



## Research article

## Adaptive coping strategies towards seasonal change impacts: Indonesian small-scale fisherman household

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## ABSTRACT

Small-scale fishers are always expected to adapt to fishing activities that cannot be conducted all year round due to weather and fishing season. This condition, especially when it is not the fish season, makes fishers face a problem. Notwithstanding, fishermen households need to develop an adequate adaptation strategy to solve the problem of fulfilling their needs, known as coping strategies. This study aims to analyze fishermen households' coping strategies in facing the fishing season and non-fish season by using fishermen's family resources and two types of internal and external family coping strategies. The data were gathered from approximately 150 small-scale fishing households using simple random sampling. The results indicate the fishers do fishing activities in three batch: peak season (68%), mild season (20%), and off-season (12%). The use of resources for fishermen households' coping strategy is carried out by diversifying the sources of household income. Some economic activities include cultivating forest land belonging to the forest department, marine tour guides, livestock, and his wife. This study also confirm that all households use internal family coping strategies with humor indicator as the highest percentage. Accordingly, the households also adopt the external family coping strategy to deal with the existing situation. This strategy follows the local community's characteristics and culture who are friendly and open and based on religion. The household coping strategy strengthening model is generated through the synergy of formal institutional roles in society and government institutions as policymakers.

## 1. Introduction

Small-scale fishing in Indonesia has confronted the issue of shifting from a fishing environment to a tourist destination. The Prigi Bay area is an excellent example of these remarkable changes in Indonesia. For a long time, the area of Prigi Bay is well-known for the fishing area, which is dominated by small-scale fishers. They utilized boat with 9–12 m long and 2–3.5 m wide that made from fiberglass or wood. For almost two decades, Karanggongso Beach Prigi Bay has undergone extraordinary changes. After the Fish Sanctuary project in 2001, Karanggongso Beach was better known as a tourist destination. This situation forced fishing households to implement and develop adaptation strategies, both socially and economically.

In addition to the functional changes, small-scale fishing has been faced fishing season approximately four months a year. During the off-fishing season, most small-scale fishers tend to wait and do not carry out fishing activities in the sea. As a consequence, small-scale fisher

suffers socio-economic problems in their household. Dealing with this issue, the household needs to develop an adequate adaptation strategy called a coping strategy (Ostlund and Persson, 2014). Maryam (2017) points out that family coping is a behavioral and thought response to stress using existing resources in individuals or the surrounding environment. The implementation of this activity aims to reduce and manage the emergence of conflicts from internal and external to improve life better.

Despite the escalating studies on the impact of the functional changes on socio-economic of household, the study on what determinant factors and how adaptation strategy of small-scale fishing households in Indonesia through coping strategies has overlooked by scholars. Previous published studies focused on strategy in diversifying income sources, utilizing social relationships, diversifying fishing gears and changing fishing grounds (Hedianto and Satria, 2018). Additionally, Aji et al. (2017) measures shrimp farmers' response in the sultanate's land management policy in Bantul through coping strategies, including criticizing

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decisions, accepting, forced acceptance, and self-evaluation. Syuryani (2017) studied traditional fisherman household coping strategies in overcoming poverty by actively extending working hours and passively reducing spending during fishing seasons. The findings of Salmi (2005) remarks that coping strategies for small-scale fishing are shown by pro-activity to get productive wages, be farmers, and wage workers. For this matter, this study aims at examining fishermen households' coping strategies in facing the fishing season and non-fish season by using fishermen's family resources and two types of internal and external family coping strategies.

This study provides three main contributions. First, this study contributes to the existing literature on coping strategies for fishers' by identifying determinants factors that are missing in the prior studies. In more detail, it adds insight into the fishers' perception of seasonal fluctuations, how fishing household communities facing the circumstances use coping, and the adaptive capacity of the coastal fishing household. Second, this study is the first to investigate the functional shifting from the fishing environment into a tourism destination and its impact on the household economy for small-scale workers. This research offers a new topic to deal with the relevant issue in different regions. The focus in Indonesia, primarily at Prigi Bay of East Java is reasonable because this area has faced a remarkable change from fishing environment to tourism compared to other sites in Indonesia. Third, undergoing empirically evaluation on the adaptation strategies for fishers, this study proposes critical issue for economic household and inform better policy assisting the household community to achieve economic welfare.

This paper has been divided into six sections. Section 1 deals with the background of the household issue in facing the seasonal changes. Section 2 reviews the literature on adaptive strategy and hypotheses proposed in this study. This is followed by an illustration of data collection and methodology used in Section 3. The findings and discussion are provided in section 4 and section 5, respectively. Lastly, the conclusion of the research is presented in Section 6.

## 2. Literature review and hypothesis

This section reviews adaptive strategies in households to cope with the existing issues of seasonal changes. Furthermore, the literature provides the internal and external coping strategies and presents the adaptability of small-scale fishers in detail.

### 2.1. Adaptive strategy and its effect on adaptation ability

Adaptive strategy success is also contingent on successful adaptation ability. From the start of the pandemic, fishermen used a variety of adaptation strategies, including selling and delivering seafood directly to customers, changing their target species to fish those with higher demand or better prices, and frequently changing the timing and location of their fishing trips. Many others relied on federal financial assistance to make ends meet and keep their fishing businesses afloat. A prior literature by Damanpour et al. (2018) divides coping strategies in the household into two: internal (intrafamilial) and external strategy (extrafamilial). For the internal strategy, it consists of six indicators, including relying on one's abilities and family; humor, deliberation, and family discussion; giving rise to optimistic beliefs and positive assessments; solving common problems to state how the family can manage the family's response to stress (Belachew et al., 2013; Notenbaert et al., 2013; Damanpour et al., 2018). Meanwhile, Friedman (1998) noted that there are four indicators for external coping strategies, including looking for information related to stressors to control situations and reduce feelings of fear; maintaining an active relationship with the community, in this case, family members are family leaders in a group; looking for social support in the family social work network. It is a prominent external family coping strategy. Social support includes, among others, the kinship system of families, professional groups, community leaders, and others based on shared interests; seek for spiritual support. Some studies also in believing that

adaptation strategies will impact adaptational ability and behavioral changes (van Valkengoed and Steg, 2019; Uddin et al., 2014; Omerkhil et al., 2020). From these explanations, the first hypothesis proposed as follow.

**H<sub>1</sub>.** Adaptation strategies have a positive and significant effect on adaptability behavior.

### 2.2. Internal coping strategy, adaptation strategy, and adaptability

The adaptive capability at the fisher' community level is essential to shape community resilience and enabling adaptation (Omerkhil et al., 2020). The fundamental rationale is due to the obstacle which is facing by the fisher, such as human pressure and climate variability, and change (Seara et al., 2016). Also, the fisher has many difficulties due to fish stock are known to fluctuate naturally regarding temporal environmental variability (Moustahfid et al., 2020). Those conditions have forced the fishers to deal with various strategies to maintain their life using coping strategies. Family coping is the family's positive behavioral responses to solve a problem or reduce stress caused by specific events. Families are expected to play a role in solving problems through effective coping strategies. One form of internal coping strategy in fishermen's families is sharing responsibilities with household members. Internal coping strategies that involve the family's role are proven to improve fishermen's livelihoods through strategies and their adaptability (Mozumder et al., 2018).

In addition to the family roles, Manczak et al. (2016) noted that someone's stressful state would have less effect both physiologically and psychologically. The individual will not allow the effect of this negativity to keep happening and immediately takes action to solve an issue. That action taken by the individual is well-known as a coping strategy. Coping strategies are often influenced by setting behind culture, experience in dealing with problems, environmental factors, personality, self-concept, social factors, and others' very influential abilities in solving the problem (Bhowmik et al., 2018). Coping behavior can also be said as transactions that individuals undertake to overcome various demands (internal and external) as burdens and interfere with their vulnerability. The coping strategy aims to resolve situations and perceived demands to press, challenge, overwhelm, and exceed other resources to cover up their inadequacies (Markova and Nikitskaya, 2017; Das et al., 2020).

Shdaifat et al. (2018) added two types of coping mechanisms performed by individuals: a problem-focused form of direct action and an emotion-focused form of coping (palliative form). The coping types adopted and how they work depends on the type of stress or problem at hand (Evans and Kim, 2013). The situation still can change constructively (e.g., experiencing catastrophic starvation) strategy used is problem-focused. In a difficult situation such as a partner's death, the coping strategy used is an emotion-focused because individuals expect more to pray and be patient. The success or failure of coping will determine whether the stress reaction will decrease and fulfill the expected various demands (Rutter, 2013; Compas et al., 2014). Thus, the hypothesis proposed as follow.

**H<sub>2</sub>.** Internal coping has a positive and significant effect on the adaptation strategy

**H<sub>3</sub>.** Internal coping has a positive and significant impact on adaptability

### 2.3. External coping strategy, adaptation strategy, and adaptability

Small-scale fisheries require solutions to social and cultural issues of fish management to ensure their long-term survival. With various kinds of problems and pressures, such as pressure on their income, rising operating costs, unstable fuel prices, recruitment problems, declining fish stocks, and marine habitats' degradation (Prosperi et al., 2019). In the instability condition felt by small-scale fishermen, they have

implemented several internal and external survival strategies. It is conducted to create a self-financing mechanism and carried out by building solidarity and collective action in the community, cooperatives, or collaborative business groups (Mulyadi, 2007). With the cooperation between fishers in the provision of capital in economic institutions, it will make it easier for members to meet their needs. Several studies prove the importance of economic institutions as an external coping strategy built from fishing communities, including adopting a “post-productive” activity model that states that institutions can accommodate the community's problems and needs, mostly fishermen (Salmi, 2015; Urquhart and Acott, 2013).

In fishermen's life, social relationship patterns also influence external coping strategies through livelihood strategies. In fishing households, Paulus et al. (2019) concluded that they implemented livelihood strategies, including: doing a variety of jobs even at low wages; utilizing kinship ties and exchanging returns in providing a sense of security and protection; carry out-migration as the last alternative if there are no more choices of income sources in the area.

According to Ritzer and Yagatich (2012), in order for a system to be sustainable, there must be four functions of AGIL, namely: 1) Adaptation (A): a system must address immediate external situational needs; 2) Goal Attainment (G): a system must define and achieve its primary goals; 3) Integration (I): a system must regulate the interrelationships of the parts of its components, also manage the relationship between three other functional imperatives (A, G, L); and 4) Latency (L) or pattern maintenance function: a process when the system maintains social motivation and agreement by using social control, the commitment of the members must remain intact. It is concluded that improving community livelihoods will necessitate strengthening supplementary livelihood occupations and educating fishermen on the dangers of using illicit fishing methods in order to grow the sector and increase fishermen's income levels (Dzantor et al., 2020). From these explanations, the hypothesis provided as follow.

**H<sub>4</sub>.** External coping has a positive and significant effect on adaptation strategies

**H<sub>5</sub>.** External coping has a positive and significant effect on adaptability

### 3. Materials and method

#### 3.1. Study site

This study focused on several representative places in East Java of Indonesia. There areas were sampled, including Karanggongso Beach, Tasikmadu Village, Watulimo District, Trenggalek Regency that has been faced the shifting the functional changes from full fisheries to ecotourism site, accessibility to the road, and harbor establishment. The study area extended over 111.71621 BT - 8.28347 SL, with the area's topography in beaches and mountains (See Figure 1). Karanggongso located on the coast south of Trenggalek with potential marine tourism, which is Pasir Putih Beach, which invited the attention of visitors and investors to invest in the form of hotels and accommodation. Karanggongso beach has no central management, either by government or community-based. The data from Indonesian Statistics (BPS, 2020) documented that the family member of Karanggongso was approximately 1,275 people consisting of 652 male and 623 resident's female population with 458 households with 75 percent as fishers resulting in dependence on activities fishing high. Additionally, majority residents engaged in small-scale fisheries, agriculture, and wage labor due to its geographical area.

#### 3.2. Sampling, questionnaire and data collection

The adaptation strategies of small-scale fishers were performed by internal coping, external coping, alternative strategies, participation in groups, surplus, and time spent. This study involved approximately 150 small-scale fishers using a simple random sampling technique that was widely used in the study area. The data were collected undergoing 70

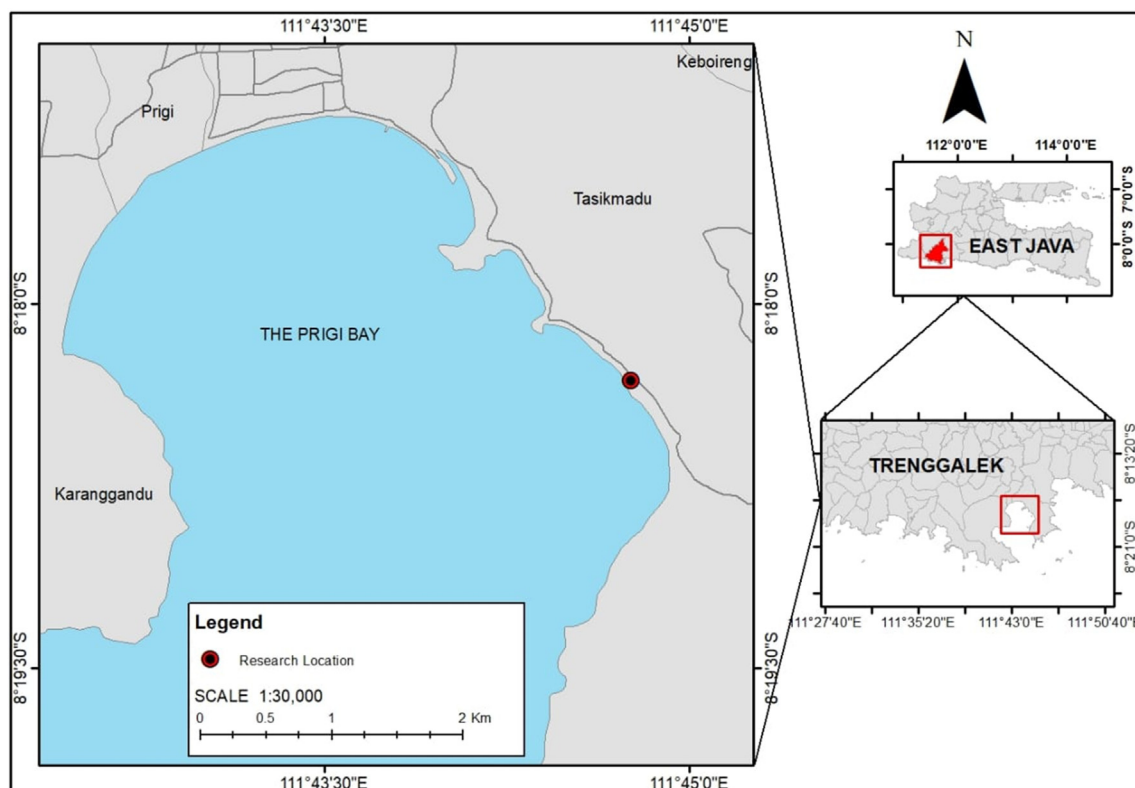


Figure 1. Map of the study region.

questions on semi-structured questionnaires used during the surveys in August and October 2019. These surveys were intended to assess if there have any recent changes in fishing activities by focusing on how fishers responded to the changes area's function from full fisheries to ecotourism sites and harbor presence over the last decade (2009–2019). In detail, to determine how adaptive capacity solving the problem of fulfilling fishers' household needs, we focused on eleven coping strategies in the household, including self-ability, humor, family discussion, problem-solving, take over the responsibilities, working, gathering information, community service, good relationship, religious community. Before the interviews, we also conducted a group discussion with local government and fishers' representatives, which aims to introduce and ask for their cooperation. The majority of interviews were performed in the fishers' household, and the participants were asked for their anonymity. Furthermore, the data obtained were coded and analyzed using Smart-PLS 3.0 application. In more detail, the adaptation ability indicator is provided in Table 1.

### 3.3. Data analysis

This study adopted a quantitative approach with Partial Least Square (PLS) to gain a deeper understanding of what factors affecting coping strategies for the household. In this study, the analysis of fishermen households for emotional coping strategy by distinguishing internal and external coping strategies refers to Friedman's (1998). Lastly, the adaptability capacity index was the adaptability capacity sum of all three indicators after scaling using the Guttman scale. Before computation, indicators were scaled 'yes', 'maybe', 'no' based on their importance to adaptation. This use of this method is very suitable for analyzing the off-season fish season. To analyze small-scale fishermen households' coping, we adapted indicators from Friedman (1998). This study's path diagram was performed based on theories, findings of preliminary studies, and prior focus group discussions with small-scale fishers to produce exogenous and endogenous variables. The detailed connectivity between variables is illustrated in Table 2 and Figure 2).

This study also followed several estimations, including the outer model evaluation and inner model assessment. This study performed three indicators for the outer assessment model, namely composite reliability, discriminant validity and convergent validity. After evaluating the outer model, the next step is to evaluate the inner model, also known as structural model evaluation. This research performed a five-stage procedure in the structural model test, consisting of path coefficient, R-square ( $R^2$ ), relevant predictions test ( $Q^2$ ). The  $R^2$  test aims to comprehend whether each endogenous latent variable has predictive power on the model or not, while the  $Q^2$  relevant prediction test intends to evaluate the value and its parameter estimation.

The notation in PLS is as follows:

- $\delta$  (Delta): Measurement Error Exogenous Indicator
- $\epsilon$  (Epsilon): Measurement Error Endogenous Indicator

Table 1. Adaptation ability indicator.

No	Function	Production Activity
1.	Livelihood strategies	Not changing primary profession
		Partly changes in primary profession
		Fully changes in primary profession
		New activity performed by the fishers
		New activity performed by the wife to help the fishers
2.	Resource Availability	Sea
		Forest
		Farmland
		Ecotourism
3.	Social Networking	Assistance received from coastal and religion community

- $\xi$  (Ksi): Exogenous Latent Variable
- $\eta$  (Eta): Endogenous Latent Variable
- $\lambda$  (Lamda): Factor Weight between Latent Variable and Indicator
- $\gamma$  (Gamma): The coefficient of direct influence between Exogenous Latent Variable and Endogenous Latent Variable
- $\zeta$  (Zeta): error term

The path diagram is converted into the outer model and inner model equation, as follows:

The outer model is a specification of the relationship between latent variables and their indicators. Eq. (1) refers to exogenous latent of variable 1 (reflective):

$$\begin{aligned} X_{1.1} &= \lambda_{x1.1}\xi_1 + \delta_{1.1} \\ X_{1.2} &= \lambda_{x1.2}\xi_1 + \delta_{1.2} \\ X_{1.3} &= \lambda_{x1.3}\xi_1 + \delta_{1.3} \\ X_{1.4} &= \lambda_{x1.4}\xi_1 + \delta_{1.4} \\ X_{1.5} &= \lambda_{x1.5}\xi_1 + \delta_{1.5} \\ X_{1.6} &= \lambda_{x1.6}\xi_1 + \delta_{1.6} \end{aligned} \tag{1}$$

Eq. (2) explains for exogenous latent of variable 2 (reflective):

$$\begin{aligned} X_{2.1} &= \lambda_{x2.1}\xi_2 + \delta_{2.1} \\ X_{2.2} &= \lambda_{x2.2}\xi_2 + \delta_{2.2} \\ X_{2.3} &= \lambda_{x2.3}\xi_2 + \delta_{2.3} \\ X_{2.4} &= \lambda_{x2.4}\xi_2 + \delta_{2.4} \end{aligned} \tag{2}$$

Eq. (3) informs for endogenous latent of variable 1 (reflective):

$$\begin{aligned} Y_{1.1} &= \lambda_{y1.1}\eta_1 + \epsilon_{1.1} \\ Y_{1.2} &= \lambda_{y1.2}\eta_1 + \epsilon_{1.2} \end{aligned} \tag{3}$$

Eq. (4) provides for endogenous latent of variable 2 (reflective):

$$\begin{aligned} Y_{2.1} &= \lambda_{y2.1}\eta_2 + \epsilon_{2.1} \\ Y_{2.2} &= \lambda_{y2.2}\eta_2 + \epsilon_{2.2} \end{aligned} \tag{4}$$

The inner model which proxied in Eq. (5) is a specification of the relationship between latent variables (structural model). The Inner model equation is stated as follows:

$$\begin{aligned} \eta_1 &= \gamma_1\xi_1 + \gamma_2\xi_2 + \zeta_1 \\ \eta_2 &= \beta_1\eta_1 + \gamma_3\xi_1 + \gamma_4\xi_2 + \zeta_2 \end{aligned} \tag{5}$$

$\gamma$  is the path coefficient that connects the endogenous latent variable ( $\eta$ ) with exogenous ( $\xi$ ). Whereas  $\beta$  is the path coefficient that connects the endogenous latent variable ( $\eta$ ) to endogenous ( $\eta$ ) and  $\zeta$  is the inner residual variable.

## 4. Data analysis and findings

The section provides the findings of the study and results of analysis data. The Smart-PLS (version 3) was performed to calculate the collected data using stages of statistical requirements. The validity and reliability results are also provided in this section. The discussions are presented later in more precise.

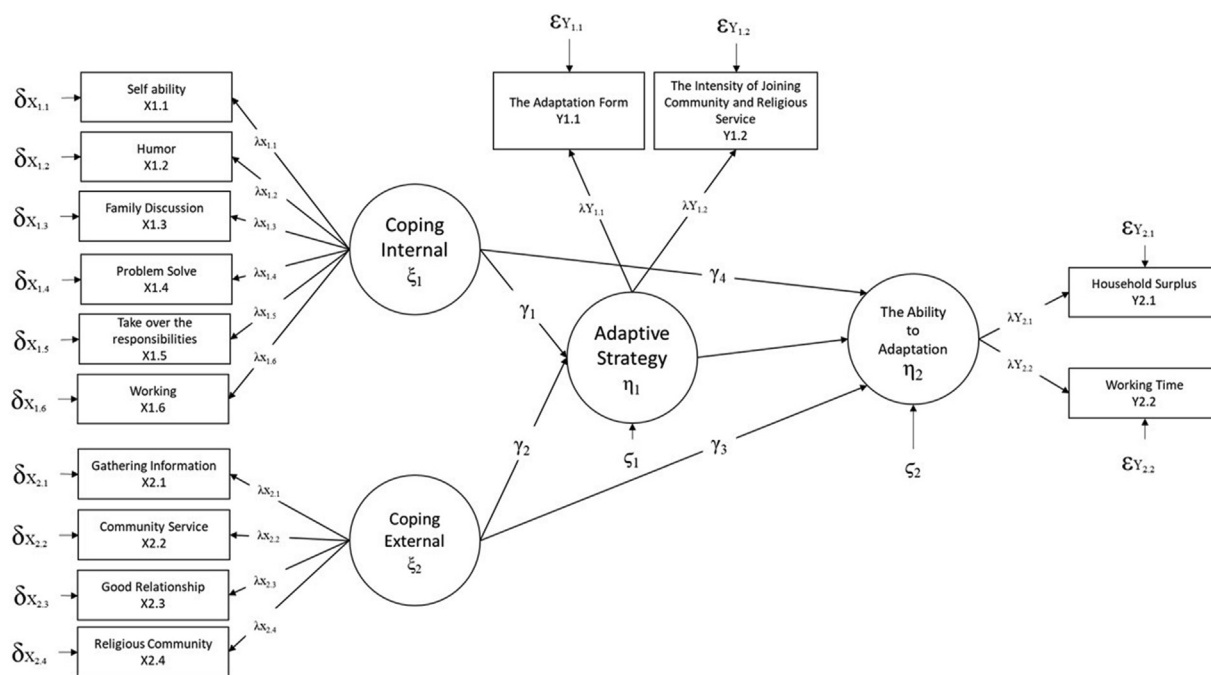
### 4.1. The outer model evaluation

#### 4.1.1. Composite validity test

Using Smart PLS, the reliability test in this study was calculated undergoing composite reliability. The Cronbach's Alpha value of this study ranges from 0.704 – 0.957, while the composite reliability value was around 0.871–0.979. It can be stated that the variables confirmed the composite criteria due to it was greater than 0.7 (see Table 3). According to Alfa et al. (2017), the value of Cronbach's alpha and composite reliability were greater than 0.7, and it can be said that the latent variables were reliable.

**Table 2.** The detail indicator of each variable.

Internal Coping Indicator ( $\xi_1$ )	
X1.1 (self-ability)	Fishing families rely on their abilities when faced with difficulties during the dry season/no fishing season or moderate season
X1.2 (humor)	Family members use humor or jokes to deal with stress
X1.3 (family discussion)	Families have time together for deliberation
X1.4 (problem solve)	The family always tries to solve problems and find solutions together
X1.5 (take over the responsibilities)	When there is an emergency or stress, family members are willing to replace the duties of other family members
X1.6 (working)	When there is an emergency or stress, family members continue to carry out their respective duties
External Coping ( $\xi_2$ )	
X2.1 (gathering information)	Families seek information from colleagues, groups, community leaders, or village officials when they get into trouble during times of famine/non-fishing season
X2.2 (community service)	Family members belong to community groups
X2.3 (good relationship)	Family members can establish good relationships with colleagues, neighbors, or groups
X2.4 (religious community)	Family members are members of religious activities or groups
Adaptation Strategy ( $\eta_1$ )	
Y1.1 (adaptation form)	Alternative work is done by fishermen to adapt
Y1.2 (the intensity of joining community and religious service)	The participation of social and religious groups
Adaptability ( $\eta_2$ )	
Y2.1 (household surplus)	Fisherman household surplus
Y2.2 (working time)	Spending of productive time of fisherman household



**Figure 2.** The Variables in Coping Strategy Analysis. Source: Own elaboration based on Friedman (1998) and Maryam (2017).

**Table 3.** The reliability test and discriminant validity test.

Latent Variable	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Internal Coping ( $X_1$ )	0.704	0.871	0.772
External Coping ( $X_2$ )	0.957	0.979	0.958
Adaptive Strategy ( $Y_1$ )	0.857	0.895	0.589
Adaptive Ability ( $Y_2$ )	0.891	0.924	0.754

**4.1.2. Discriminant validity test**

As illustrated in Table 3, the square root value of AVE for each construct was greater than the correlation between constructs in the model. These implicate that the construct model satisfied the discriminant validity (Joushan et al., 2015). The AVE value in this study resulted in a value between 0.589 - 0.958 (>0.5), thus, it was declared valid.

**4.1.3. The convergent validity test**

According to Henseler and Chin (2010), a correlation can meet convergent validity when it has a loading value greater than 0.5. Meanwhile, the construct correlation with the indicator is higher than

other constructs declared valid (Alfa et al., 2017). From the preliminary calculation, it can be seen in Table 4 that the cross-loading value was ranging from 0.675 to 0.978, meaning that all indicator satisfied the convergent validity criteria.

## 4.2. Inner model evaluation

### 4.2.1. R-square ( $R^2$ )

The structural model was evaluated using the R-square ( $R^2$ ) for the dependent variable and the coefficient value on the path ( $\beta$ ) for the independent variable (Wardhani et al., 2015). The adaptation strategy variable produces the  $R^2$  of 0.725, which means that the variable of adaptation strategy can be explained by the construct variables of internal coping and external coping by 72.5 percent. In comparison, the remaining 27.5 percent was influenced by other variables not included in the research model. Meanwhile, the ability to adapt 51.4 percent can be explained by the variables of internal coping, external coping, and adaptation strategies, while the remaining 48.6 percent was influenced by other variables not included in the research model.

### 4.2.2. Q-square ( $Q^2$ )

Q-Square ( $Q^2$ ) predictive relevance, which indicates that the observations generated by the model can estimate its parameters. If this value is obtained, 0.02 (small), 0.15 (medium) and 0.35 (large) (Hair et al., 2013). This study produces a predictive relevance  $Q^2$  of 0.65, thus it can be stated that this model has a large predictive prevalence. In this paper, the endogenous variable with reflective indicator. Thus, predictive relevance is used for knowing the relative influence of the structural model on the observed measurement for the endogenous variables.

Variations in the dependent variable having a large or strong influence can be explained by the constructs included in this research model to have a relevant predictive value. Fishers during the medium season and not the fish season are faced with limited resources. Household activities are mostly used as cultivators and farmers. Activities as cultivators and farmers certainly have a waiting period to conduct their harvest. Therefore, households need properly regulate household conditions so that their resources are sufficient until the fishing season comes or the next harvest season for upland and crops. In this condition, fishermen households are subject to various pressures from within and outside, and they carry out strategies to overcome these conditions. This strategy is part of a household coping strategy that is analyzed through internal and external emotional sources. Emotional coping strategy analysis refers to Friedman (1998) by distinguishing internal and external coping strategies in the household.

Hypothesis testing in the final test of Smart-PLS analysis is the bootstrap resampling method. In this final test, the t-statistic score should be  $\geq 1.96$ , and p-values should be  $< 0.050$  to confirm the statistically significant (Ringle et al., 2015). Table 5 and Figure 3 informs the statistical calculation of the variables studied. From the table and figure, it can be seen that the p-values of variables were 0.000 ( $< 0.05$ ), and the t-statistics ranged between 3.611 to 11.792 ( $\geq 1.96$ ). From this information, it can be concluded that all hypotheses proposed were accepted.

## 5. Discussions

The first hypothesis in this study sought to examine the relation between adaptation and households' adaptability behavior. From the statistical calculation, it showed that the adaptation strategy to households' adaptability has a t-statistical value of 4.637 with a p-value of 0.000, meaning that the first hypothesis was accepted. The rationale behind this finding is that fishing activities at sea face two seasons, namely fish season and non-fish season, so it requires an adaptation strategy. The peak season for fish in one year only occurs during the four months from August to November. Meanwhile, the season lasts for four months, from April to July. From the 150 respondents, as many as eighteen fishermen (12 percent) only catch in the sea all year round, even though it is not the fishing season. Under those seasons, the catch is only squid and octopus. Additionally, twenty-four fishermen (16%) solely catch fish during the peak and medium seasons. When it is not the fishing season, they choose not to catch fish. Thus, the coping mechanism for small-scale fishing households is carried out by diversifying household income sources. In more detail, the strategy for diversifying sources is provided in Table 6.

Most fishermen households do fishing solely during the peak season for four months and managing land in the forest belonging to the Forestry Department. According to respondents, if fishing activities are carried out during the moderate season, the catch cannot be ascertained and even often does not earn income. Then, they chose to carry out activities to manage land in the forest belonging to the Forestry Department with a profit-sharing system. These findings confirm that fishers increased their efforts as an adaptive mechanism to declining fish stocks by changing their work. Many of them would willingly exit fishing for an alternative livelihood. However, it is always strategic for a community to be flexible (Ksenofontov et al., 2017).

The development of the coastal environment to become a tourist destination does not provide much opportunity to develop small-scale fishermen's household work. As illustrated in Table 7, approximately 16 percent of households have a job as tour guides. It was not found that other fisher family members, such as fishermen's wives, had jobs related to tourism activities. Small-scale fishing households in the research area

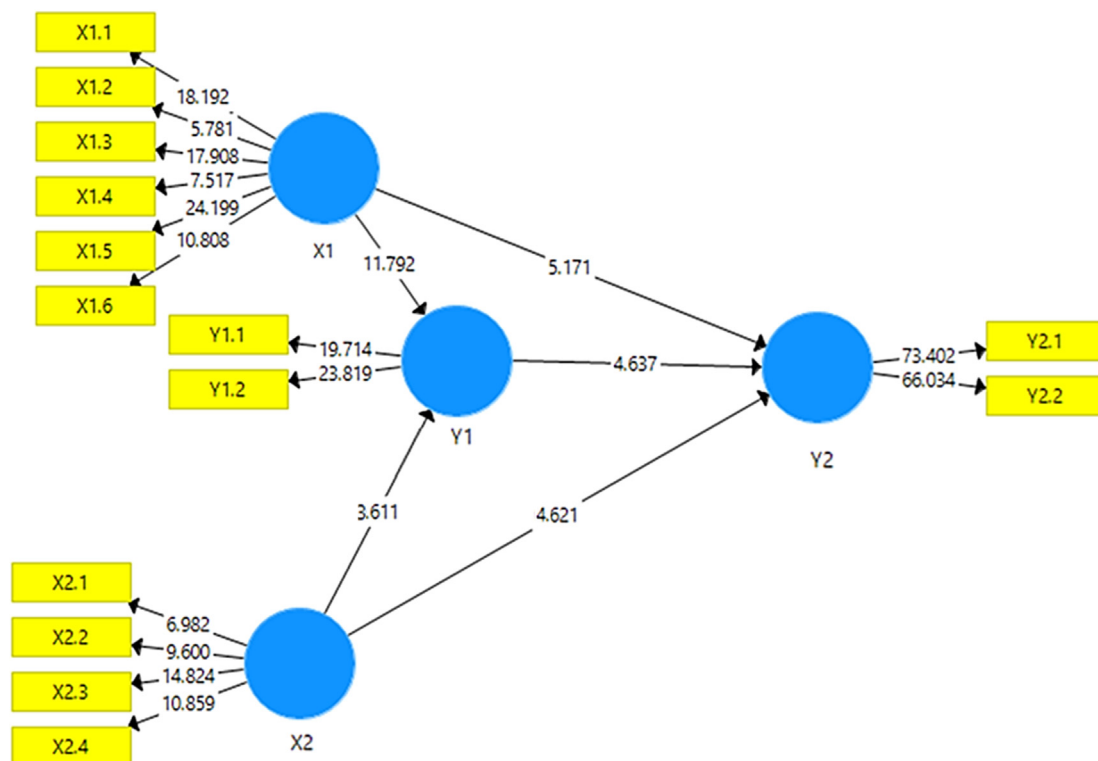
Table 4. Cross loading value.

Latent Variable	X <sub>1</sub>	X <sub>2</sub>	Y <sub>1</sub>	Y <sub>2</sub>
X <sub>1.1</sub>	<b>0.839</b>	0.522	0.734	0.254
X <sub>1.2</sub>	<b>0.622</b>	0.344	0.375	0.695
X <sub>1.3</sub>	<b>0.803</b>	0.283	0.825	0.260
X <sub>1.4</sub>	<b>0.675</b>	0.320	0.499	0.461
X <sub>1.5</sub>	<b>0.870</b>	0.425	0.784	0.309
X <sub>1.6</sub>	<b>0.766</b>	0.468	0.625	0.371
X <sub>2.1</sub>	0.508	<b>0.730</b>	0.579	0.145
X <sub>2.2</sub>	0.364	<b>0.888</b>	0.284	0.260
X <sub>2.3</sub>	0.464	<b>0.922</b>	0.409	0.296
X <sub>2.4</sub>	0.368	<b>0.918</b>	0.288	0.268
Y <sub>1.1</sub>	0.725	0.485	<b>0.870</b>	0.081
Y <sub>1.2</sub>	0.767	0.365	<b>0.887</b>	0.179
Y <sub>2.1</sub>	0.482	0.258	0.138	<b>0.979</b>
Y <sub>2.2</sub>	0.485	0.282	0.156	<b>0.978</b>

The bold sign in the table shows the loading factor value of each variables that be used for calculation.

**Table 5.** The summarize of resampling methods.

Relationship	Original Sample (O)	t-statistics ( O/STDEV )	P-values
The Adaptive Strategy -> The Ability to Adaptation	0.990	4.637	0.000
The Internal Coping -> The Adaptive Strategy	0.818	11.792	0.000
The Internal Coping -> The Ability to Adaptation	1.288	5.171	0.000
The External Coping -> The Adaptive Strategy	0.863	3.611	0.000
The External Coping -> The Ability to Adaptation	0.993	4.621	0.000



**Figure 3.** The result of structural equation modeling calculation.

**Table 6.** Strategies for diversifying sources of household income.

No	Production Activity	Number of Households
1.	Only become a fisherman throughout the year	25
2.	Fishing activities during the peak and moderate seasons and managing land in the forest	20
3.	Sea activities during the peak and moderate seasons and activities to manage land in the forest, raising goats	8
4.	Sea activities during the peak season; moderate season, activities managing land in the forest and the wife works	9
5.	Fishing activities are only in peak season, and land management activities in forests.	50
6.	fishing activities are only in peak season, and activities are managing land in the forest and renting out	10
7.	Fishing is only in peak season; activities managing land in the forest; renting tour boats and raising birds	8
8.	Fishing activities during the peak season; activities managing land in the forest and the wife works	10
9.	Sea activities during the peak season; activities managing land in the forest and the wife works, and he becomes a tour guide.	10

**Table 7.** Fishermen household income in the agricultural/forest sector.

Plant Variety	Number of People	Salary (Rp/year)
Clove	38	39.700.000
Durian	6	3.400.000
Banana	4	1.125.000
Rice	1	28.000.000
Corn	2	1.100.000

to increase their adaptability ( $Y_2$ ) carry out fishing activities in the sea and have productive activities outside of fishing. Several household respondents have wives who carry out productive businesses in the labor market. The wives mostly processing the results traditional fish catch according to the capital they have and they sell the product in the market. Traditionally processed fish, or “traditional cured,” is a product that is processed simply and generally carried out on a home industry scale because of the tools and processing methods simple, so it does not require a large capital (Intyas and Tjahjono, 2019). In fact, there is a peak season for the fish in one-year, moderate season, and not in season.

During the fishing season, fishers carry out fishing activities at sea all day long. The peak season for fish is August to November and the types of fish caught during this season include Layur fish, Tuna, Anchovies, Octopus, and Squid. At the same time, the season that is happening from April to July, the fishers can catch tuna, anchovies, octopus, and squid. However, in the off-fishing season, there are solely fishers with paddle fishing gear carry out fishing activities and the types of fish caught are octopus and squid.

Small-scale fishermen's activities adopt assets, including fern-type boats, motorized engines, and fishing rods. Boat prices vary, depending on the boat material used. The price of fiberglass boats is lower than wooden boats. Fiberglass raw materials have a price per boat unit between Rp 10,000,000 to Rp 27,000,000. Meanwhile, the price of wooden boats ranges from 40,000,000 to Rp 60,000,000. The power of the boat engines also varies, with a range of 12–24 PK. The price of the engine power ranges from Rp 7,500,000 to Rp 23,000,000. Production costs consist of fixed costs and variable costs. Types of fixed costs include depreciation of boats, depreciation of boat engines, and depreciation of fishing gear. Moreover, there are boat and engine (oil) maintenance costs. The average fixed cost is Rp 7,300,000 per year, while the variable costs consist of fuel and retribution costs. Then, fishing rods are usually used once a month. The cost of buying a fishing line in a month is between Rp 150,000 to 400,000. The use of fishing rods depends on the type of fish and fish caught. On one trip, it requires as much fuel as Rp 150,000 to Rp 300,000 and a levy of Rp 50,000 per trip. The average variable cost per trip is Rp 480,000.

The average fish catch during the peak season is approximately 7,874 kg/season, with the average selling price is Rp 28,000 per kilogram. From these activities, the fishers obtain about Rp 220,472,000 per season during peak condition, and the catch of fishers during the medium season is 49 kg per season, with the average selling price is Rp 24,000 per kilogram. In general, the average revenue from fishers during the medium season is approximately Rp 19,800,000 per season. Income from fishermen's catch is the difference between revenue and total costs incurred in fishing activities. The average income of fishers in the peak season (fishing season) is Rp 112,056,000 per season, and the average fishermen's income in the medium season is Rp 19,770,000. Our findings reveal that fishers have adapted to the declining fish catches by choosing other activities rather than using more efficient gear during this decade. Their choices due to such adaptation are expensive as it requires upgrading of fishing vessels and gear to withstand rough weather in offshore waters, and it involves extra fishing costs associated with fuel consumption while navigating to distant offshore areas (Silas et al., 2020).

Small-scale fishing households generally have business activities outside of fishing. The household does this because fish's peak season in one year is only four months. Some of the businesses run by fishermen's households include, among others, farmers or forest cultivators, marine tour guides, and breeders. Work as 41 respondents carried out farmers and forest cultivators. The results of farming are rice and corn. While activities as forest cultivators, households become cultivators of forest land through the Forestry Department's social forestry program. The products of managed forest plants include cloves, durian, bananas, rice, and corn. In addition, a broad set of alternative livelihoods is known to give greater choice of flexibility by spreading risks and reducing community vulnerability upon fishery impacts (Akaba and Akuamoah-Boateng, 2018; Allison and Ellis, 2001; Cinner et al., 2018; Savo et al., 2017; Waiyaki et al., 2012).

Apart from farming, the respondent's livestock business activities include goats and birds. Based on the data, fisherman respondents have a side job as a bird breeder with an income of Rp 28,000,000 per year. Besides, there is a respondent who is a goat breeder with an income of Rp 28,000,000 per year. Meanwhile, other jobs such as marine tour guides are carried out by seven fisherman households using boats for fishing. The average income received as a tour guide is Rp 9,600,000 per year.

Furthermore, approximately 16 percent of fishermen's wives contribute income to fishermen's household income.

In addition to the first hypothesis, this study confirmed that the internal coping strategy has a significant effect on the households' adaptation strategy with an effect of 0.818. In addition, the t-statistic value of the coping strategy for the adaptation strategy is 11.792 and the t-statistic value of internal coping on adaptability is 5.171, meaning that internal coping has a significant effect on adaptability with a contribution of 1.288. These findings indicate that fishers strive for internal coping in their household to survive an emergency or stress condition by developing alternative jobs and group participation.

Figure 4 depicts the percentage of internal coping strategies by household. The highest percentage was humor, while the lowest portion was self-ability. In detail, for internal coping strategies rely on their abilities ( $X_{1.1}$ ), approximately fifty-eight percent of respondents said their families rely on their abilities when facing difficulties while waiting for the harvest. As many as 30 percent said they sometimes rely on their abilities, and the rest mentioned they did not rely on their abilities. This condition is motivated by a reluctance to depend on others because they do not want to be burdensome when asking for help from other people or relatives. Additionally, most families involve jokes ( $X_{1.2}$ ) to deal with stress at a challenging time to reduce the pressure. Furthermore, deliberation or family discussion ( $X_{1.3}$ ) was essential for fisherman households to make decisions in diversifying other productive activities during fishing off-season. Through this deliberation process, about 84 percent of respondents solved problems and found solutions together ( $X_{1.4}$ ). Most of the respondents did problem-solving together with household members. Its custom needs to be involved in finding the solutions that all household members can agree with. This study found that the culture of the Teluk Prigi community is open-minded and mutually reinforcing in the family.

Role flexibility ( $X_{1.5}$ ) refers to family members' ability to adjust their actions and be flexible in their roles with one another during the waiting periods for fish and harvest. Nearly forty percent of the total respondents apply flexibility in their household roles, primarily for farming activities. Meanwhile, flexibility with the role in fishing production activities is only done by the head of the family and can only be replaced by sons. Fishermen's wives cannot replace the role of fishers. However, more than a half percent of respondents said that sometimes role flexibility is not necessary. The role flexibility is related to gender composition in the household. Entrepreneurship, fishing and farming are stereotypically seen as a male domain (Ahl, 2006; Campbell and Bell, 2000; Driga et al., 2009), and rural areas tend to be characterized by unequal power relations and uneven access to resources between men and women (Charatsari et al., 2015).

An emergency does not prevent family members from continuing to carry out their duties. It is evidenced by more than 80 percent of family members working, as usual, even in emergency conditions happens. The rest of those respondents chose to take a break and stop doing their activity for a moment. Fishers' households mostly stay working even there is an emergency condition ( $X_{1.6}$ ) due to their customs. Family farming strategies are not only aimed at business-related objectives but also the more complex range of objectives, including family welfare (Jonasson et al., 2014).

With respect to the previous research hypotheses, it was found that most of the small-scale fishing households have pursued an external coping strategy in their household. Therefore, it can withstand emergencies and under pressure to restore their household conditions. The t-statistic value of internal coping for the adaptation strategy was 0.863, implicating that external coping significantly affects the adaptation strategy with an effect of 3.611. Meanwhile, the t-statistic value of external coping on adaptability has 0.993, meaning that external coping has a significant effect on adaptability with a contribution of 4.621. It confirmed that external coping in seeking information, community groups' participation, building good relationships, and participation of religious groups have a significant effect on strategies and adaptability.



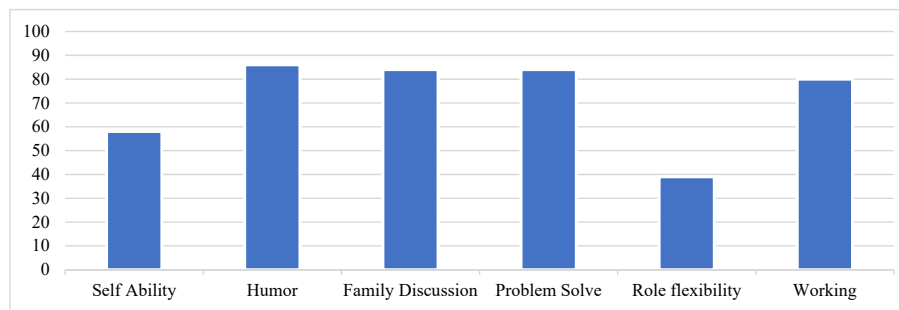


Figure 4. The percentage of internal coping strategies.

Small-scale fishermen's external coping strategy aims to carry out various social activities outside the household (Das et al., 2020). Several social activities carried out by small-scale fishers include joining various formal and non-formal institutional groups around their environment. Several formal institutional groups cover the local community for forest supervision, the business community for fishers, the tourism community local group, and non-formal institutions such as religious communities. In general, the fishermen are joining the business community for fishers. In such an area like in Karanggongso, there was ten business community for fishermen with an approximate member of 10–13 fishers. The activities conduct in the community are group meetings, deliberations, membership fees, and social activities. Each group has complete group administration, namely guest book, production book, member data book, and member inventory book. The community also has technical activities related to business activities, including fishing activities, cultivation, technical training activities, and beach cleaning activities.

The fishermen join the business community for fishers and the tourism community local group. It is due to their number of 16 percent respondents on those memberships. The fishermen involved in this group will be tour guides on weekends and holidays. Karanggongso has two local tourism community groups called “Rembeng Raya” and “Mutiaara.” The purpose of establishing “Rembeng Raya” aims to conserve coral reefs, floating net cages in floating houses, and supervise marine protected areas used as tourist areas, whilst “Mutiaara” aims to facilitate the gathering of fishing fishermen who work as tour guides.

Another group that has a great interest in fishers was the local community for forest supervision. It was evidenced from as many as 88 percent of respondents who joined this program. The number of fishers who also joined the community is enormous because the forest area in Tasikmadu Village is mainly covered by forest. Its area is divided into a production forest with the number 2,192,847 Ha and protected forests with the number 249.56 Ha. The total area of the forest in Tasikmadu Village is around 2,442,407 Ha. Most of the forest is managed by communities that are part of the Forestry Department's Community Forest Management program. In order to facilitate the implementation of programs in forest resource management, a local community for forest supervision called “Gunung Madu” was formed.

Apart from official organizations, fishers are also active in the religious community. It was evidenced by the fact that as many as 36 fishermen participated in it every week. The religious group routinely holds religious activities every Thursday night. People usually voluntarily come to these religious activities. Respondents stated that they benefited from participating with the group, such as the enthusiasm for worship, friendship, and a sense of peace. Fishers' coping and adaptation strategies comprise a fluid combination of complex overlapping sets of actions that the households undertake based on their capitals and capabilities, perceptions, socio-cultural embeddedness, and experiential learnings from earlier adverse situations. Broadly, these are survival, economic, physiological, social, institutional, and religiosity-psychological in nature. Adaptation mechanisms involve some implicit principles or self-provisioning actions that households are compelled to do or choose

under given sets of abnormal stresses to reach certain levels of livelihood functions (Deb and Haque, 2017).

Figure 5 illustrates the percentage of external coping strategies by households. According to Friedman (1998), external coping strategies are some of the households' efforts with the outside environment, including the ability to seek information, participate in groups, network, or relationships, and seek spiritual support. Their families seek information needed when they have difficulty waiting for the harvest season from colleagues, groups, community leaders, or village officials ( $X_{2.1}$ ) as many as 52 percent of respondents. Based on the prior interview results, respondents find it easier information from their closest colleagues than community leaders or relatives. Using their social capital, the fisher could enhance their specialization in the fishing sector (Coulthard, 2008). All respondents confirmed that their family members belong to the community group ( $X_{2.2}$ ). Several formal institutional groups such as the local community for forest supervision, the business community for fishermen, the tourism community local group, and non-formal institutions such as religious communities. Participation of respondents in groups will help respondents with coping strategies, obtain information and protection, ease bureaucracy, develop interests and talents, and channel hobbies.

In addition, as illustrated in Figure 5, almost all respondents remarked that their families could establish good relationships with colleagues, neighbors, or groups ( $X_{2.3}$ ). The ability to network properly is needed for households to survive the waiting period for harvest. The people of Prigi Bay have a friendly and open culture, not only to their families but also to their neighbors, making this straightforward to establish a network. The fishermen's family members (84%) were members of a religious group ( $X_{2.4}$ ). They regularly organize reciting religious events every Thursday night. Meanwhile, the rest stated that they sometimes and do not participate in religious activities. Spiritual support for respondents is essential in order to gain inner strength. Religious activities will help increase the positive energy within oneself. The model results indicate that adaptation strategies' choice is significantly influenced by social capital and access to institutions (Alam et al., 2016).

From these findings, a strategy for strengthening the adaptability of small-scale fisher households can be provided. Fishermen households adapt to the coping mechanism strategy by diversifying the productive economy. Coping mechanism activities based on existing natural resources can make households survive environmental changes. Therefore, they rely on income sources from fishing in the sea and use natural resources to cultivate the fields in the Forest Department's social forestry program. This business diversification is a very positive activity for the sustainability of fish resources to recover. It is indicated by most fishermen's behavior on the coast of Prigi Bay not fishing all the time.

Based on the analysis of internal and external coping strategies, it can be seen that the external coping strategies used by small-scale fishermen are by carrying out various social activities, including joining various formal institutional groups. Through formal institutional groups, community-based fisheries management is considered one of the most feasible approaches to secure sustainable small-scale fisheries (D'Armenhol et al., 2018). The existence of community-based co-management

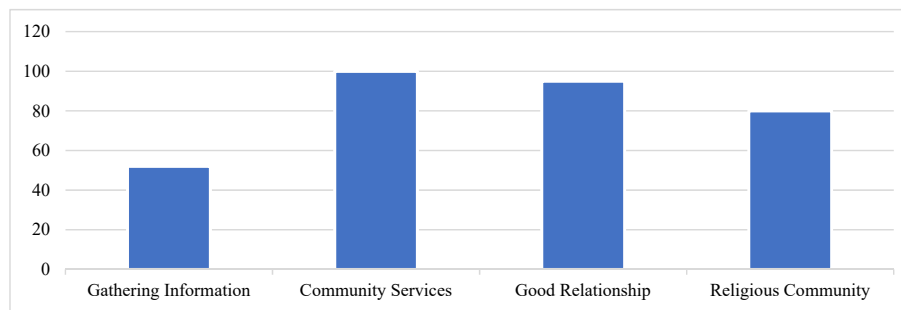


Figure 5. The percentage of external coping strategies.

through formal institutional groups strengthens the legal framework. The supporting legal and institutional framework facilitates the emergence of co-management, contributing to clarifying and legitimizing property rights over fish resources. It was also found that co-management provided ecological and social benefits: increasing species abundance and habitat, fish catch, participant participation, fisheries adaptive capacity, and promoting social learning processes.

Moreover, co-management is more effective if artisanal fishers and multiple stakeholders are involved through an adaptive institutional framework (Blythe et al., 2017). This external strategy has more vital adaptability than the internal strategy. This external strategy has more robust adaptability than the internal strategy. It is consistent with Susilo et al. (2017), which provides information that institutional adaptability provides a higher and broader adaptation power than individual adaptation. There are quite a lot of work and business opportunities available in the tourism sector. However, it turns out that small fishing families who can access the tourism sector are only about 14 percent of the field data. Therefore, the model to be developed will focus on two sides, namely the availability of work and business opportunities and fishermen's families' access ability. The sectors that can be accessed by households remain in the fisheries and agriculture sectors through the Forest Department Program.

Community institutions that oversee activities in the fisheries and agriculture sectors are the local community for forest supervision "Gunung Madu," business community for fishermen, tourism community local group "Mutiarra," local community group for supervision "Rembeng Raya." "Gunung Madu" deals with forest resources management where fishing communities can work as workers, while "Rembeng Raya" conducts coral reef conservation and floating net cages and monitoring in the fish sanctuary area. Lastly, the local tourism community group "Mutiarra" manages new tourist destinations in Karangongso. In addition, the government institutions that intersect with the community in Prigi Bay are the manager of the commercial port, the tourism office of Trenggalek Regency, the office of marine and fisheries, and the government of Tasikmadu village. A small-scale fisherman institutional model can be developed to strengthen the adaptation strategy based on the institutional composition. Institutions consist of government institutions and formal community institutions in Prigi Bay. Each of these institutions, both formal institutions in society and government institutions, perform their respective roles in synergy. It will strengthen the adaptation strategy of small-scale fishing households. Its visualization of community and government institutional models. Institutional is a thing to do with the institution, which the institution itself is a content thing regulations, norms, and cultural-cognitive elements which provides guidelines, resources, provide stability and meaning in social life (Blythe et al., 2017). Alexander et al. (2018) concluded that the institution is a set of norms with all levels to fulfil necessities in life socialize regardless of cultural level. In maintaining its existence, institutions need development innovative so that they can compete in the future to come. Utilization of institutions from their community, then

when the off-fish season is expected to be one of the fishermen's survival strategies.

## 6. Conclusions

The study concluded that fishermen's households carry out a coping strategy in all economic activities, both fishing or non-fishing activity. Not all fishermen work as full-time fishermen. Some solely work during the peak and mild seasons, while others will do non-fishing work. In fishermen's households, there are several variations in production activities in the household economic adaptation strategy. From the several activities, most of them are fishermen during the peak season and cultivating forest land, while another activity is to become a tour guide. However, not many works in this sector, even though environmental development has become a massive tourist destination. Additionally, wives also play an essential role in supporting the fishermen's households. Referring to the findings, the household's external institution as a way of external coping strategies carried out by fishermen is to carry out various social activities outside the household to obtain the state of pressure and restore their household conditions. This study confirmed that becoming a member of the community group is a way for households to carry out external coping strategies. The analysis produced in this study presents the relationship of fishing community groups to productive economic activities and is an external coping strategy of fishermen households. In implementing the strategy strengthening strategy for adapting small-scale fishers, it is necessary to examine each community institutional group's roles as a forum for empowering traditional fishing communities. An in-depth analysis of each government agency's roles as a policymaker is needed to force the strategy. The integration of community institutions and government institutions' respective roles will strengthen small-scale fishing households' economic strategy in the research area. Moreover, there were some limitations to this study. First, there is no vulnerability index calculation, and it only used three indicators of adaptability. Therefore, further research is suggested to elaborate on two more hands: adjustment practices and resource accessibility. The second limitation is that this study does not analyze government policies in business activities and job creation. Even though this policy greatly determines the adaptation of fishermen households to access the availability of work and business opportunities. Human adaptation is also determined by their access to job and business opportunities created by fisheries development policies. Future research can expand for other groups of people or social classes of other groups.

## Declarations

### Author contribution statement

Edi Susilo: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

Mochammad Fattah: conceived and designed the experiments; Analyzed and interpreted the data.

Pudji Purwant; Vika Annisa Qurrata: Performed the experiments; Contributed reagents, materials, analysis tools or data.

Bagus Shandy Narmaditya: Analyzed and interpreted the data; Wrote the paper.

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#### Data availability statement

Data included in article/supplementary material/referenced in article.

#### Declaration of interests statement

The authors declare no conflict of interest.

#### Additional information

No additional information is available for this paper.

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