearce, 2013; Worthington & Whittaker, 2006).

The first factor was labelled as "financial resources", with five items extracted. The factor loadings for all five items are acceptable because they were in the acceptable range (Hair *et al.*, 1998). All the items in the financial resources explained 21.094% of the variance with an eigenvalue of 2.980. This result showed that financial resources were one of the critical factors that have a significant association with the quantity of fish catch, which was in line with a study by Al Jabri *et al.* (2013). However, the fishermen's financial resources were usually insufficient, so they could not afford to buy suitable gear for their fishing operations (Mahmud *et al.*, 2015; Wasak, 2012).

The second factor was labelled as "fishery resources". Three items extracted the fishery resources factor. The factor loading of three items was accepted since they were above 0.6, which was in the acceptable range. All the items for the fishery resources factor explained 15.049% of the variance in the data with an eigenvalue of 2.059. Fishery resources are crucial among fishermen and have become an essential factor that impacts the quantity of fish caught. The decreasing number of fishery resources caused the decline in the quantity of fish catch by the fishermen (Ramli, 2005). On the contrary, the numbers of fish resources were affected by reclamation activities and technological advances in fishing, pollution, and global regulations (Cheong, 2003).

The third factor was labelled as "fishing grounds". The factor was extracted by three items as well. The factor loading of the three items was above 0.6, which was considered acceptable. All the items for fishing grounds explained 14.705% of the total variance with an eigenvalue of 1.829. According to Cheong (2003), the reclamation activities might have restricted the fishing ground, thus decreasing fishermen's fishing operations and the quantity of fish catch.

Lastly, the factor was labelled "government incentive", with two items extracted. Even though this factor consisted of only two items, the factor was considered acceptable because both items had a factor loading greater than 0.8. All the items for government incentives explained 12.592% of the total variance with an eigenvalue of 1.380. Acquah and Abunyuwah (2011) suggested that government assistance and easy access to credit can help fishermen improve their fishing operations. Fishing allowance was revealed to be helpful for the fishermen during times of crisis. However, the existence of subsidies or incentives from

the government made the fishermen highly dependent on it and became less effective for the livelihood of fishermen (Ali *et al.*, 2017).

Table 3. Rotated Component Matrix

Items	Factor Loading
Financial Resources	
1. Lack of financial resources becomes an obstacle for fishermen to buy suitable fishing gear.	0.809
2. Financial resources for fishing operations that fishermen have been insufficient.	0.791
3 Financial resources are the factor that can affect the quantity of fish catch and the income of fishermen.	0.756
4. Lack of financial resources becomes an obstacle to increasing the quantity of fish catch.	0.694
5. Usually, the financial resources of the fishermen come from their savings and it is insufficient.	0.579
Eigenvalues	**2.980**
Percentage (%) of variance	**21.094**
Cumulative (%) of variance	**21.094**
Fishery Resources	
1. Fishes and other marine life have been decreasing during this period.	0.777
2. Decreasing the number of fishes, crabs and prawns had given a negative impact on the quantity of fish catch by fishermen.	0.757
3. Fish catch of fishermen will increase if the marine life did not suffer any reduction.	0.688
Eigenvalues	**2.059**
Percentage (%) of variance	**15.049**
Cumulative (%) of variance	**36.143**
Fishing grounds	
1. Reclamation activities caused a reduction in the size of the fishing ground.	0.771
2. The reducing size of fishing grounds caused the decrease in the fish catch of the fishermen.	0.763
3. It is difficult for fishermen to catch a lot of fish once the size of the fishing ground is reduced.	0.708
Eigenvalues	**1.829**
Percentage (%) of variance	**14.705**
Cumulative (%) of variance	**50.848**
Government Incentives	
1. The government's aid helps in reducing the cost of living and improving the quality of life of fishermen.	0.872

2. Financial assistance such as a loan from the government could help fishermen to be able to buy suitable gear for fishing operations.	0.842
Eigenvalues	**1.380**
Percentage (%) of variance	**12.592**
Cumulative (%) of variance	**63.440**

3.3. Effects of Land Reclamation Activities on Fish Catch among Fishermen

Multiple regression analysis was conducted to determine the relationship and the effects of the independent variables (number of trips, duration to catch fish, distance from the coast to the fishing ground, fishermen's experience in fishing, number of crew in vessels, full-time or part-time, financial resources, fishery resources, size of fishing grounds and government incentives) on the dependent variable (fish catch). Hence, the independent variables are hypothesized to explain the variables that affect the quantity of fish catch by the fishermen. The significance of coefficient regression was tested with t-statistics. In contrast, the coefficient of determination (R^2) and adjusted R^2 were assessed to find the goodness-of-fit of the regression (Draper & Smith, 1998). Table 4 shows the result of the regression analysis. The R^2 was 0.331, indicating the combination of independent variables in the regression model, which are the number of trips, duration to catch fish, distance from the coast to the fishing ground, fishermen's experience in fishing, the number of crew in vessels, financial resources, fishery resources, size of fishing grounds and government incentive had explained the 33.10% of the variation in the dependent variable (fish catch).

The result revealed that five (5) independent variables have statistically significant relationships with the dependent variable: the number of trips per month, duration to catch fish, distance to the fishing grounds from the coast, number of crew on the vessels, and government incentives. Among these five (5) variables, the number of crew was the most highly influenced factor that affected the quantity of fish caught. Fishermen's experience, financial resources, fishery resources, and the size of the fishing grounds did not significantly affect the quantity of fish caught. A study by Tzanatos *et al.* (2006) revealed that fishing operations could affect the quantity of fish caught.

The number of trips per month was found to have a positive and significant relationship at a 5% significance level ($\beta = 13.437$, $p = 0.034$) with the quantity of fish catch. This result suggests that an increase in the number of trips fishermen go for fishing per month leads to an increase in the quantity of fish catch by the fishermen. Hence, the result indicates that, on average, an increase in the number of fishermen's trips to go fishing resulted in a 13.43 kg increase in the quantity of fish catch. This implies that the number of trips for the fishermen is directly related to fish catch. The finding was in line with Hill (2005), who stated that the fishermen who want to get more fish catch usually increased their number of trips in fishing.

The duration for the fishermen to catch fish per trip has a negative and significant relationship with the quantity of fish caught. It was significant at a 1% significance level (β= -2.004, p = 0.006). This implies that an increase in the duration for the fishermen to catch fish per trip leads to a decrease in the quantity of fish catch by fishermen. The results suggest that, on average, an increase in the duration for the fishermen to catch fish by one hour resulted in a 2.0 kg decrease in fish catch. The findings contradicted the findings by Abd Kadir and Sohor (2009), who revealed that the duration of fish catch had a significant positive relationship with the fish catch. The findings from this study indicated that there were no guarantees of higher quantities of fish caught even if the fishermen increased their fishing duration per trip once the reclamation occurred.

The distance from the coast is found to be positively and significantly (β= 0.779, p= 0.018) affected the fish catch at less than 5% significance level. It means that an increase in the distance for fishermen to catch fish from the coast will increase the quantity of fish caught. The result suggests that, on average, when the distance from the coast increases by one unit, the quantity of fish catch will increase by 0.779 kg, holding another variable constant. This implies that if fishermen increase the distance to catch fish from the coast, there is a higher probability of getting a high amount of catch instead of catching fish at their original fishing ground near the reclamation sites. The finding was supported by Akanni (2008), who said that reaching out further from the sea enabled fishermen to catch many fish. Besides, due to the degradation, fishermen need to find other fishing grounds to catch fish, and usually, the new fishing ground is far from the coast (Sampono *et al.*, 2012). Pfeiffer and Gratz (2016) and Senapati and Gupta (2015) asserted that fishing further from the coast was risky to the fishermen, mainly when the small vessel was used due to large waves or other unpredictable conditions.

Besides, the number of crew affected the quantity of fish catches positively and significantly at less than 1% significance level (β = 182.383, p = 0.004). This result implies that an increase in the number of crew on the vessels increases the quantity of fish catch. This result suggests that, on average, when the number of crew increases by one unit, the quantity of fish catch will increase by 182.383 kg, holding other variables constant. Thus, it is suggested that the number of crew on vessels can ease catching fish, especially in handling the fishing gear, thereby increasing the quantity of fish caught. Abdul Hamid Jaafar and Siwar (2007) revealed that the number of crew members is significantly related to the quantity of fish caught. Conversely, due to the uncertain quantity of fish catch, fishermen tend to catch fish alone rather than having the crew in their vessels (Ünal & Franquesa, 2010). Fishermen can have all the income by themselves instead of dividing it up with the crew in their vessels.

Finally, government incentives were found to have a positive and significant relationship at less than a 10% significance level (β= 84.262, p = 0.092) with the quantity of fish catch. This indicates that an increase in the incentives provided by the government leads to an increase in the quantity of fish caught. The results also suggest that, on average, when government incentives increased by one unit, the quantity of fish catch would increase by

84.262 kg, holding other variables constant. Government incentives will help fishermen catch more fish when the reclamation occurs, and the loans could afford fishermen to buy suitable gear. According to Acquah and Abunyuwah (2011), government incentives are much-needed aid for the fishermen to catch more fish. Hussin *et al.* (2015) agreed that for the fishermen to successfully overcome problems that arise in their fishing areas, they needed incentives from the government to buy suitable gear. As stated by Ali *et al.* (2017), fuel subsidy is an essential subsidy for fishermen that can reduce operation costs if they need to increase their number of trips to catch fish or travel far from the coast.

Table 4. Multiple Regression Analysis Result

Model	**Unstandardized Coefficients**		**Standardized Coefficients**	***t*-value**	**Sig.**
	B	**Std. Error**	**Beta**		
(Constant)	240.310	240.858			
Number of trips (month)	13.437	6.224	0.314	2.159	.034**
Duration per trips (hour)	-2.004	0.701	-0.401	-2.859	.006***
Distance (nmi)	0.779	0.322	0.354	2.417	.018**
Experience (year)	0.420	3.213	0.015	0.131	.896
Number of crew	182.383	61.658	0.309	2.958	.004***
Full time	-133.652	98.400	-0.145	-1.358	.179
Financial resources	-40.203	48.386	-0.087	-0.831	.409
Fishery resources	2.600	47.946	0.006	0.054	.957
Fishing ground	-60.555	46.619	-0.131	-1.299	.198
Government incentives	84.262	49.370	0.183	1.707	.092*
R Square: 0.331.			F= 3.368	Sig F= 0.01	
Adjusted R Square: 0.231					
a. Dependent variable: Fish Catch					

Note: *significant at 10% significance level, **significant at 5% significance level ***significant at 1% significance level

The equation model for results in Table 6 was given as follows:

Fish catch = 240.31+ (13.437) Number of trips – (2.004) Duration per trips + (0.779) Distance + (182.383) Number of crew + (84.262) Government incentives (2)

5. Conclusions

Reclamation activities are related to converting the sea or lakes into arable land that can be used for urbanization and residential areas. As reclamation activities positively affect society and improve the country's income, they have also been identified to negatively impact the environment and fishing community in the affected area. Several factors affect the

quantity of fish caught. The results showed that the number of trips, duration of a trip to catch fish, distance to fish from the coast, number of crew in vessels, and government incentives were the factors that affected the fishermen's fish catch. Meanwhile, the number of crew in vessels became the most influential factor affecting fish catch. Therefore, addressing these factors by providing alternatives and solutions can help the fishermen increase their fish catch and income. The government can increase the number of incentives and provide more loans for the fishermen to upgrade their fishing gear to travel further and spend longer in the sea to catch fish. Incentives and subsidies could also reduce the fishermen's operation costs so that crews can be hired in their vessels to help them operate their fishing operations effectively and catch much fish. Alternatively, the fishermen can explore different fishing grounds to catch more fish.

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