

Analysis of Catch and Fishermen Family Welfare in West Sumatra Province: Simultaneous Equation Approach



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ABSTRACT

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This research is motivated by the catch and the fishermen family welfare in West Sumatra Province is not yet optimal, so this study aims to analyze the factors that affect them. Furthermore, the novelty of this research is to carry out an elaboration of studies on fishermen households by focusing on the analysis of catches and the fishermen family welfare being investigated within a simultaneous equation framework. The population in this study were fishing households in West Sumatra Province which had 498 fishing gears. The sampling in this study used the cluster method, which a total sample of 373 respondents. The important finding in this study is the catch will increase if it is driven by the fishermen family welfare, the type of catch, fishermen productivity and fishermen socio-cultural environment. Furthermore, the fishermen family welfare will improve if it is driven by catch, fishermen socio-cultural environment, selling price of fish and fishermen family happiness. The recommendation from this study is that the government needs to facilitate increasing catches and fishermen family welfare through fishermen insurance programs, institutions, funding and business diversification training based on the bottom up concept so that fishermen have access and stronger bargaining power.

1. INTRODUCTION

West Sumatra is one of the provinces in Indonesia which has a water area with great resource potential in the utilization of national development [1]. Development that aims to increase welfare is an effort made to create more choices for community members so that they can meet their unlimited needs. The role of the agricultural/fishery sector in development in West Sumatra Province is quite promising [2]. In observing the development in West Sumatra Province so far, empirically the development of marine and fisheries has received less attention and has always been positioned as a periphery in economic development. This condition is very ironic, considering that the sea area of West Sumatra is 186,580 km² which is larger than the land area of 42,297 km², so that West Sumatra is known as a province that has a large sea area.

The large marine potential in an area will provide opportunities for the people of that region to live in coastal areas, where coastal areas have potential for biological and non-biological natural resources, artificial resources and environmental services which are very important for people's livelihoods and geographical conditions, which has a longer coastline plus existing fishery potential [3-5]. Furthermore, the fisheries sector has a promising potential to drive the economy because it has an impact on providing labor and increasing people's purchasing power along with increasing fishermen's income [6-8].

With an area consisting mostly of oceans and having considerable marine potential, West Sumatra Province should be able to prosper the lives of fishing communities who

depend on this marine potential. However, the conditions that have occurred have not been optimal because the fishermen's exchange rate in West Sumatra Province fluctuated and tended to decrease. The condition of fishermen's exchange rates in West Sumatra Province over the past five years is summarized in Figure 1.

Based on the information in Figure 1, during the last three years the fishermen's exchange rate has tended to experience a continuous decline. In fact, the fishermen's exchange rate is a measure of fishermen's welfare obtained from a comparison of the price received by fishermen with the price paid by fishermen, so this condition indicates that the welfare of fishermen in West Sumatra Province has decreased. This phenomenon proves that the magnitude of marine potential is often not directly proportional to the level of welfare of fishermen.

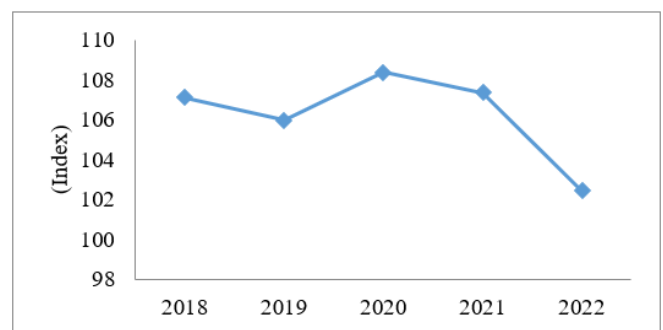


Figure 1. Fishermen exchange rates in West Sumatra Province [9]

Fishermen are often seen as a group of people who are synonymous with poverty [10-12]. Furthermore, the problem of poverty is also caused by inequality in the utilization of fish resources [13, 14]. This condition occurs because the potential of fish resources has not been utilized optimally and there is an imbalance in the utilization of resources both by commodity and region. The fishing fleet is also very unequal, with 70% of the fishing fleet being traditional, more than 50% being boats without motors, so 3/4 of the fishing fleet only rely on small boats. The main characteristic of fishing communities is poverty caused by a lack of access to sources of capital, access to technology, access to markets and low community participation in resource management and other causes are natural resources which are seen as limited and lack of development infrastructure [15]. This condition is supported by the characteristics of the fishing community, which are strongly influenced by the type of activity, such as capture fisheries, pond fisheries, and fisheries product management businesses which are dominantly carried out. Furthermore, the structure of the fishing community is still simple and not many outsiders have entered it. This is because both culture, way of life, and community activities are relatively homogeneous and each individual feels they have the same interests and responsibilities in implementing and supervising the laws that have been mutually agreed upon.

Some literature states that fishermen are a group of people who have a low level of welfare [16-18]. In fact, when compared to other community groups in the agricultural sector, fishermen can be classified as the poorest social layer, especially labor fishermen and individual fishermen. Labor fishermen are fishermen who work with other people's fishing gear. On the other hand, individual fishermen are fishermen who have their own fishing equipment and do not involve other people in their operations. Because the two types of fishermen groups are the majority, the image of poverty is attached to the lives of fishermen [19].

The conditions experienced by fishermen are of course very concerning because fishermen are the spearhead of managing fisheries in coastal areas. Considering that the rate of population growth continues to increase, so that land on the mainland will be felt to be increasingly narrow, it is hoped that livelihoods as fishermen will be the basis of hope in the future. For this reason, in the future, it is hoped that the community will gradually be encouraged to shift their economic activities towards the sea.

Poverty experienced by fishermen will result in the diversion of economic activities to the sea, it is feared that it will be difficult to occur because it is feared that the fishermen's children will no longer be interested in pursuing fishing jobs. If that happens, activities on land will become more crowded, while the sea which has high economic value will be neglected. As a result, the economic potential contained therein will be wasted. In order for this to not happen, attention is needed from all parties to the fate of the fishermen. This attention is of course not just in the form of empathy, but more than that, namely finding the best alternative to improve the welfare of fishermen.

The urgency of this research is to describe and analyze the various factors that cause the catch and welfare of fishermen in West Sumatra Province that have not been optimal. This is considered to be able to reveal what obstacles fishermen face in their efforts to increase the economic needs of their families and in their efforts to meet their family's needs.

2. LITERATURE REVIEW

Various researchers have conducted studies on the catch of fishermen and the welfare of fishermen in maritime countries, both of which are related to the economic stability of fishing communities. The two concepts are interrelated to progressively improve the living conditions of fishermen through developing human resources with use, creating community resources, providing institutional structures for the functioning of organized services and change-oriented development. Research that has been conducted on fishing communities in North Konawe found that to boost productivity and income, the role of empowering fishing communities is needed [20]. In addition, added value is also needed in anticipation of abundant catches to improve the welfare of fishermen in West Sumatra [21]. A different analysis for studies conducted on fishermen in Mertasinga Village that fishermen adaptation is needed to deal with climatic conditions to maintain catches [22]. Then, a study for marine fisheries in Indonesia found that the social dimension is an important aspect in achieving sustainable fisheries for the welfare of fishermen [23].

The problem of fishermen found in Sierra Leona is that the fisheries sector has been exploited, but market access to fish commodities is not fulfilled [24]. Furthermore, the problem of the selling price of fish that occurs in West Aceh can be overcome through empowering the fishermen's economy [25]. In addition, another solution offered to increase fish catches in fishing communities in Bontang is through the necessary education and training [26]. The same research results were found for fishing communities in Kwara State that the education sector for fishermen plays an important role in introducing task diversification and understanding for the use of fishing gear technology to utilize marine resources efficiently in achieving optimal welfare [27]. Then, the welfare of fishing households in Indonesia can be achieved through the use of modern fishing gear, harvested and processed [28]. In addition, the condition of fishermen's welfare in Semarang can be achieved through the provision of venture capital by the government [29]. The selling price of fish is also an important component in determining the level of fishermen's welfare, where the value is determined by external factors from the fishermen. The selling price of fish is the price charged to the buyer which is calculated from the costs of going to sea and non-going to get the expected profit. One of the external factors that determine the selling price of fish is the price based on costs, including costs incurred in fishing activities such as operational costs [30].

The socio-cultural environment influences the characteristics of local communities such as cultural values that prioritize tolerance by helping each other. In addition, kinship appears as the most significant factor in shaping the socio-cultural environment. Subjective evaluation in the context of personal and professional development based on the realization of basic values depends on personal potential, career orientation and socio-cultural environment [31]. The conditions prevailing in the Mediterranean coastal lagoons are among the most productive of marine ecosystems but, at the same time, are heavily influenced by anthropogenic pressures that can alter fisheries [32]. Furthermore, the application of an integrated and interdisciplinary conceptual framework to assess the uptake potential of bycatch reduction measures by small-scale fisheries along the Andaman coast and the eastern Gulf of Thailand and in Sabah, Malaysia [33].

Based on the presentation of several relevant research results, this study will carry out an elaboration of studies on fishing households by focusing on the analysis of catches and the welfare of the investigated fishing households in a simultaneous equation framework, so this study also considers several other variables as determinants of the two types of analysis to be carried out. First, the determining factors for catch include catch type, fishermen productivity and fishermen socio-cultural. Second, the determining factors for fishermen family welfare are fishermen socio-cultural, selling price of fish and fishermen family happiness. The purpose of considering some of these determining variables is to produce a comprehensive policy for local governments in overcoming the economic problems of fishing households.

3. METHODOLOGY

3.1 Population and sample

The population of this study was all fishing households with fishing gear in West Sumatra Province consisting of seven districts/cities, including the Mentawai Islands District, Pesisir Selatan District, Padang Pariaman District, Agam District, West Pasaman District, Padang City and Pariaman City. The population in this study can be seen in Table 1.

Table 1. Number of fishermen households having fishing gear in West Sumatra Province [34]

Districts/Cities	Number of Households (People)
Mentawai Islands District	3.884
Pesisir Selatan District	2.735
Padang Pariaman District	497
Agam District	561
West Pasaman District	1.605
Padang City	1.219
Pariaman City	498



Figure 2. Geographical location of the research area

Based on the population information in Table 1, it is possible to determine the research sample using the cluster method because districts/cities are the primary sampling unit. The first stage is area sampling with a primary sampling unit of 40%, where the total sample is $40\% \times 7 = 2.8 = 3$. Then, proportionally selected for districts and cities, which for districts is $5/7 \times 3 = 2.14 = 2$ and for the city is $2/7 \times 3 = 0.86 = 1$. Next is the selection of purposive samples for districts and cities, which consist of West Pasaman District, Pesisir Selatan District and Padang City, where the total number of fishing households for these 3 regions is 5,559 people. This selection is based on the highest amount of marine capture fisheries production sequentially by District/City in West Sumatra Province in 2022. Furthermore, geographical location of the research area can be seen in Figure 2.

The second stage is sampling all fishing households that have fishing gear in West Pasaman District, Pesisir Selatan District and Padang City using the Slovin formula, which is summarized in Eq. (1).

$$n = \frac{N}{1 + N e^2} \tag{1}$$

where,

n = Sample size

N = Population size

e = Desired margin of error (percentage of slack due to sampling error in this case used 5%).

By using the formula in Eq. (1), the following results are obtained:

$$n = \frac{5.559}{1 + (5.559) 0,05^2}$$

$$n = \frac{5.559}{1 + ((5.559) 0,0025)}$$

$$n = \frac{5.559}{1 + 13,89}$$

$$n = \frac{5.559}{14,89}$$

$$n = 373 \tag{2}$$

Based on the calculation results in Eq. (2), it can be seen that the sample size for West Pasaman District, Pesisir Selatan District and Padang City uses a proportional random sampling approach, which is summarized in Eqns. (3)-(5).

West Pasaman District

$$n = \frac{1.605}{5.559} \times 373$$

$$n = 0.29 \times 373$$

$$n = 108 \tag{3}$$

Pesisir Selatan District

$$n = \frac{2.735}{5.559} \times 373$$

$$n = 0.49 \times 373$$

$$n = 183 \tag{4}$$

Padang City

$$n = \frac{1.219}{5.559} \times 373$$

$$n = 0.22 \times 373$$

$$n = 82 \tag{5}$$

Based on the calculation results in Eqns. (3)-(5), it can be

concluded for the total sample in this study, which is summarized in Table 2.

Table 2. Sample size for West Pasaman District, Pesisir Selatan District and Padang City with proportional random sampling [34]

Districts/Cities	Number of Households (People)
West Pasaman District	108
Pesisir Selatan District	183
Padang City	82
Total	373

3.2 Data and variable

This study uses primary data obtained from questionnaires of respondents from fishing households who own fishing gear in West Pasaman District, Pesisir Selatan District and Padang City. Furthermore, this study uses two categories for the types of variables used, namely endogenous and exogenous. The variable group included in the endogenous category is the catch and fishermen family welfare. In addition, the group of variables included in the exogenous category are catch type, fishermen productivity, fishermen socio-cultural environment, selling price of fish and fishermen family happiness. Based on the categories of the types of variables used in this study, a conceptual research framework can be determined, which is summarized in Figure 3.

Based on Figure 3, the indicators for each variable used in this study are described in Table 3. The Explanation for the indicators of each variable is important because as a reference in providing a more objective assessment of research activities. In addition, the function of the indicators is as a guide in efforts to develop an activity in accordance with the characteristics, potential, needs, and environment of the research results to be obtained.

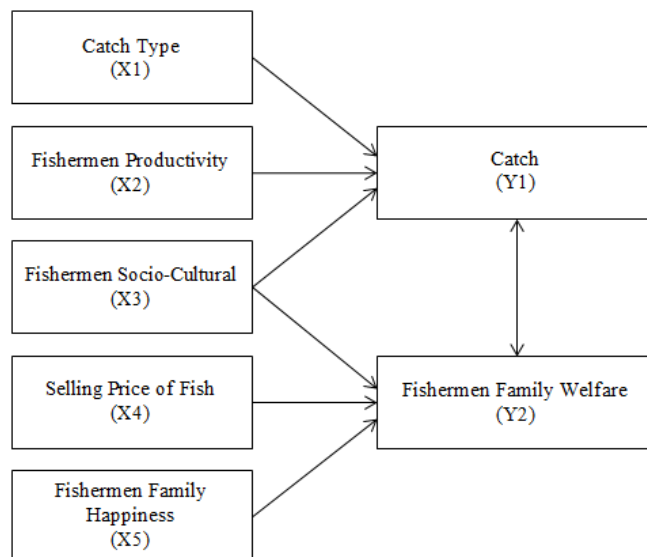


Figure 3. Research conceptual framework

Table 3. Variable indicators

Variable	Indicator
Catch (Y ₁)	The catch of fishermen in West Sumatra Province is determined by the length of time spent at sea, measured using a likert scale
Fishermen Family Welfare (Y ₂)	The fishermen family welfare in West Sumatra Province is determined by the experience possessed by fishermen in West Sumatra which can help them determine the selling price of fish, measured using a likert scale
Catch Type (X ₁)	Catch type by fishermen in West Sumatra Province is determined by the type of fishing gear used, measured using a likert scale
Fishermen Productivity (X ₂)	Fishermen productivity in Sumatra Province is determined by the ratio of total output and input, measured using a likert scale
Fishermen Socio-Cultural Environment (X ₃)	Fishermen socio-cultural environment in West Sumatra Province is determined by mutually beneficial cooperation to obtain welfare and a decent life, measured using a likert scale
Selling Price of Fish (X ₄)	Selling price of fish to fishermen in West Sumatra Province is determined by the quality of the fish, measured using a likert scale
Fishermen Family Happiness (X ₅)	Fishermen family happiness in West Sumatra Province is determined by the ability to endure all the obstacles that occur in their household, measured using a likert scale

3.3 Analysis model

This study applies the simultaneous equation analysis model, which is an analysis that has more than one equation and has a causal relationship between the endogenous variables (Y₁ and Y₂) and their exogenous variables (X₁, X₂, X₃, X₄ and X₅). The analytical model applied in this study is derived from a predetermined conceptual framework. Furthermore, the purpose of applying this model is to analyze what factors cause disruption to catch and fishermen family welfare, so that through the results of data analysis comprehensive policies can be formulated. Then, this study has two simultaneous equation models, which are summarized in Eqns. (6)-(7).

Based on Eqns. (6)-(7), the simultaneous equations in the study consist of two analytical models, so it is not possible to

get a numerical value for each parameter in each equation because these equations cannot be distinguished by observation or appear to be very similar to one another. otherwise, it is necessary to carry out an identification test.

$$Y_{1i} = \alpha_{1.0} + \alpha_{1.1}Y_{2i} + \alpha_{1.2}X_{1i} + \alpha_{1.3}X_{2i} + \alpha_{1.4}X_{3i} + \varepsilon_{1i} \quad (6)$$

$$Y_{2i} = \alpha_{2.0} + \alpha_{2.1}Y_{1i} + \alpha_{2.2}X_{3i} + \alpha_{2.3}X_{4i} + \alpha_{2.4}X_{5i} + \varepsilon_{2i} \quad (7)$$

where,

α = Parameters

i = Respondent

ε = Error term.

The identification test arises because different sets of

structural coefficients may fit the same set of data. Identification tests are often found in econometric models with more than one equation. To solve this problem, tests or requirements must be carried out so that it is known which equation coefficient is estimated. One type of identification test, namely the order condition.

Equations that can be solved using a system of simultaneous equations are equations resulting from order conditions that are identified (using Indirect Least Square/ILS) and overidentified (using Two Stage Least Square/2SLS). Based on this explanation, the results for the order condition for the two analytical models in this study are over identified, which can be seen in Eqns. (8)-(9).

$$\begin{aligned} \text{Eq. (6)} &\rightarrow \text{Catch (Y}_1\text{)} \\ 5 - 3 &> 2 - 1 \\ 2 &> 1(\text{overidentified}) \end{aligned} \tag{8}$$

$$\begin{aligned} \text{Eq. (7)} &\rightarrow \text{Fishermen Family Welfare (Y}_2\text{)} \\ 5 - 3 &> 2 - 1 \\ 2 &> 1(\text{overidentified}) \end{aligned} \tag{9}$$

The 2SLS method is implemented through the use of Ordinary Least Square (OLS) in two stages. In the first step, each endogenous variable is regressed against all predetermined variables of a system so that we get reduced form equations. The second stage, the forecast value is used to estimate the structural equation of the model. The estimated or predicted value of the endogenous variables is obtained by inputting the observed values of the exogenous variables into a simple equation. The estimated values of the endogenous variables are not correlated with the confounding errors, so that 2SLS produces consistent structural parameter estimates.

4. RESULTS AND DISCUSSION

4.1 Characteristics of respondents

Based on the results of testing the respondent's questionnaire data with the frequency test, it can be seen the description of the characteristics of the respondents who are the samples in this study, which are summarized in Tables 4 to 10.

4.1.1 Description of respondents based on gender

Information in Table 4, according to the gender of the 373 respondents who were the object of the study, shows that the majority of the gender of the respondents who became fishermen in West Sumatra Province was male, with 317 respondents. This informs that fishermen households who have fishing gear in West Pasaman District, Pesisir Selatan District and Padang City are dominated by respondents whose gender is male at 84.99%.

Table 4. Frequency test for respondents based on gender

Gender	Frequency	Percent
Man	317	84.99
Woman	56	15.01
Total	373	100

Source: Author's work, 2023

4.1.2 Description of respondents based on age

Information in Table 5, according to the age of the 373

respondents who were the object of the study, shows that the majority of the age of the respondents who became fishermen in West Sumatra Province was 26-35 years, with 105 respondents. This informs that fishermen households who have fishing gear in West Pasaman District, Pesisir Selatan District and Padang City are dominated by respondents whose age is 26-35 years at 28.15%.

Table 5. Frequency test for respondents based on age

Age	Frequency	Percent
16-25 years	93	24.93
26-35 years	105	28.15
36-45 years	96	25.74
> 45 years	79	21.18
Total	373	100

Source: Author's work, 2023

4.1.3 Description of respondents based on education

Information in Table 6, according to the education of the 373 respondents who were the object of the study, shows that the majority of the education of the respondents who became fishermen in West Sumatra Province was senior high school, with 200 respondents. This informs that fishermen households who have fishing gear in West Pasaman District, Pesisir Selatan District and Padang City are dominated by respondents whose education is senior high school at 53.62%.

Table 6. Frequency test for respondents based on education

Education	Frequency	Percent
Elementary school	99	26.54
Junior high school	74	19.84
Senior High School	200	53.62
Total	373	100

Source: Author's work, 2023

4.1.4 Description of respondents based on number of family dependents

Information in Table 7, according to the number of family dependents of the 373 respondents who were the object of the study, shows that the majority of the education of the respondents who became fishermen in West Sumatra Province was 0-3 people, with 195 respondents. This informs that fishermen households who have fishing gear in West Pasaman District, Pesisir Selatan District and Padang City are dominated by respondents whose number of family dependents is 0-3 people at 52.28%.

Table 7. Frequency test for respondents based on number of family dependents

Number of Family Dependents	Frequency	Percent
0-3 people	195	52.28
4-6 people	154	41.29
> 6 people	24	6.43
Total	373	100

Source: Author's work, 2023

4.1.5 Description of respondents based on experience as a fishermen

Information in Table 8, according to the experience as a fishermen of the 373 respondents who were the object of the study, shows that the majority of the experience as a fishermen of the respondents who became fishermen in West Sumatra

Province was 5-10 years, with 136 respondents. This informs that fishermen households who have fishing gear in West Pasaman District, Pesisir Selatan District and Padang City are dominated by respondents whose experience as a fishermen is 5-10 years at 36.46%.

Table 8. Frequency test for respondents based on experience as a fishermen

Experience as a Fishermen	Frequency	Percent
< 5 years	40	10.72
5-10 years	136	36.46
11-15 years	51	13.67
16-20 years	79	21.18
> 20 years	67	17.96
Total	373	100

Source: Author's work, 2023

4.1.6 Description of respondents based on having other jobs

Information in Table 9, according to the have another job of the 373 respondents who were the object of the study, shows that the majority of the have another job of the respondents who became fishermen in West Sumatra Province was no, with 256 respondents. This informs that fishermen households who have fishing gear in West Pasaman District, Pesisir Selatan District and Padang City are dominated by respondents whose have another job is no at 95.44%.

Table 9. Frequency test for respondents based on having other jobs

Have Another Job	Frequency	Percent
Yes	17	4.56
No	256	95.44
Total	373	100

Source: Author's work, 2023

4.1.7 Description of respondents based on fishing gear owners

Information in Table 10, according to the fishing gear owners of the 373 respondents who were the object of the study, shows that the majority of the have another job of the respondents who became fishermen in West Sumatra Province was outboard motorboat, with 204 respondents. This informs that fishermen households who have fishing gear in West Pasaman District, Pesisir Selatan District and Padang City are dominated by respondents whose fishing gear owners is outboard motorboat at 54.69%.

Table 10. Frequency test for respondents based on fishing gear owners

Ownership of Fishing Gear	Frequency	Percent
Boat Without Motor	107	28.69
Outboard Motorboat	204	54.69
Motor Ship	62	16.62
Total	373	100

Source: Author's work, 2023

4.2 Simultaneous equation analysis: Two Stage Least Square/2SLS

4.2.1 Catch analysis

Simultaneous equation analysis for catches is summarized in Eq. (10). The influence of Y_2 , X_1 , X_2 and X_3 contributes to increasing Y_1 .

$$Y_{1i} = -0.28^* + 1.15 Y_{2i}^{**} + 0.08 X_{1i}^{**} + 0.38 X_{2i}^{***} + 0.27 X_{3i}^{***} \quad (10)$$

*** significant at $\alpha=1\%$
 ** significant at $\alpha=5\%$
 * significant at $\alpha=10\%$

Fishermen family welfare (Y_2) has a significant influence on catch (Y_1) in West Sumatra Province, so that the perception of the sample in this study assesses that family welfare contributes to their catch. This result is supported by the sample frequency distribution based on experience as fishermen in this study, on average, they are quite experienced, which is dominated by work experience between 5-10 years. Based on the indicators of the fishermen family welfare variable in this study, the experience they have can help them influence market prices, so that it will increase their welfare. The welfare of fishermen is related to the level of income received by fishermen, so that the more income they earn, the more the needs they want will be fulfilled, in which part of the income they earn will be allocated to purchase more advanced fishing gear such as motorized boats, so that it will support their catch. In addition, improving the welfare of fishermen will also increase their productivity, in which fishermen will make efforts to increase the results achieved in a cost-effective manner, but with high quality. The results of this study are consistent with research that has been conducted by previous researchers, including fishermen who are prosperous will tend to get more catches because the fishing gear technology used is more modern [35]. Furthermore, the increase in welfare is reflected in the high income they get from fishing, so that their ability to increase their catch will be even better from the improvement in the fishing gear they use [36]. Then, prosperous fishermen will have good productivity to increase catches [37].

Catch type (X_1) has a significant influence on the catch (Y_1) in West Sumatra Province, so that the perception of the sample in this study assesses that the type of catch contributes to their catch. Based on the indicators of the variable type of catch in this study, it really depends on the fishing gear used. This study analyzed samples using three types of fishing gear, including boats without motors, outboard motor boats and motorized boats. A boat without a motor is a boat that does not use engine power as propulsion, but uses sails or oars. Furthermore, an outboard motor boat is a boat that uses an engine as propulsion, and the motor is placed outside either at the stern or on the side of the boat. This outboard motor can be installed on a jukung or a board boat. Board boats that use outboard motors are included in the category of outboard motor boats. Then, a motor ship is a ship that uses engine power which is permanently placed in the engine room. Based on the classification of the types of fishing gear, the use of more advanced fishing gear such as motor boats will produce a greater variety of catches, which will have an impact on increasing the catch of fishermen. The results of this study are consistent with research that has been conducted by previous researchers, including fishermen who use motor boats to get high catches [38]. Furthermore, the use of effective and efficient fishing gear will encourage an increase in catch [39]. Then, innovation in fishing gear is needed to increase the catch type [40].

Fishermen productivity (X_2) has a significant influence on catch (Y_1) in West Sumatra Province, so that the perception of the sample in this study assesses that productivity contributes

to their catch. Based on indicators of fishermen's productivity variables in this study related to input and output ratios. Productivity is a measure that states how well resources are managed and utilized to achieve optimal results. Furthermore, the catch of fishermen is directly proportional to the length of time used to go to sea. Productivity is an important concept in the analysis of an economic activity because apart from the addition of production inputs, income growth can occur as a result of increased productivity. The productivity of fishermen is used as a measure of the success of a fishermen in getting the catch, so the higher the comparison, the higher the catch produced. The results of this study are consistent with research that has been conducted by previous researchers, including productive fishermen tend to be more enthusiastic in carrying out their activities. In addition, fishermen who have good productivity already have a plan for what they will do [41]. Furthermore, the high productivity of fishermen will result in a high volume of catch from their fishing trips [42]. Then, the fishermen productivity which is supported by the ability of good fishing gear will increase the ratio between the catch and the amount of time spent fishing [43].

Fishermen socio-cultural environment (X_3) has a significant influence on catch (Y_1) in West Sumatra Province, so that the perception of the sample in this study assesses that the socio-cultural environment contributes to their catch. Based on indicators from the socio-cultural environmental variables in this study, fishermen establish mutually beneficial cooperation between them, such as tolerance, namely allowing fellow fishermen to use their own fishing gear, so that this action will encourage catches. The results of this study are consistent with research that has been conducted by previous researchers, including that ecosystems in fisheries management require ecosystems to be viewed holistically, including the dynamics not only within an ecosystem but also between ecosystems and society. Justification theory was found to be useful for identifying socio-cultural values related to fisheries as it suggests a diversion from interests that conflict with the common good [44]. Furthermore, the coastal management unit succeeded in educating fishermen and they know the rules and regulations of fishing [45]. Then, it will become increasingly necessary to manage fisheries from a food security perspective, and briefly attempt to review fisheries from a food security perspective and evaluate them using a vulnerability framework. Some of the main ways to develop fisheries aspects are to reduce the many potential environmental and social threats that increase the vulnerability of fisheries [46].

4.2.2 Analysis of fishermen family welfare

Simultaneous equation analysis for fishermen family welfare is summarized in Eq. (11). The influence of Y_1 , X_3 , X_4 and X_5 contributes to increasing Y_2 .

$$Y_{2i} = -3.12^{**} + 2.91 Y_{1i}^{**} + 0.58 X_{3i}^* + 0.73 X_{4i}^{***} + 1.84 X_{5i}^{***} \quad (11)$$

*** significant at $\alpha=1\%$
 ** significant at $\alpha=5\%$
 * significant at $\alpha=10\%$

Catch (Y_1) has a significant influence on the fishermen family welfare (Y_2) in West Sumatra Province, so that the perception of the sample in this study considers that the catch contributes to their welfare. Based on the indicators of the catch variable in this study, the catch is very dependent on the

length of time spent at sea. This result is supported by the sample frequency distribution based on having other jobs in this study dominated by those who only focus on being fishermen, amounting to 95.44%. This condition has an impact on the maximum allocation of their working hours as fishermen to go to sea, so that the catch can boost their welfare. The results of this study are consistent with research that has been conducted by previous researchers, including well-managed marine resources will improve the welfare of people in coastal areas [47]. Furthermore, the economic welfare of fishermen is very dependent on the catch, which is determined by internal factors that come from the time allocation of fishermen while at sea. Then, in order to achieve sustainable use of marine fisheries resources, fisheries management policies should be developed to improve total yield control and ecosystem reconstruction [11].

Fishermen socio-cultural environment (X_3) has a significant influence on the fishermen family welfare (Y_2) in West Sumatra Province, so that the perception of the sample in this study assesses that the socio-cultural environment contributes to their welfare. Based on the indicators of the socio-cultural environmental variables in this study, fishermen establish mutually beneficial cooperation between them, such as tolerance, that is, they have very high solidarity in terms of helping each other, they maintain trust among friends and with courtiers, they always respect fellow fishermen and they always try to interact with more experienced fishing communities to gain knowledge to find more catches. The results of this study are consistent with research that has been conducted by previous researchers, including the importance of locally identified cultural services that are appropriate to the context for local communities who perceive them as exceeding their income [48]. Furthermore, fishermen will usually try to adjust their fishing behavior before considering diversification and some will reject it due to economic and socio-cultural constraints. Then, knowledge of cultural landscapes enhances understanding of the positive feedback relationships between the social, cultural, and ecological dimensions of a fishery system, which can increase the likelihood of the sustainable use of fishery resources [26].

Selling price of fish (X_4) has a significant influence on the welfare of fishing households (Y_2) in West Sumatra, so that the perception of the sample in this study considers that the selling price of fish contributes to household welfare. Based on indicators from the variable price of fish in this study, the selling price of fish is related to the quality of the catch. Furthermore, the selling price of fish is the main determinant of the level of community welfare because it relates to the income that will be obtained by fishermen. In addition, the selling price of fish is related to the fishermen's exchange rate, which is a measuring tool used to determine the ability to exchange fish caught for goods/ services needed for production needs and household consumption needs. The results of this study are consistent with research that has been conducted by previous researchers, including high selling prices of fish will increase the welfare of fishermen [49]. Furthermore, the welfare of fishermen is closely related to the selling price of the fish they get [50]. Then, the stability of the selling price of fish must be maintained to maintain the stability of the fishing household [26].

Fishermen family happiness (X_5) has a significant influence on fishermen family welfare (Y_2) in West Sumatra, so that the perception of the sample in this study assesses that family happiness contributes to household welfare. Based on the

indicators of the family happiness variable in this study, fishermen are able to overcome all the obstacles that occur in their household, so that if this is fulfilled, it will increase their welfare. Furthermore, the happiness of fishermen's families is also achieved by the motivation of their families and the maximum effort they make. The results of this study are consistent with research that has been conducted by previous researchers, including family happiness will encourage the welfare of fishermen [35]. Furthermore, if the happiness of the fishermen's family is getting happier, then their welfare will get better [43]. Then, prosperous fishermen are supported by happy families [47].

5. CONCLUSION

The analysis that has been carried out in this study is used as the basis for research conclusions. First, the conclusion for the analysis of the catch is that fishermen family welfare, catch type, fishermen productivity and fishermen socio-cultural environment have a significant influence with a positive direction coefficient. Second, the conclusion for the analysis of fishermen family welfare is that the catch, fishermen socio-cultural environment, selling price of fish and fishermen family happiness have a significant effect with a positive direction coefficient.

Policy recommendations from this research to the government in West Sumatra, including increasing fisheries productivity through providing fish shelters for fishermen to maintain their selling value against market prices. Furthermore, the government needs to provide guidance for traditional fishermen through socialization in order to increase and expand their knowledge so that they can increase the productivity of their catches. Then, the government needs to innovate related to the productivity of fisheries products by integrating fish shelters and restaurants or seafood restaurants so as to further increase fishermen's income so that welfare is realized for them. In addition, the government needs to develop the functions of microfinance institutions and cooperatives that side with fishermen, besides that there needs to be efforts to build joint businesses, such as through collective ownership of fishing and marketing facilities. Finally, the government needs to carry out a social policy that contains pro-fishermen programs, which in relation to poverty alleviation must be bottom up in accordance with the conditions, characteristics and needs of fishing communities. Policies that are born based on the participation or involvement of fishing communities no longer make fishermen as program objects, but as subjects. Strengthening in terms of laws related to fishing zones, strengthening marine patrol fleets, and regulating fishing gear that does not exploit marine wealth and is environmentally friendly.

This research has several limitations, so that it becomes an opportunity for future studies to expand the study as a novelty. The area of study focused on in this study is quite small because it only analyzes one province, while Indonesia has 34 provinces, so further research needs to consider other provinces in Indonesia or conduct comparative studies between islands in Indonesia. Furthermore, the variables used in this study do not involve the physical environment such as sea surface temperature, rainfall, and wave height, which indicators are thought to also affect fishermen's productivity.

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