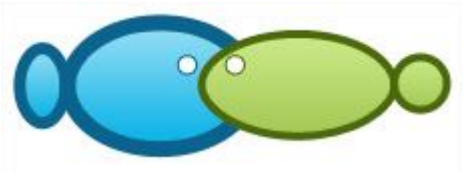

The resilience of small fishermen's livelihood in Maya Island Indonesia; a case study on purse seine capture fisheries

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Abstract. By increasing the resilience of small fishermen it will have an impact on prevention and poverty alleviation. Therefore effective interventions require an accurate evaluation of fishermen. The purpose of this study was to analyze the status of the resilience of small-scale fishermen purse seine livelihoods on Maya Island, Indonesia. The method of collecting data uses the fisheries livelihoods resilience communities check (FLIRES check). Methods of data analysis use multidimensional scaling (MDS) and leverage analysis through RAPFISH software. The results of this study found 11 sensitive attributes which were the driving factors and inhibitors of the resilience of small-scale purse seine fishermen's livelihoods. We find that the status of the resilience of livelihood as a shipowner is sufficient resilient with the highest average index value of 71.77. The status of the resilience of livelihood as a ship captain is also sufficient resilient but with an average index value that is much lower than that of a shipowner, which is equal to 54.06. While the status of the resilience of livelihoods as crew member is less resilient with an average index value of 47.84.

Key Words: evaluation, management, poverty, vulnerability, welfare.

Introduction. Resilience is the ability of the community to deal with disturbances or changes that occur (Adger 2000). A resilient community is a community that is able to respond to change or pressures in a positive way (Adger 2006). Resilience often contains adaptability (Hardy et al 2017). Measuring resilience can be done by comparing fishermen's adaptability to a particular community or sector. The first aspect of measuring resilience is identifying vulnerability attributes as factors that can strengthen or weaken resilience (Mamauag et al 2013). The vulnerability is an adaptation system that experiences adverse effects due to external pressure (Tilley et al 2018). The difference between vulnerability and resilience is that vulnerability is one component of a society that will determine the level of resilience (Smit & Wandel 2006).

Maya Island is one of Indonesia's capture fisheries centers. In 2016, it contributed 12,807.30 tons of marine produce or 43% of the total marine produce in North Kayong Regency (BPS 2017). One of the biggest contributors to marine production on Maya Island is a small-scale purse seine fishery located in Tanjung Satai Village, Maya Island. However, many people are suspected that there are still many who live less prosperously. The main actor in the management of small-scale capture fisheries is; fishermen, traders, government officials, non-governmental organizations (NGOs) (Basurto et al 2013; Mazumder et al 2016). Meanwhile, there are three groups of poor fishermen that can be identified, most of which are fish boat workers, small-scale boat owners and small-scale fish traders (Stanford et al 2014a). According to Espinosa-Romero et al (2014) actually, small-scale fishermen are very critical in maintaining their sources of income and opportunities for livelihood development but because of their limitations, they experience difficulties in financing the utilization of these fisheries resources. On the other hand, small-scale capture fisheries currently contribute greatly to maintaining the work of coastal communities, maintaining social structures, the economic

health of small communities and contributing to the supply of fresh fish products (Veiga et al 2016).

One of the problems faced by small-scale fishermen is low income (Pomeroy 2016). Small fishermen are economically less cared for and often marginalized (Schuhbauer et al 2017). Small fishers are very dependent on fishing activities because small fishermen tend not to have alternative livelihood options (Pomeroy 2016). Therefore small-scale fisheries must continue to be considered as a source of livelihood for coastal and island communities (Barnes-Mauthe et al 2013; Saville et al 2015). Small-scale fisheries are very important for livelihoods but vulnerable to pressure (Stanford et al 2017). Increasing the resilience of small fishermen will have an impact on the prevention and eradication of poverty. Effective intervention requires an accurate evaluation of fishermen. Therefore the main objective of this research is to analyze the status of the resilience of small fishermen's livelihoods (case studies on purse seine capture fisheries) on Maya Island, Indonesia.

Material and Method

Description of the study sites. The research was conducted in September 2017 until February 2018 in Tanjung Satai Village, Pulau Maya District, North Kayong Regency, West Kalimantan Province, Indonesia, at positions $0^{o}55'44''$-$1^{o}18'53''$ South latitude and $109^{o}13'58''$-$109^{o}47'03''$ East longitude.

Data collecting method. The method of collecting data uses the fisheries livelihoods resilience communities check (FLIRES check) (Stanford et al 2017). FLIRES check is an instrument in the form of a questionnaire to measure the level of resilience of fishermen's livelihoods. This instrument identifies the strengths and weaknesses of fishermen's household livelihoods (Stanford et al 2017). Respondents involved in this study were 62 fisherman households consisting of 2 shipowners, 14 ship captain, and 46 crew members. In the field interview, each respondent was asked about each of the attributes found on FLIRES check. The FLIRES check data is then entered into the spreadsheet and stored as a CSV file. This FLIRES instrument consists of 6 fields and 43 assessment attributes. These fields are natural, human, physical, financial, social, and institutional fields. Each attribute contains a statement given a score from good to bad (4-1), as shown in Table 1.

Statistical analysis. Data were analyzed by multidimensional scaling (MDS) and leverage analysis, using RAPFISH software (Pitcher & Preikshot 2001; Pitcher et al 2013). The software can be used free of charge (www.rapfish.org/software) or downloaded and then applied through R programming (www.r-project.org). The results obtained by the MDS analysis are in the form of an index that describes the status of the resilience of the livelihood of each fisherman household. The assumption is that a high index value indicates that fishermen households have a profitable livelihood portfolio (high level of resilience). The index is visualized in the form of scatterplots for each field with each fisherman household represented by plot points spread on MDS. This RAPFISH describes the sustainability of fisheries but FLIRES check is understood as the level of resilience of fishermen's livelihoods (Stanford et al 2017). In reading these scatterplots, the x-axis displays the position of each fisherman household on a scale of 0 (vulnerable) to 100 (resilient) then the y-axis displays the difference between fisherman households but at the same status in the field but with a combination of scores different on each attribute. The more right the position of the fishermen's household (ship owner, captain, crew), the better the index value and status obtained. Determination of resilience status using a predetermined scale, where index values in the range 0.00-25.00 are categorized as not resilient, range 25.10-50.00 categorized as less resilient, range 50.10-75.00 categorized as sufficient resilient and the range 75.10-100.00 categorized as highly resilient. Leverage analysis will display sensitive attributes that can be levered to increase the index value of the aspects that have been measured (Kavanagh & Pitcher 2004). These sensitive attributes are the main inhibiting factors or drivers in the resilience of fishermen's livelihood (Stanford et al 2017), because these sensitive attributes can be

used as a material for evaluation and consideration to improve the status of the resilience of the fishermen's livelihood. Improvement of this status can be done through appropriate fisheries management interventions. The results of the leverage analysis are displayed in the form of a bar chart. In the bar chart, there will be attributes that make up each of the fields analyzed. To determine sensitive attributes is done by sorting attributes that have a root mean square (RMS) change value of more than half the value scale on the x-axis. Then the index that has been produced by MDS from all fields that have been obtained by fisherman households is displayed in one plot in the form of a radar diagram.

Table 1

Fields, attributes and scores for the resilience of fishermen's livelihoods

Field	*Attributes*	*Scores*
		Good (4) - Bad (1)
Natural	1. Geographic isolation	4, or 3, or 2, or 1
	2. Harbor/mooring	4, or 3, or 2, or 1
	3. Status of coastal resources (stock)	4, or 3, or 2, or 1
	4. Status of coastal resources (income)	4, or 3, or 2, or 1
	5. Status of land resources	4, or 3, or 2, or 1
	6. Natural hazards	4, or 3, or 2, or 1
Human	1. Readiness to save	4, or 3, or 2, or 1
	2. Market awareness	4, or 3, or 2, or 1
	3. Work ethic (main earner)	4, or 3, or 2, or 1
	4. Occupational multiplicity--skills and motivation	4, or 3, or 2, or 1
	5. Entrepreneurial spirit	4, or 3, or 2, or 1
	6. Wives working	4, or 3, or 2, or 1
	7. Number of children	4, or 3, or 2, or 1
	8. Education aspirations for children	4, or 3, or 2, or 1
	9. The probable ability of the family to provide education	4, or 3, or 2, or 1
	10. Retirement planning/long-term thinking	4, or 3, or 2, or 1
	11. Family thriftiness/wastefulness	4, or 3, or 2, or 1
Physical	1. Fishing boat ownership	4, or 3, or 2, or 1
	2. Fishing gear adequate	4, or 3, or 2, or 1
	3. Physical asset ownership outside of fishing	4, or 3, or 2, or 1
	4. Processing/added value	4, or 3, or 2, or 1
	5. Ice availability	4, or 3, or 2, or 1
	6. Housing/sanitation	4, or 3, or 2, or 1
	7. Market/fish aution place	4, or 3, or 2, or 1
Financial	1. Ability to save	4, or 3, or 2, or 1
	2. Collateral for credit	4, or 3, or 2, or 1
	3. Access to credit	4, or 3, or 2, or 1
	4. Ability to make repayments	4, or 3, or 2, or 1
	5. Current "savings"	4, or 3, or 2, or 1
	6. Remittances	4, or 3, or 2, or 1
	7. Supplementary income	4, or 3, or 2, or 1
Social	1. Community cooperation	4, or 3, or 2, or 1
	2. Trust/honesty	4, or 3, or 2, or 1
	3. Leadership	4, or 3, or 2, or 1
	4. Social security	4, or 3, or 2, or 1
	5. Equity–right to speak	4, or 3, or 2, or 1
	6. Fairness/Sanctions	4, or 3, or 2, or 1
Institutional	1. Extension/counseling	4, or 3, or 2, or 1
	2. Livelihoods programmes–for the community	4, or 3, or 2, or 1
	3. Livelihood programmes–for the household	4, or 3, or 2, or 1
	4. Empower people's capacity before intervention	4, or 3, or 2, or 1
	5. advocacy/participation	4, or 3, or 2, or 1
	6. Training and capacity building	4, or 3, or 2, or 1

Results and Discussion. As explained in the research background, the purpose of this study was to analyze the status of the resilience of small-scale purse seine fishermen's livelihoods in six fields of resilience, namely natural, human, physical, financial, social,

and institutional. The fishermen households that are determined to be resilient are shipowners, captain and crew members. This resilience status is obtained through multidimensional scaling (MDS) analysis expressed in the resilience index. Leverage analysis is performed to display sensitive attributes that can be levers. These sensitive attributes are the main inhibiting factors or drivers in the resilience of the fishermen's household livelihood.

Status of resilience in the natural field. The results of the MDS analysis of natural fields in Figure 1 (A) show that there is a diversity of indices obtained by each fisherman household. Shipowners obtain the highest index of 82.53 in the range 75.10-100.00 with highly resilient status. Meanwhile, the captain and crew members obtained an index of 61.13 and 57.61 respectively in the range 50.10-75.00 with sufficient resilient status.

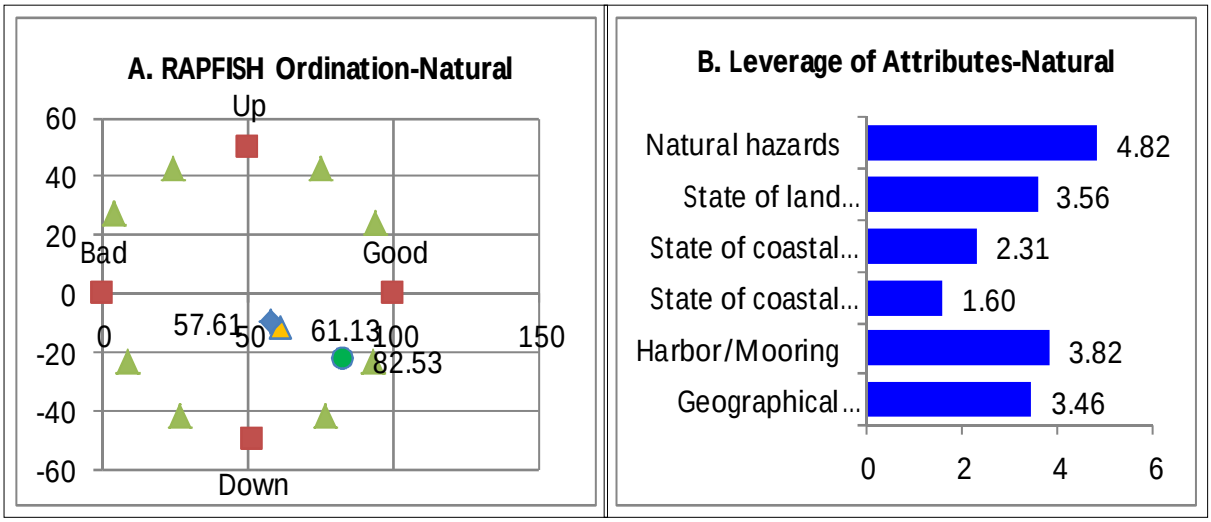

Figure 1. (A) The score of each fishing household from MDS projected on a bad (0) to good (100) x-axis for the analysis of the natural field. The y-axis shows the similarity/dissimilarity scores. Circle = shipowner, triangle = captain, diamond = crew members. (B) Leverage (%) exerted on the x-axis scores by each attribute for the natural field.

The results of the leverage analysis in Figure 1 (B) show that of the 6 attributes analyzed there are 4 sensitive attributes that influence the status of the resilience of the fishermen's livelihood. Where these sensitive attributes have a root mean square (RMS) change value of more than half the value scale on the x-axis. These sensitive attributes are (1) natural hazards with a value of 4.82, (2) harbor/mooring with a value of 3.82, (3) land resource status with a value of 3.56 and (4) geographical isolation with a value of 3.46. From the results of FLIRES check, the attributes of natural hazards and harbor/mooring are the driving factors for resilience that must be maintained. In Tanjung Satai Village, Maya Island rarely occur natural hazards such as earthquakes, floods, and erosion. The harbor/mooring for the ship is also very good because it is protected from wind and waves and its core is deep enough so that the ship can dock safely. However, the attributes of land resource status and geographical isolation are inhibiting factors that must be corrected. In their area, the land is not suitable for agriculture because sand and freshwater sources are relatively difficult to obtain. Their area is also isolated because it cannot be reached by land transportation. To get there you have to use water transport, so the mobility of the fishing community there is limited. According to Makailipessy et al (2018), spatial information about the condition of fishing areas is very important for fishermen. Added by Tilley et al (2018) the diversity of ecosystems and the carrying capacity of the environment in an area affects the resilience of fishermen.

Status of resilience in the human field. The results of the MDS analysis in the human field in Figure 2 (A) explain that shipowners obtain the highest index of 79.68 in the range 75.10-100.00 with highly resilient status. The ship captain obtains an index value of 57.75 and the crew receives an index of 53.99 both are in the range 50.10-75.00 with sufficient resilient status. Meanwhile, the results of the leverage analysis in Figure 2 (B)

show that of the 11 attributes analyzed there was only 1 sensitive attribute, namely the wife's work attributes (contributing to household income) with a value of 4.85. Where the attribute has a root mean square (RMS) change value of more than half the value scale on the x-axis. From the results of FLIRES check, the wife's work attributes are an inhibiting factor for the fishermen's livelihood that must be improved.

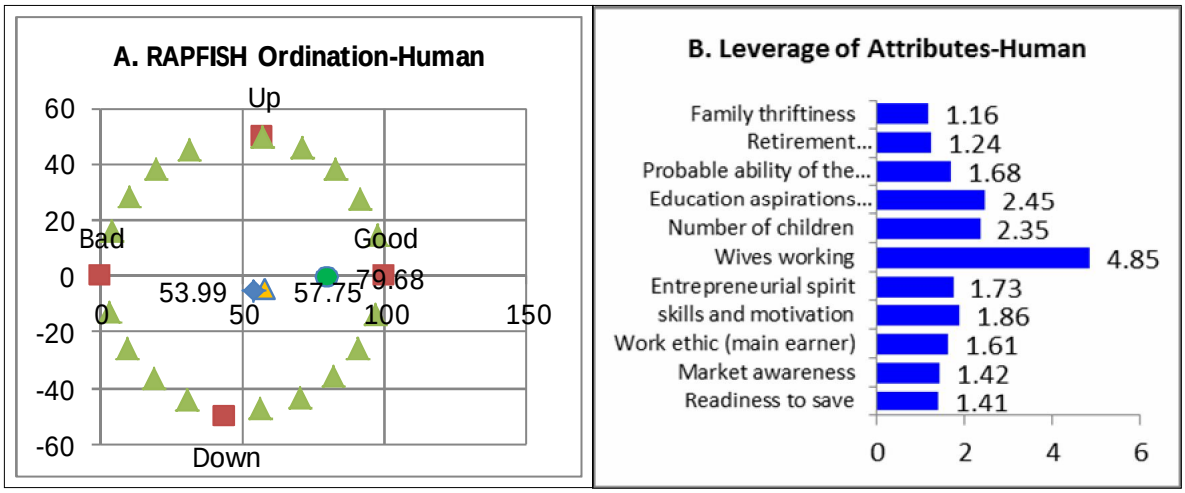

Figure 2. (A) The score of each fishing household from MDS projected on a bad (0) to good (100) x-axis for the analysis of the human field. The y-axis shows the similarity/dissimilarity scores. Circle = shipowner, triangle = captain, diamond = crew members. (B) Leverage (%) exerted on the x-axis scores by each attribute for the human field.

Most of the wives of fishermen are only housewives, so they do not contribute to household income. The main reason is that they find it difficult to get a job. Some of the fishermen's wives do not have time to work on their side. According to Febri et al (2017), women can work according to their abilities so they do not burden their husbands. Furthermore, Koralagama et al (2017) state gender discrimination will hamper economic sustainability in the fisheries sector.

Resilience status in the physical field. The results of the MDS analysis in the physical field in Figure 3 (A) illustrate a considerable difference in indexes between shipowners with captain and crew. Shipowners obtain the highest index of 81.03 in the range 75.10-100.00 with highly resilient status. Furthermore, the captain obtained an index of 51.32 in the range 50.10-75.00 with a sufficient resilient status. Whereas the crew receives an index of 48.92 in the range 25.10-50.00 with less resilient status.

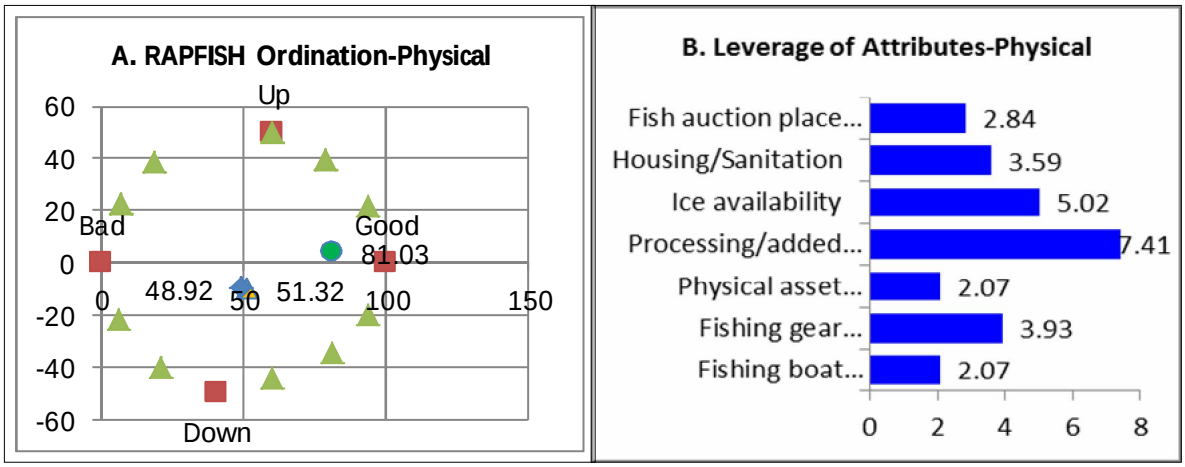

Figure 3. (A) The score of each fishing household from MDS projected on a bad (0) to good (100) x-axis for the analysis of the physical field. The y-axis shows the similarity/dissimilarity scores. Circle = shipowner, triangle = captain, diamond = crew members. (B) Leverage (%) exerted on the x-axis scores by each attribute for the physical field.

The results of the leverage analysis in Figure 3 (B) show that of the 7 attributes analyzed there are 2 sensitive attributes, namely processing/value-added attributes with a value of 7.41 and ice availability attributes with a value of 5.02. Where both of these attributes have a root mean square (RMS) change value of more than half the value scale on the x-axis. The results of FLIRES check, processing/value-added sensitive attributes are inhibiting resilience factors that must be corrected. The catches they get are all sold in fresh form, so when the harvest season they sell at low prices. To increase profits, diversification of catches is needed (Stanford et al 2014b). Furthermore, the attribute of ice availability is a driving factor for resilience because there is sufficient a lot of ice available and their awareness to maintain the quality of the catch is sufficient good.

Status of resilience in the financial field. MDS analysis of financial fields in Figure 4 (A) finds a high index gap between shipowners with captain and crew. Shipowners obtain the highest index of 86.15 in the range 75.10-100.00 with highly resilient status. Meanwhile, the captain and crew only obtained an index of 57.31 and 52.25 respectively in the range 50.10-75.00 with a sufficient resilient status.

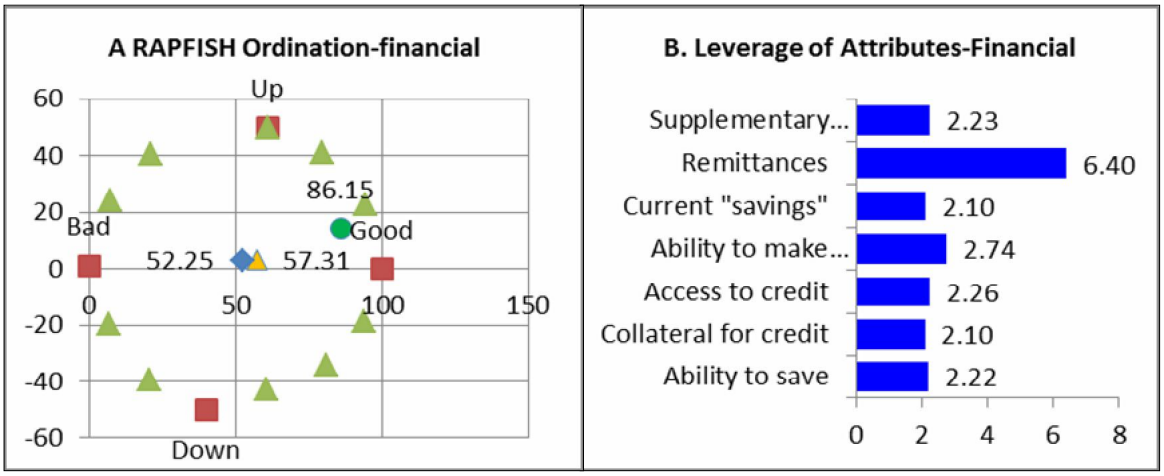

Figure 4. (A) The score of each fishing household from MDS projected on a bad (0) to good (100) x-axis for the analysis of the financial field. The y-axis shows the similarity/dissimilarity scores. Circle = shipowner, triangle = captain, diamond = crew members. (B) Leverage (%) exerted on the x-axis scores by each attribute for the financial field.

The results of the leverage analysis in Figure 4 (B) explain that of the 7 attributes analyzed there is only one sensitive attribute that affects the resilience status of the fishermen's livelihood, namely the remittances attribute with a value of 6.40. Where the sensitive attribute has a root mean square (RMS) change value of more than half the value scale on the x-axis. From the results of FLIRES check, it was found that the attributes of remittances are inhibiting resilience factors that must be corrected. Most of the fishermen stated that they had never received remittances from their families who could add to their household income. On the other hand, the income of shipowners is very high because the profit sharing obtained is far higher than the captain and crew members whose status is only as laborers. In addition, shipowners also have more than one fishing fleet which makes their income even greater. In this position, the captain and crew keep up as fishermen despite low income. According to Miñarro et al (2016), the patron-client work bond is an economic social security institution for them.

Status of resilience in the social field. MDS analysis in the social field in Figure 5 (A) describes that there is no difference in the index that is too far between shipowners, captain and crew members with index values of 57.95, 58.75 and 56.81 respectively in the range 50.10-75.00 with sufficient resilient status.

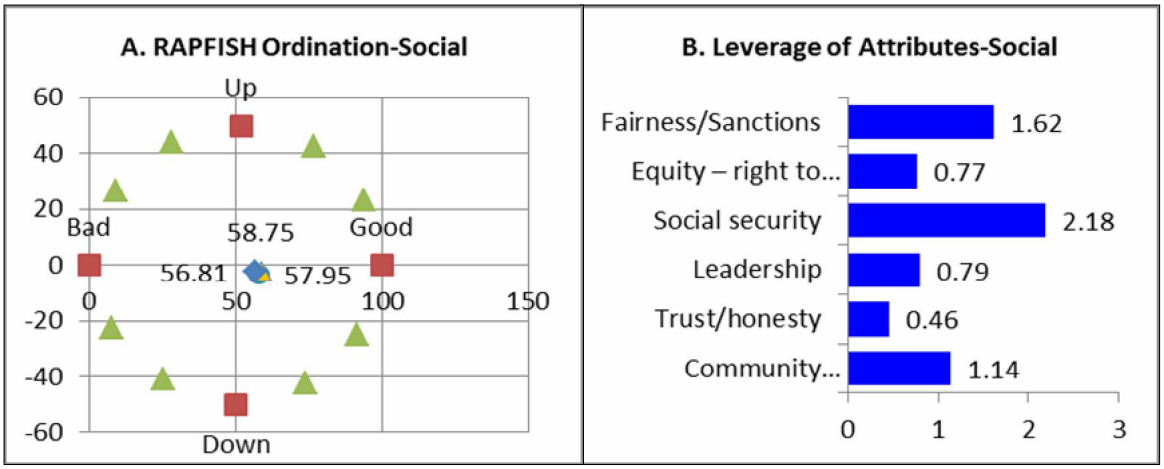

Figure 5. (A) The score of each fishing household from MDS projected on a bad (0) to good (100) x-axis for the analysis of the social field. The y-axis shows the similarity/dissimilarity scores. Circle = shipowner, triangle = captain, diamond = crew members. (B) Leverage (%) exerted on the x-axis scores by each attribute for the social field.

The results of the leverage analysis in Figure 5 (B) explain that from the 6 attributes analyzed there are 2 sensitive attributes, namely social security attributes with a value of 2.18 and attributes of justice/sanction with a value of 1.62. Where both of these attributes have a root mean square (RMS) change value of more than half the value scale on the x-axis. From the results of FLIRES check, sensitive attributes of social security are inhibiting resilience factors that must be corrected. The reason is that most fishermen only rely on the help of their immediate family if they are facing problems and some are hoping for middlemen. There is no form of social cooperation that handles such problems in their area. According to García Lozano & Heinen (2016), the government needs to intervene to build a good social structure in the community. While the attributes of justice/sanction are the driving factors for resilience that must be maintained. Their attitude in giving social sanctions to community members who are guilty/cheating is sufficient firm and fair, which is decided together with the head / local village leader. According to Sutton & Rudd (2015), community leaders are the key to success in community-based fisheries management.

Status of resilience in the institutional field. MDS analysis of institutional fields in Figure 6 (A) reveals that the index obtained by the three fishermen households is sufficiently low. Shipowners and captains obtain indexes of 43.30 and 38.12 respectively in the range 25.10-50.00 with less resilient status. While the crew receives a lower index of 17.44 in the range 0.00-25.00 with non-resilient status.

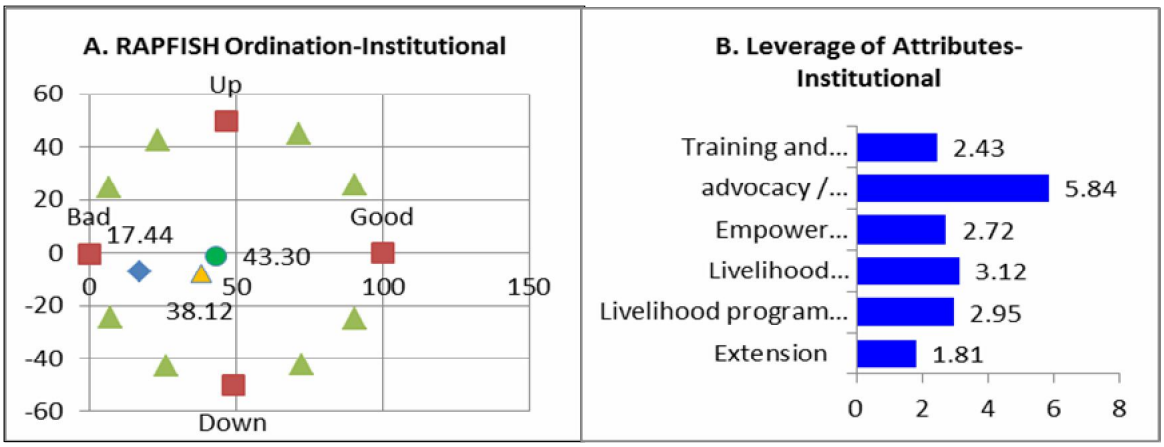

Figure 6. (A) The score of each fishing household from MDS projected on a bad (0) to good (100) x-axis for the analysis of the institutional field. The y-axis shows the similarity/dissimilarity scores. Circle = shipowner, triangle = captain, diamond = crew members. (B) Leverage (%) exerted on the x-axis scores by each attribute for the institutional field.

The results of the leverage analysis in Figure 6 (B) explain that the 6 attributes analyzed are only the support/participation attributes that are sensitive attributes with a value of 5.84. Where the sensitive attribute has a root mean square (RMS) change value of more than half the value scale on the x-axis. The FLIRES check results found that sensitive support/participation attributes were the driving factors for resilience that must be maintained. This fact shows that they strongly support government programs in developing fishermen's capacity. But in reality, these programs are rarely carried out in their place. According to Mizuta & Vlachopoulou (2017), the initiative and participation of fishing communities are very influential in producing competitive capture fisheries. Because the success of the assistance of production factors from the government depends on the level of acceptance of fishermen (Wiyono et al 2018). Furthermore, Stanford et al (2013) explained that the empowerment of coastal communities to improve their livelihoods was influenced by aspects of leadership, trust, advocacy, administration, accountability, and ongoing institutional support.

Comparison of the index from all fields. The index value obtained from the three purse seine fishing households varies in each field. Therefore to facilitate interpretation, it is displayed on the radar diagram (Figure 7) so that it is easier to understand which fields of each fisherman's household are the drivers or inhibitors of the resilience of their livelihoods.

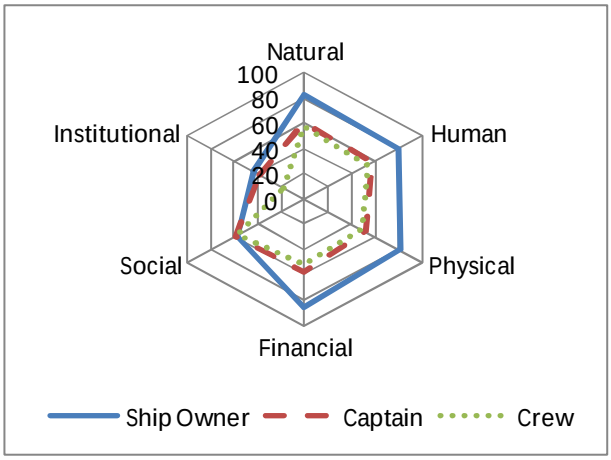

Figure 7. Mean livelihood resilience scores for shipowners, captain, and crew from multidimensional scaling projected on a vulnerable (0) to resilient (100) axis for the six fields. Shipowners scores are shown as solid lines, captain scores as dashed lines, crew scores as a perforated line.

The results of the calculation of the average index of the six fields that have been analyzed through MSD previously show that shipowners obtain the highest average index of 71.77 but are still in a sufficient resilient status (range 50.10-75.00). The ship captain is also in a sufficient resilient state (range 50.10-75.00) but the average index value is much lower than that of the shipowner which is equal to 54.06. Whereas the crew receives an average index of 47.84 (range 50.10-75.00) which shows that the livelihood of the crew of the purse seine is less resilient.

Conclusions. There are 11 sensitive attributes which are the driving factors and inhibitors of the resilience status of the purse seine fishermen in Maya Island, Indonesia, namely: (1) natural hazards with a value of 4.82; (2) harbor/mooring with a value of 3.82; (3) resource status land with a value of 3.56; (4) geographical isolation with a value of 3.46; (5) wife's work (contributing to household income) with a value of 4.85; (6) processing/added value with a value of 7.41; (7) ice availability with a value of 5.02; (8) remittances with a value of 6.40; (9) social security with a value of 2.18; (10) justice/sanction with a value of 1.62; and (11) support/participation with a value of 5.84. The status of the resilience of livelihoods as owners of purse seine vessels from the 6 fields that have been measured is sufficient resilient with the highest average index value of 71.77. The status of the resilience of livelihood as a captainship purse seine is also

sufficient resilient but with an average index value that is much lower than that of a shipowner, which is equal to 54.06. While the status of the resilience of livelihoods as crew member of purse seine vessels is less resilient with an average index value of 47.84.

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