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THE SUSTAINABILITY OF SMALL-SCALE FISHING HOUSEHOLDS IN THE PANDEMIC ERA IN PRIGI BAY, EAST JAVA, INDONESIA

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Abstract: The COVID-19 pandemic has changed the livelihoods of fishing communities socially and economically. This study examines the sustainability of small-scale fishing households in Prigi Bay during the COVID-19 pandemic based on the sustainable livelihoods approach (SLA). The objectives of this research are: (1) To identify small-scale fishing households' access to human resource capital, natural resources, financial capital, physical capital and institutional social capital during the pandemic, (2) To examine the sustainability of small-scale fishing households' livelihoods during the pandemic based on the five dimensions and (3) To determine the priority scale of the five capitals. This study is a quantitative research utilising the multidimensional scaling household economic analysis to determine the sustainability status of the five constituent capitals and strengthen the sustainability of small-scale fishing households. It was found that fishing households before and during the COVID-19 pandemic show insufficient sustainability (47.62%). Social capital is the SLA capital that changed the most among the five during the COVID-19 pandemic and has become entirely sustainable.

Keywords: Sustainability, small-scale 'fishers', household economic, MDS *Rap-household*.

Introduction

At the end of 2019, the world was hit by the COVID-19 pandemic. The virus responsible for the global health crisis is known as SARS-CoV-2 which rapidly spread worldwide in early 2020 and caused lockdowns the world over (Lai *et al.,* 2020) including in Indonesia. It showed how a pandemic can significantly influence our systems such as physical public health (Ma *et al.,* 2020; Wu *et al.,* 2020), mental health (Grover *et al.,* 2020; Tanoue *et al.,* 2020), the economy (Laing, 2020; Sharif *et al.,* 2020) and the environment (Saadat *et al.,* 2020; Wang *et al.,* 2020). Even today, restrictions on certain activities are still in effect. The COVID-19 pandemic has had an economic impact on both supply and demand. Several studies (Atkeson, 2020; Hausmann, 2020) have indicated that the global production capacity has lowered due to the large number of infected workers and policies that limit activities to suppress the spread of COVID-19 which in turn weakened the supply side. This led to the demand side experiencing severe shocks (Guerrieri *et al.,* 2020). A high number of people were infected and activities outside the home were severely limited, which preventing many people from working. This resulted in a decrease in income, thereby reducing people's purchasing power sharply. This condition is expected to lead to an economic recession (Eichenbaum *et al.,* 2020).

Fishing households in Indonesia are generally part of the lower middle class. Several studies have classified fishing households in the low-income category (Sudiyono, 2015; Rosni, 2017). However, some have also classified fishers in Java, Indonesia in the prosperous category (Nugroho *et al.,* 2013; Aldila *et al.,* 2017). Fishers were unable to go out to sea throughout the year. Therefore, fishing households had to deploy several strategies and diversify their business (Slamet, 2010;

Wulandari *et al.,* 2016; Syuryani, 2017). For instance, small-scale fishers in Prigi Bay worked as forest land cultivators and tour guides (Susilo *et al.,* 2021). The COVID-19 pandemic dramatically affected the survival of fishing households. Among the negative impact of the COVID-19 pandemic on the fisheries sector was that fishers' income dropped due to the disconnection of the marketing chain for fishery products. It also negatively impacted the world of fisheries in Indonesia, namely the decline in exports of fishery commodities (Kurnia, 2020; Mardhia *et al.,* 2020).

The tourism sector has also slumped due to the COVID-19 pandemic. Dwina (2020) mentioned that the decline in tourist visits during the pandemic negatively impacted fishing households, which are usually economically assisted by the existence of tourism areas on the coast, and this weakened their resilience. Prigi Bay, apart from being known as a fishing base in East Java is also known for its coastal tourism areas and mangrove forests. Fishing households in Prigi Bay are still feeling the effects of the COVID-19 pandemic. The reduction in visits to tourist destinations in the Prigi Bay area and a decrease in exports of fishery products will undoubtedly have an impact on the socio-economic conditions of fishing households.

Fishing households are vulnerable to socio-economic changes due to the pandemic and efforts are needed to strengthen the socio-economic resilience of fishing households for the sustainability of their livelihoods. Therefore, this study intends to examine the socio-economic conditions of fishing households during the COVID-19 pandemic by looking into their economic sustainability. The framework used by the British Department for International Development (DFID) (1999), the sustainable livelihoods approach (SLA) is adopted for this study. The SLA is one of the methods to increase understanding of household livelihoods using a holistic approach to capture the community's ability to survive. This approach examines households' capacity or ability and ownership of resources (assets) to achieve livelihood levels, and provides a means of understanding of the primary causes and dimensions of poverty, with a focus on several factors (Triyanti & Firdaus, 2016). The SLA measures technical feasibility indicators which are referred to as the SLA analytical framework. The SLA is divided into five categories: Human capital, natural resource capital, financial capital, physical capital and social capital (Purwanti *et al.,* 2017).

Materials and Methods

Study Location

This research focused on the coastal areas of Indonesia's East Java province. Prigi Bay is located at coordinates 8°17'12.14"S 111°43'28.61"E in Tasikmadu Village, Watulimo District, Trenggalek Regency (Figure 1). Prigi Bay is an attractive tourist beach that has a unique selling point. According to Statistics Indonesia (2020), out of the 175 households there, 75% are fishing households, indicating a significant reliance on fishing operations. Due to its geographical location, most of the population is involved in small-scale fisheries, agriculture and the informal sector.

Prigi Bay was chosen to be the research area due to the massive technological changes experienced by fishermen in the region, from using only fishing rods and nets to using giant ships with longer fishing rods (e.g., 15 metres in length for fishing rods and 4 metres in size for ships) (Susilo, 1991; 2010). Moreover, the small-scale fishing households' economic existence depended not only on fishing activities but also on tourism (Purwanti *et al.*, 2020; Susilo *et al.*, 2021) and forest management by coastal communities (Susilo, 1991, Normansyah *et al.*, 2020).

Sampling and Data Collection

This study aims to investigate the sustainability of small-scale fishing households during the COVID-19 pandemic in Prigi Bay in Trenggalek, Indonesia. The number of multidimensional scaling (MDS) Rap-household respondents is 75 small-scale fishing households, with the criteria

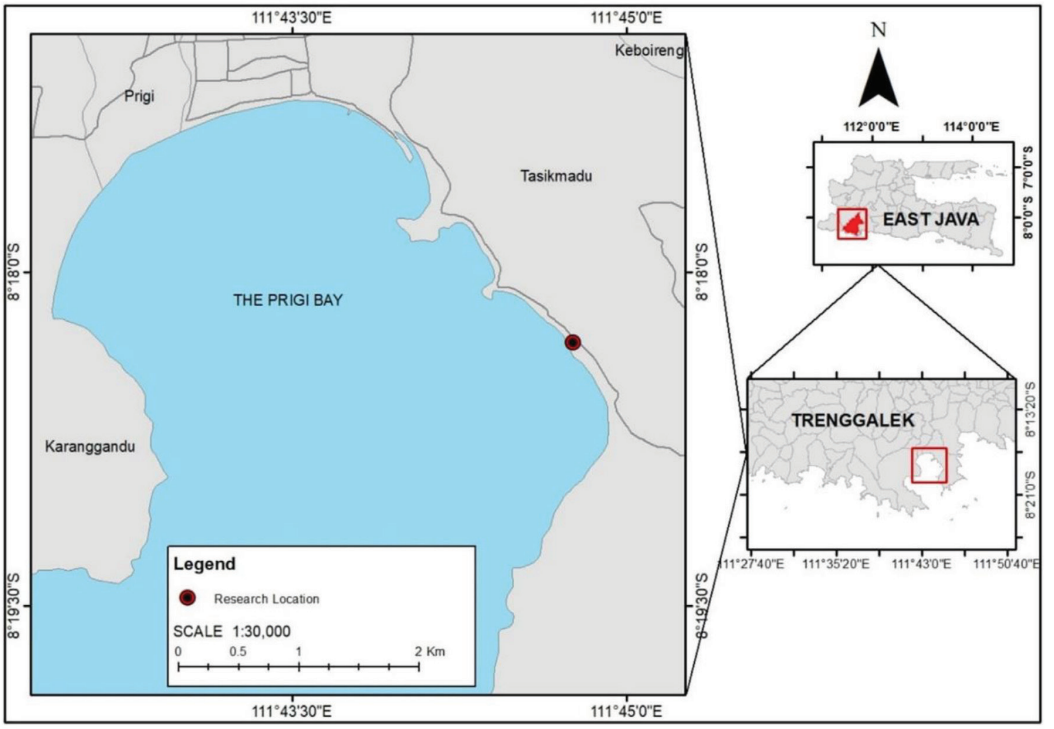

Figure 1: Map shows the location of Prigi Bay as the study sites

of having a boat less than 20 GT and practising one-day fishing. In addition, the researchers also collected the responses of 20 key figures to determine the policy priorities for the livelihoods of small-scale fishing households. The data were collected from July 2019 to August 2021.

The data analysis method refers to the rapfish technique (rapid appraisal for fisheries) which aims to evaluate the sustainability of the fisheries sector in a multidisciplinary manner as well as attributes that are easy to assess and flexible (Alder *et al.,* 2000; Pitcher & Preikshot, 2001; Kavanagh & Pitcher, 2004). Rapfish works by using an ordination technique by placing something according to the order of attributes that have been measured using MDS (Alder *et al.,* 2000). The technique has been used by Purwanti *et al.* (2021) to analyse the sustainability of mangrove forest management. This study involves five rapfish aspects, referring to the SLA analysis framework (DFID, 1999). The five aspects are natural resource capital, human capital, financial capital, social and institutional capital, and physical capital. Then, based on the results of in-depth interviews with respondents and key figures, the indicators for each aspect of the SLA analysis (see Table 1) are identified. There are several stages in the analysis of the data. First, MDS, the ordination technique is used to determine the position of good and bad points. The Monte Carlo (MC) methods aim to evaluate the impact of random errors made in estimating the ordination value using leverage to find out the sensitive attributes of each sustainability dimension (Kavanagh & Pitcher, 2004; Eunike *et al.,* 2018).

The sustainability of small-scale fishing households is assessed based on five dimensions using a questionnaire. Each indicator of the five dimensions is measured from 0 (inadequate) to 10 (adequate). A higher score indicates that a fishing household is in good condition (Pitcher & David, 2001). The ordination technique in MDS is based on the Euclidean distance, which is in dimensional space and can be written as (Pitcher & Preikshot, 2001):

Table 1: Multi-dimensional scaling dimensions and indicators

No.	Dimension				
	Ecology	**Economy**	**Physical**	**Human Resources**	**Social**
1	Fish production	Production asset	Fish market/port availability	Fishing working hours	Community group participation
2	Fish species	Profit from fishing activities	Fuel availability	Non-fishing working hours	The conflict rate
3	Range area	Non-fishing activities income	Ice availability	Fishing experience	Fishers' dependency on wholesalers
4	Fish size	Non-fishing alternative activities	Individual assets	Non-fishing experience	Fishers' dependency on government subsidy
5	Fishing season	Fish selling price		Fishing management ability	Local wisdom
6	Conserve area	Source of operational cost during fishing season		Technological ability	
7	The availability of forest area			Productive age	

$$d = \sqrt{(|x_1 - x_2|^2 + |y_1 - y_2|^2 + |z_1 - z_2|^2 + \cdots)} \quad (1)$$

The configuration or ordinance of an object or point in the MDS is approximated by regressing the Euclidean distance (d_{ij}) from point i to point j, with the origin with the following equation:

$$d_{ij} = \alpha + \beta\delta_{ij} + \varepsilon \quad (2)$$

The technique used to regress these equations is the ALSCAL algorithm. The ALSCAL method optimises the squared distance (squared distance = d_{ijk}) to the data square (starting point = O_{ijk}), which in three dimensions (i, j, k) is written as in the following formula called S-Stress (Alder *et al*., 2000):

$$S = \sqrt{\frac{1}{m}\sum_{k=1}^{m}\left|\frac{\sum_i\sum_j\left(d_{ijk}^2 - o_{ijk}^2\right)^2}{\sum_i\sum_j o_{ijk}^4}\right|} \quad (3)$$

where the squared distance is the Euclidean distance is written as:

$$d_{ijk}^2 = \sum_{a=1}^{r} w_{ka}\left(x_{ia} - x_{ja}\right)^2 \quad (4)$$

The goodness of fit in the MDS analysis is evaluated through the value of S-stress and coefficient of determination (R^2). It can also be used to see whether additional attributes are needed or if the existing details reflect the accuracy of each dimension being analysed about the actual situation. A low S-stress value indicates a good fit while a high S-stress value indicates the opposite (Fauzi & Anna, 2005). Therefore, the model is said to be good or almost good if the results of the analysis produce an S-stress value of less than 0.25 ($S < 0.25$) and R^2 is close to 1 (100%) (Pitcher *et al.,* 2013). Furthermore, Rap-household analysis was conducted using the rapfish software tool. The sustainability index value is important to determine the sustainability of fishing households during a pandemic. The sustainability status of fishing households is grouped into four sustainability status categories as shown in Table 2 (Pitcher & David, 2001).

Table 2: Sustainability status

Index	Category
0 - 25	Unsustainable
25.5 - 50	Insufficiently sustainable
50.5 - 75	Moderately sustainable
75.5 - 100	Sustainable

Results and Discussion

The Sustainability of Small-scale Fishing Households from the SLA

Trenggalek Regency has promising aquaculture and capture fisheries potential with the development of a minapolitan area in Watulimo District for capture fisheries and aquaculture. Trenggalek has a length of 96 km with a sea area of 4 miles and 71,117 ha, and a utilisation rate of 20% (Statistics Indonesia, 2020). The potential for capture fisheries production in Watulimo District increased significantly in the last three years from 4,632 tonnes in 2016 to 28,690 tonnes in 2018 (Mutiara *et al.,* 2018). Small-scale fishers make up most of the fishers living in Prigi Bay. This is indicated by the fact that most fishers use fishing rods. The boats used are 9 to 12 metres long and 2 to 3.5 metres wide. The boats used are made of fibreglass but some are made of wood with a powerful engine between 5 and 12 horsepowers.

Dependence on resources also causes differences in the economic conditions of fishers, considering that fishers use different production tools, especially in terms of the size of the fleet used (Ramadhan *et al.,* 2017). Fishing groups in Prigi with varied fishing gear tend to have a higher dependency on fish resources than groups with fewer fishing gears. Groups with less fishing gear are more likely to have jobs other than fishing (Akbarsyah *et al.,* 2017). Fishing gear is still widely used by fishers in Prigi Bay since 1991. Operating fishing rods involve: (a) Preparing the equipment (fishing gear, bait, fuel, food) before leaving for the fishing grounds, (b) Determining the fishing grounds, after which the setting and immersing stages first to prepare the bait and (c) Lowering the boat anchor so that the boat does not move, lowering the ballast on the fishing line and then, lowering the hooks that have been tied with bait one by one. Fishers who use outboard motors are mostly tour guides who work on weekends.

The increased experience of fishers at sea is in line with fish catches due to the role of fishers in determining the fishing grounds and the movement of the ship's bow to chase groups of fish, which is determined by the experience of fishers in catching fish (Esa & Putra, 2016). This fishing experience is directly proportional to the age when they become a fisherman. Working

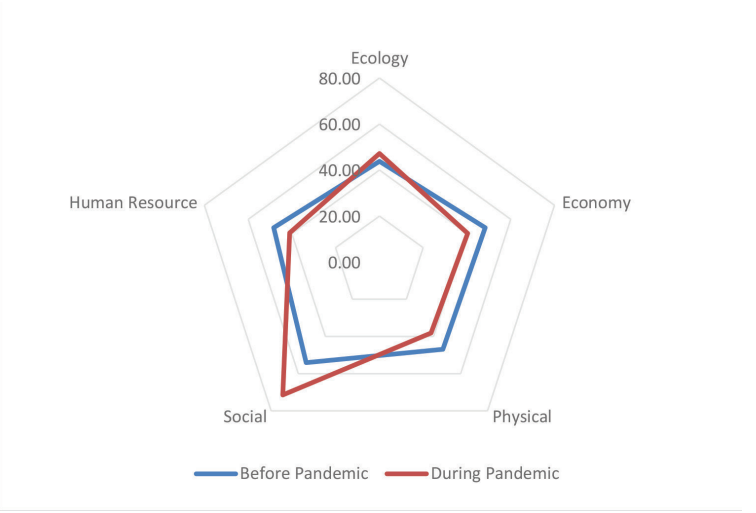

Figure 2: Kite diagram of the multidimensional sustainability index of Prigi Bay

as a fisher takes up a significant amount of time, even from a young age and it was found that respondents had become fishers between the ages of 10 to 12. As many as 50% of the respondents became fishers under the age of 15. Therefore, it is shown that being a fisher is a choice that has been determined since young.

If the sustainability value is closer to 100, the sustainability status is getting better and vice versa. If it gets closer to 0, then, the sustainability status will worsen. Based on the five SLA sustainability capitals used to measure the sustainability status of small-scale fishing households before the COVID-19 pandemic, the capital that produces the highest value is the social capital at 54.10 (see Figure 2). In contrast, the capital with the lowest value is the natural capital at 43.77. The multimodal average before the COVID-19 pandemic was 48.29, so we can say that it is less sustainable. During the COVID-19 pandemic, the capital that has the highest value is the social capital at 71.46 while the capital with the lowest value is the natural capital at 38.16. The multimodal average during the COVID-19 pandemic was 47.62, so, it can be said to be insufficiently sustainable.

Using the MC methods, it is proven that the little difference in the value of the sustainability index between the analysis results from MDS and MC shows the effect of errors can be avoided (Wibowo *et al.,* 2015). Furthermore, the MDS value when compared with the MC resulted in a low difference value. This indicates that the MDS value has a high level of confidence because of the minimum procedural errors or understanding of indicators and variation in scoring, which can be seen in Table 3.

The accuracy of the MDS rapfish analysis is determined by the S-stress value generated from the calculation of the S-value. A low S-stress value indicates high accuracy (goodness of fit) while a high S-stress value indicates the opposite. The S-stress value shows a good model in this Rap-beach tour when it is smaller than 0.25 (<25%) with the coefficient of determination (R^2) approaching 1.0 or 100%. On the contrary, if the S-Stress value is higher than 0.25 or 25%, then, the accuracy of the MDS results is low (Suwarno *et al.,* 2011). The S-stress value of the five sustainability modalities result is 0.25 with a squared correlation value close to 1.00 or in the interval of 0.90–0.95. So, we can conclude

Table 3: The difference in the value of MDS and MC before and during the pandemic

Sustainability Index	Ecology	Economy	Physical	Human Resources	Social
MDS-MC difference before the pandemic (2019)	0.45	0.07	0.13	0.13	0.33
MDS-MC difference during the pandemic (2020-2021)	0.31	0.35	0.49	1.27	0.48

Table 4: S-stress value and squared correlation (RSQ)

	Ecology	Economic	Physical	Human Resources	Social
Before the pandemic (2019)					
S-Stress value	0.16	0.15	0.17	0.14	0.15
Squared correlation (RSQ)	0.92	0.94	0.93	0.94	0.93
During the pandemic (2020-2021)					
S-Stress value	0.16	0.16	0.17	0.15	0.14
Squared correlation (RSQ)	0.92	0.94	0.93	0.95	0.94

that all the attributes used in the analysis of the sustainability of small-scale fishing households before and during the COVID-19 pandemic were good in explaining the five dimensions analysed.

Ecological Asset

Fishing activities are dynamic due to environmental changes both internally and externally, affecting fish resources. In addition, fishing activities have several obstacles such as capital, skills, weather and seasonal fish population. There are three seasons in fishing activity: The peak, moderate and famine seasons. The peak season is when the availability of fish is abundant, the moderate season is when there are fish but not as much as the peak season and the famine season is when the availability of fish is very low (Wiyono, 2013). During the peak season between August and November, fishers go out to sea all and the types of fish usually caught during this season include squid, tuna, anchovies and octopus. The moderate season from April to July sees the capture of tuna, anchovies, octopus and squid. Only fishers with oars go to the sea when it is the famine season and the types of fish caught are octopus and squid with few catches.

The size of the fish caught by fishing rods has not changed or remained constant. Fish size is an indicator of the availability of fish resources. According to Widodo and Suadi (2008), some characteristics can be used to benchmark whether the fishing activities are in upgrading conditions. The time at sea is longer than usual, and the mesh size is smaller than expected, followed by the catch per unit effort decreases, fish size decreases with fishing costs increasing.

Figure 3 shows the variable that most influenced the sustainability of the ecological dimension during and before the COVID-19 pandemic was the availability of forest land with RMS values of 4.52 and 2.29, respectively. Farming activities are carried out by planting rice and corn. Through forest cultivating activities, households become cultivators of forest land through social forestry programmes under state-owned Perhutani. Products from forest plants include cloves, durian, bananas, rice and corn. On the other hand, fishing activities in the mid-season produce uncertain catches or sometimes do not generate income. Hence, fishers choose to be cultivators of Perhutani land with a profit-sharing system. In addition, fishermen make efforts to sustain fish resources through a community watch group called "Rembeng

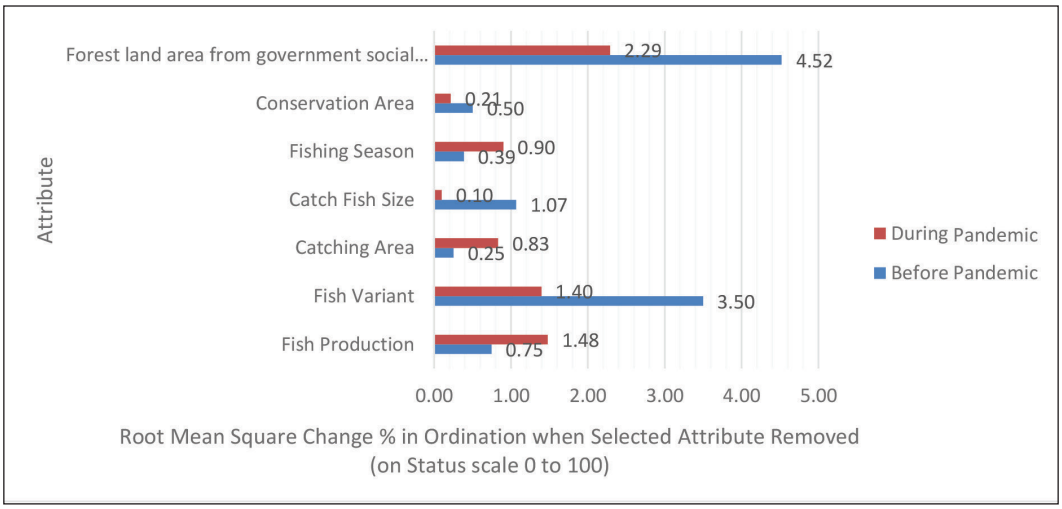

Figure 3: Leverage scoring comparison for the ecological dimension before (2019) and during the pandemic (2020-2021)

Raya" to conserve coral reefs and floating net cages at a floating house location in Bangkokan.

Economic Assets

In Tasikmadu Village, there is the Prigi Fishery Port. Besides that, there is a fishing base located on the Karanggongso beach. During the fishing season, the catch is based on the fishing gear used, comprising layur fish, snapper, squid, tuna, octopus, grouper, mackerel and skipjack with a price range of between Rp. 10,000 per kg and Rp. 55,000 per kg. Most fishers also own land in the forest, a social programme under the Indonesian Ministry of Forest. When fishers do not go to sea during the off-fishing season, most fishers switch professions to become farmers or forest cultivators (Purwati *et al.,* 2018). Fishers do this alternative work during the off-season by working jobs outside the fisheries sector such as farming or gardening, tourism and other activities. The community manages and utilises forest resources to grow food crops and annual crops, like durian cloves. The types of plants planted for non-fishing activities include cloves, durian, stink bean, mangosteen, bananas, maize and secondary rice crops. Fisher activities are only in the peak season and 66 people are forest land cultivators. Nine fishermen only go to the sea throughout the year.

The fixed capital for forest cultivation are hoes, sickles, saws, machetes, lawnmowers and grass tanks. The average fixed costs incurred were Rp. 188,349. Variable costs for these activities include urea fertilisers, organic fertilisers, grass medicine, pest medicine, clove seeds, durian seeds and corn seeds. The need for seeds is adjusted to the types of plants grown by fishers. The majority of plants grown are annual crops such as cloves. The average variable cost is Rp. 6,779,833 per year with an average revenue of Rp. 12,165,200 per year, hence, the average profit is Rp. 6,557,018, per year. The average income of fishers from the tourism sector is Rp. 10,200,000 per year. In addition, some fishermen have side jobs as bird breeders with an income of Rp. 10,000,000 per year and goat breeders with an income of Rp. 48,000,000 per year.

Forest management carried out by coastal communities can directly increase their income. In addition, the forest management carried out by coastal communities improves their welfare because they are given arable land at no cost (Fuad *et al.,* 2021). The determination of the most common cropping pattern is the cultivation of cloves, durians and other perennials. They are annual plants that can act as a forest buffer from landslides. In addition, banana and corn plants are planted on the sidelines of annual crops. As a result, corn and bananas can be harvested every two to three months.

The government provides legal access to communities in and around forests to manage forest resources under five management schemes namely community forest, village forest, community plantation forest, partnership and customary forest (Bagaskara & Tridakusumah, 2021). In addition, the government provides access to Tarakan forest land to regulate the utilisation of the potential of forest areas according to the principle of sustainability by maintaining and protecting the forest (Syaprillah, 2015).

The fixed capital needed by fishing fishers is boats, fishing machines and equipment, and coolboxes. The average fixed costs incurred are Rp. 2,653,333 per year while the variable costs are incurred for purchasing fuel, oil, fishing rods, consumption and auction fees. As a result, the average variable cost incurred by fishers during the peak season is Rp. 25,040,117 per year with an average income of Rp. 126,250,971 per year to generate an average profit of Rp. 94,762,004 per year.

Decreased production results in lower profits as operational costs are higher than the fishing revenue. If the income from the sea decreases, fishers can look for alternative jobs. According to Paulus and Sobang (2017), alternative businesses need to be developed as a form of adaptation for fishing households in the face of a decrease in income from their main vocation as fishermen due to seasonal changes. The choice of alternative businesses made by respondents depends on the availability

of resources, technology owned by the fishers' families and the economic value of the products that are easily marketed. Alternative businesses undertaken by respondents in this study are businesses that have been carried out for generations and their products have a target market.

As far as the fishing community is concerned, the economic dimension variable that influences their sustainability the most is the source of operational fishing costs, with the RMS values being 2.92 and 5.56 before and during the pandemic, respectively (see Figure 4). Fishers before the COVID-19 pandemic sold their catch to fishers or wholesalers at a lower price than the market price because fishers have debts for operating costs at sea as much as 48% and some fishermen sell their catch to fishers or wholesalers because they still have relatives while 8% apply for loans from cooperatives and 44% use their capital. However, during the COVID-19 pandemic, 100% of fishers used their money to minimise their inability to repay loans.

Fishing communities have unique characteristics and habits, including in financial management. One of the inherent characteristics of fishing communities is being dependent on finding solutions to economic problems of intermediary traders or *"pengamba"* (the person who pays for all of the operational costs during the fishing season) in the Madurese or Makassar fishing community (Atmadjaja, 2017). In addition, for fishers, loans from relatives are usually taken by traditional fishermen to meet their daily needs. Fishers generally approach moneylenders for unexpected costs such as sudden medical expenses or even accidents (Hamdani & Wulandari, 2016). The majority of Karanggoso fishers before the COVID-19 pandemic obtained their operational expenses for fishing from fishers/wholesalers. It can be seen from the 75 respondents, 36 people or 48% obtained loans from traders/wholesalers. The more straightforward borrowing process without many requirements (administration, guarantees, payback intervals) leads to fishers preferring to take a loan for fishing capital from fishers than financial institutions. However, it comes with the consequence of the catch obtained must be sold to fishers at a lower price and determined by a single observer.

Banking institutions' interest in providing loans to traditional fishers is still minimal. Based on the applicable provisions, the provision of credit for traditional fishers can be classified as high risk, so the government plays an essential role in increasing the interest in banking

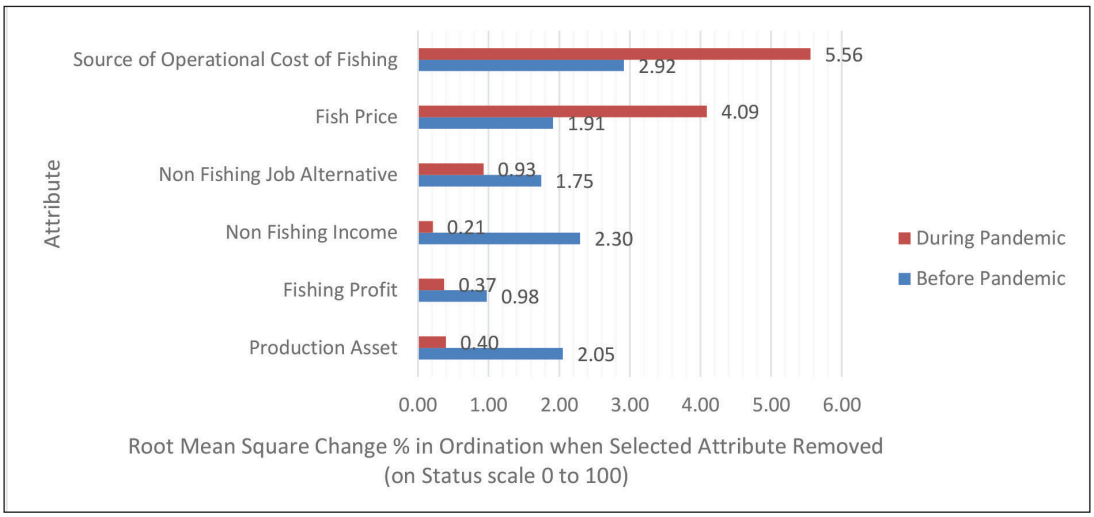

Figure 4: Leverage scoring comparison for the economic dimension before (2019) and during the pandemic (2020-2021)

institutions (Velentina, 2018). Therefore, bank financial institutions that fishers can access are government banks. In contrast, non-bank financial institutions that fishers can access are institutions that receive grant funds from local governments and local cooperations. In addition, many small-scale fishers can borrow from wholesalers. However, during the COVID-19 pandemic, 100% of fishers used their capital to minimise their inability to repay loans. These circumstances led to their failure to expand their fishing operation and their economic activities became more stagnant than before.

Physical Assets

The fishing gear operated by small-scale fishermen in Trenggalek Prigi Bay are handlines, gill nets and tug lines. There are small-scale fishers in Prigi who have various fishing gears used according to the fishing season. Fishers' selection of fishing gear may be due to differences in skills, abilities and experience in handling fishing gear (Sutjipto, 2018). Small-scale fishing activities use fern-type boats, motor propulsion engines and fishing rods. Boat prices vary, depending on the boat material.

Fishing ports are a critical aspect of the fisheries sector, especially capture fisheries. Fishing ports must serve port users from the fish-landing process to the distribution process. Therefore, fishing ports must have facilities that support activities in the field of capture fisheries (Farikin *et al.,* 2014). The fish landing facilities owned by Prigi Port are complete. Supporting facilities include docks, ship docking ponds, breakwaters, revetments, groins, clean water, electricity, water treatment, water reservoirs, fuel services, ice factories, cold storage, crushing machines, laboratories, guidance and testing of the quality of fish products as well as processing the waste of fish catches.

The level of sustainability of fishing households also depends on the physical capital and infrastructure. According to Figure 5, the most influencing variable before the COVID-19 pandemic was the availability of fish markets or ports. Fishers need a market to sell their catch as fish is a perishable food. According to Muninggar *et* a*l*. (2013), fish marketing through baskets that are providers of capital/skipper/ wholesalers determines the price. As a result, the price is usually lower than the price of fish at the port. The lack of bargaining position of fishers is suspected to be due to the dependence on the baskets is enormous in borrowing fishing capital and loans for other needs. However, during the pandemic, the most influencing variable is asset ownership such as fern-type boats and fishing

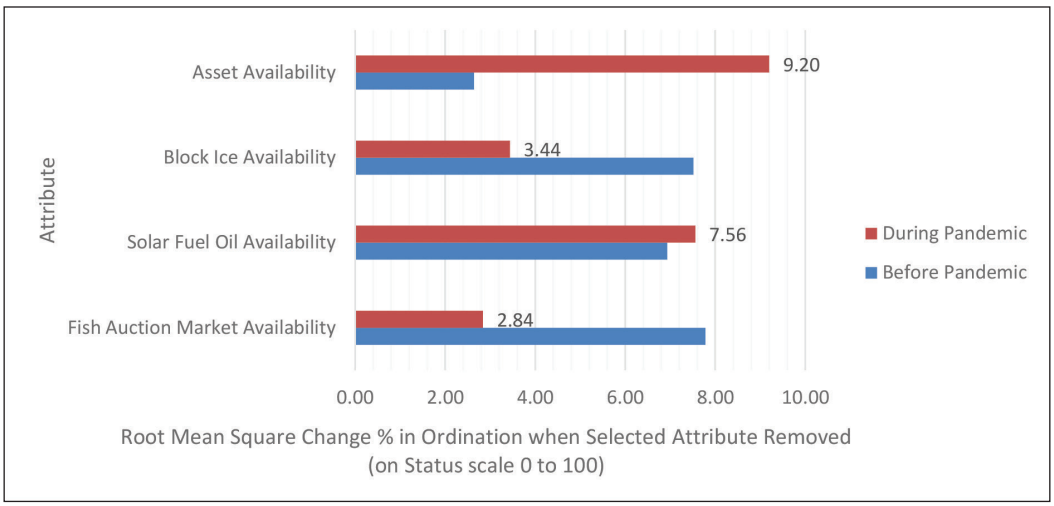

Figure 5: Leverage scoring comparison for the physical dimension before (2019) and during the pandemic (2020-2021)

rods. During the pandemic, fishers will keep their asset to support life sustainability. During the fishing season, they still go out to sea and catch fish. However, the fish caught could not be sold outside the area due to the scale restrictions. Their catch mostly was consumed by them and the rest was sold in the local market. In supporting their income, they carried out non-fishing activities.

Human Resources Assets

Their working experience dramatically determines decisions towards a better direction concerning their business because they have gone through adverse or beneficial events. These events are used as lessons for the future (Nsilapa *et al.,* 2017). The average amount of experience the fishers have in non-fishing businesses is 23 years with the dominant amount of experience being between 12 and 35 years at 56%. Meanwhile, the highest amount of fishing experience among the fishers is 58 years, the lowest being two years with the average being 27 years. The most dominant amount of experience is between 14 and 49 years at 48%.

Fishers have uncertain livelihoods. There are certain times when they go to sea and there are certain times when they do not go to sea. Fishers go to sea during the fishing and mid-season. Meanwhile, when it is off-season, fishers choose not to go to sea as the costs incurred are higher than the value of catch obtained, so they work outside the fisheries sector such as being farmers or trading to meet the needs of their households (Amir *et al.,* 2019). In one year, fishers spend an average of 74 working days performing non-fishing work and the most dominant working time in a year is between 50 and 99 working days at 66%. Those who carry out fishing activities spend as little as 176 working days and as much as 364 working days during the peak and middle seasons. On average, more than eight hours are needed in a day for fishing jobs. The majority of the working time for fishers is between 117 and 234 working days at 68%.

The development of appropriate technology can increase production efficiency and affect fish production. According to Santosa *et al.* (2019), the use of different fishing technologies for fishing activities can affect fishing production. Information and the application of new technology for other fishers is a means to improve their ability and management of fish resources.

With regard to human resource assets, the most influential variable for fishers' sustainability before and during the COVID-19 pandemic are their productive age (see Figure 6).

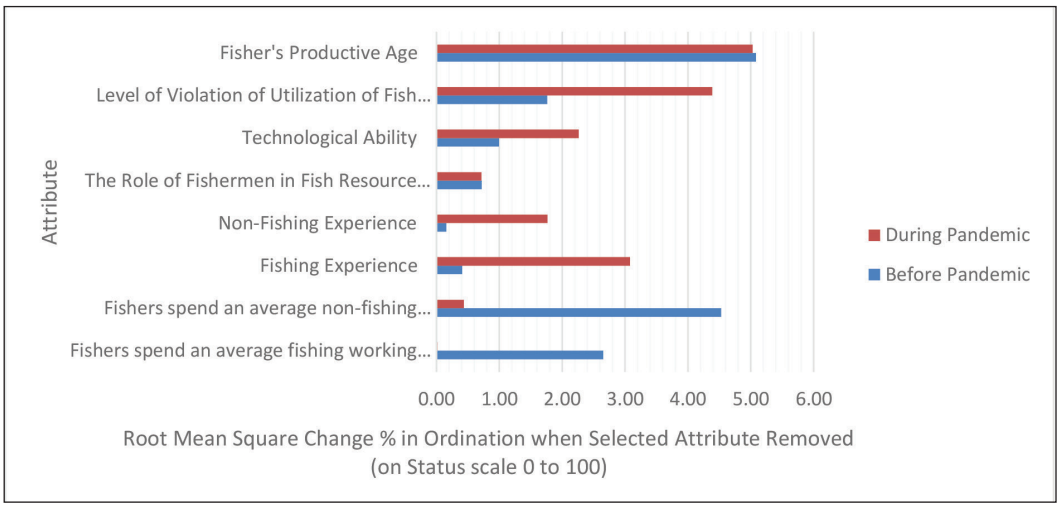

Figure 6: Leverage scoring comparison for the human resource dimension before (2019) and during the pandemic (2020-2021)

Traditional traps have been used for generations to catch fish, following the same old pattern taught by the fishers' predecessors (Ely & Henaulu, 2019). Age affects fishers' ability, which affects productivity, which in turn is based on physical strength and work experience as fishermen (Rahim *et al.,* 2018). As many as 64 fishers were in the productive category as they are under the age of 65. But of this number, 21 were older than 50.

Social Assets

Fixed capital in the form of coolboxes is obtained by fishermen from the *"pengambek"* (they provide loans in the form of coolboxes to fishermen) in exchange for the fishermen's catch to be sold to them. As a result, conflicts occur such as the government's ban on seine and trawl nets, catching lobster seeds and catching fish in coral reef conservation areas, as well as fishers' being suspicious of other fishers benefiting from subsidies provided by the government.

Fishers can improve household sustainability through subsidies to reduce their operating costs at sea. According to Moegni *et al.* (2014), subsidies are not only in the form of cash but in the form of goods as well. For example, the price of fuel is subsidised for fishers, giving them the opportunity to effectively reduce costs during periods of extreme weather.

Figure 7 shows that community group participation was the most influential variable on sustainability before the COVID-19 pandemic in terms of social capital. Joint-venture groups comprising fishers and the main actors of the fishing community are able to participate in fish catching. Joint action through groups is a strategy that fishers employ to remain competitive in their business environment. Group factors significantly related to participation are the group interaction environment, group goals and group leadership behaviour (Leilani & Restuwati, 2016). Such groups were established in Karanggongso, Tasikmadu Village with 10 groups of fishermen joined by 57 fishers.

The Forest Village Community Institution called "Gunung Madu" which is involved in forest resource management noted that 82% of fishing communities are managers of lands in forests. A community monitoring group called "Rembeng Raya" conducts coral reef conservation and sets up floating net cages at a floating house in Bangkokan. Another community monitoring group, "Mutiara" manages a new tourist destination in Karanggongso with the participation of 16% of the fishing community. In addition, 70% of fishers participate in a religious group that conducts religious ritual activities once a week, intending to provide participants with

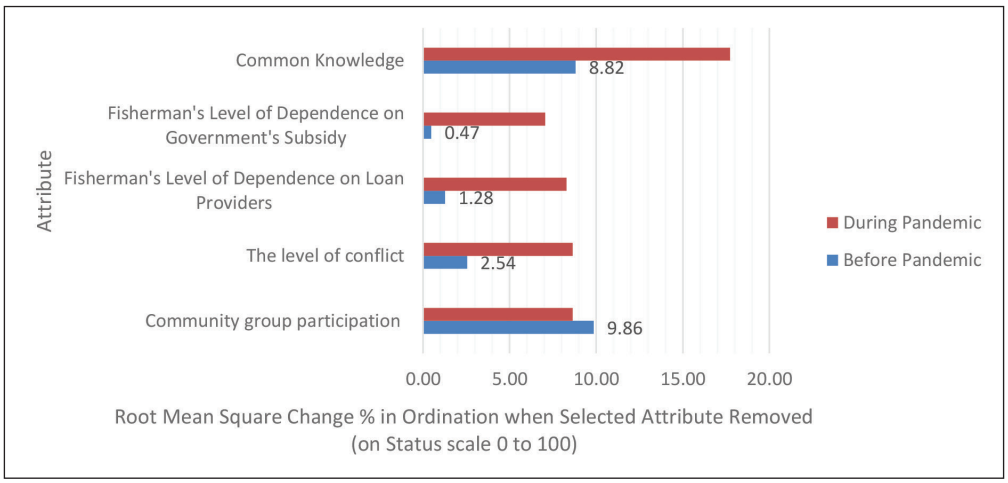

Figure 7: Leverage scoring comparison for the social dimension before (2019) and during the pandemic (2020-2021)

enthusiasm in religious worship, friendship and a sense of peace.

However, during the COVID-19 pandemic, the most influential social capital variable was common knowledge. The Larung Sembonyo traditional ceremony is a form of common knowledge that allows fishers to convey their gratitude for their catches. In addition, there is common knowledge in the Javanese community of helping relatives in need without expecting something in return, which has been practised for generations.

The practice of maintaining a universal relationship between God, nature and humans (Nurkhalis & Sempena, 2018) is observed by the fishers in Prigi Bay. They have a tradition of not going to sea from Thursday afternoon to Friday as they prioritise performing Friday prayers as Muslims. The Larung Sembonyo ceremony is held on Monday or a Kliwon Saturday in the Selo month of the Javanese calendar. Larung Sembonyo is a coastal community activity that is performed to convey gratitude to God for the provided sustenance. In addition, it aims to commemorate the ancestors who opened the Prigi Bay area. The Larung Sembonyo ceremony consists of prayers, the playing of local traditional music, a floating procession, *wayang* and *ruwatan*. 38 types of plants are used in the Larung Sembonyo ceremony, divided into 23 families. The ritual offerings used in the ceremony are divided into 31 pieces, each placed on a big plate. The Karanggongso community indirectly contributes to the plants used for rituals. Conservation efforts are carried out through the cultivation of plants in fields, yards and even forests (Zulia *et al.,* 2017). Prigi Bay is also a tourist area popular for its for beaches, scattered in the sub-bays of Karanggongso and Ketawang, with a few tourist activities on Damas Beach. Tourists mostly visit the area during holidays (Sunday and school holidays), New Year and one week after the first day of Eid. The sea-picking event organised by the fishing community once a year is also a tourism event. During the COVID-19 pandemic, the Larung Sembonyo ceremony was held at night without the use of loudspeakers while observing health protocols. Boat races were not allowed after the offerings ceremony, and the boat that accompanies it goes to the middle of the sea. However, the essence of Larung Sembonyo is as a symbol of gratitude to God.

Conclusion

The sustainability analysis of fishers' households before and during the COVID-19 pandemic shows that they are insufficiently sustainable. Among the five SLA capitals, during the COVID-19 pandemic, social capital is the most prominent factor in maintaining sustainability. Social capital is the main component of sustainability because of the strength of common knowledge possessed by fishers. Fishers need social capital because inter-group savings and loan activities are an alternative strategy for traditional fishing communities in Prigi Bay to survive. They are generally constrained by limited ownership of land resource assets and small capital, depending on a group for their livelihoods is the best option. This is also due to a lack of interest from banking institutions in providing loans to traditional fishers. Based on the applicable regulations, the provision of credit to traditional fishers is still classified as a high-risk loan. To overcome this problem, the government needs to increase the interest of banking institutions in financing the community. If the government feels that providing credit to fishers is risky, then with the strength of social capital, the government can minimise the potential for non-performing loans. The government and banking institutions can cooperate with fishing groups to assist fishers during the off-fishing season. Fishers continue to survive because their productivity does not only involve the sea but several activities outside the sea to meet their daily needs as well. Hence, during the pandemic, fishers' household still survived because of non-fishing activities such as produce of obtained from managing the forest which can be used for household consumption. Another recommendation is expanding forest land that can be loaned to be managed by fishers

during the off-season. This study is limited in terms of measuring policy priority following the findings of fishers' sustainability levels. However, notwithstanding this limitation, the study suggests that further research be conducted to obtain more comprehensive insights.

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