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RESEARCH ARTICLE

The Role of Social Capital in a Fishing Community's Adaptation to Climate Change

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Climate change threatens the livelihoods of many communities around the world, including fishing communities. Low catches of fish caused by climate change may have devastating impacts on fishing communities, particularly on those poor communities with a lack of preparation for climate change adaptation. This study investigates how social capital influences fishermen's support for climate change adaptation. We conducted a contingent valuation survey in a fishing community vulnerable to climate change in Lamongan, Indonesia. Our study results reveal that fishermen's trust in a person and their community involvement played significant roles in their support for climate change adaptation. These study findings imply a policy implication that fostering social capital can be an effective strategy to support a fishing community' adaptation to climate change.

Keywords: climate change, capture fisheries, social capital

JEL Classifications: N55, O13, Q01

Climate change is a key threat to the world, including many countries in Southeast Asia (Kreft et al., 2016). In this region, fisheries are important economic activities and major sources of jobs and household incomes. Around 7-8% of the working population in Bangladesh and Indonesia, especially in rural areas, rely on this sector for their living (Kathun, 2004; Hoegh-Guldberg et al., 2009). Besides, fish products are a major source of animal protein for up to 50% to 80% of the populations in developing countries, such as Pakistan, Bangladesh, Malaysia, and the Solomon Islands, and fish products even contribute up to 4% of the gross domestic product (GDP) in those countries (Islam et al., 2015; Bogard et al., 2015; Dey et al., 2016). Unfortunately, climate change can have devastating impacts on fishing communities in this region.

Although climate change can cause extreme weather, high temperatures, fluctuating rainfall, and economic impacts on various industries, capture fisheries are no exception (Read, 2010; Liverman, 2007; Sakuntaladewi & Sylviani, 2014; Daw et al., 2009; Allison et al., 2009; Brander, 2010; Hollowed et al., 2013). Although bioclimate envelope approaches expect a 30-70% rise in fish capture capacity in high latitudes, it is expected that fish capture would decrease by 40% in the tropics (Cheung et al., 2010). Barange et al. (2014) asserted that climate change can reduce the total productive capacity in South and Southeast Asia if the average temperature increases by around 2° Celsius by 2050.

Although there are several adaptation strategies in the fishery sector (Miller et al., 2018), there has been limited attention to a strategy to reduce social inequality as a way to improve the community, as well as the environment's resilience and adaptive capacity. This could be accomplished by, inter alia, reinforcing the role of social capital in societies (Mintewab et al., 2011; Siregar & Crane, 2011) because strong social capital can positively affect economic performance (Putnam, 1993). Fishermen's sense of belonging to their hometown is believed to be a contributing factor to a strong cooperative attitude and social reciprocity, which in turn strengthens social relations (Salik et al., 2015; Shaffril et al., 2017).

In a community where its members act collectively, social capital is often synonymous with trust (Bowles & Gintis, 2001). Based on the widely accepted norms, trust is a form of cooperation among members of society (Fukuyama, 1995), and this is an integral part of social capital. Among the fishing communities, it plays a significant role in reducing fisheries management costs. If fishermen trust each other to comply with local and regulatory rules to protect fisheries, then the cost of monitoring an individual's actions will be reduced. The relationship between trust and a community's climate change adaptation has been positive and significant (Paul et al., 2015).

Given the impact of social capital on economic performance, an effective approach to address the challenges posed by climate change involves enhancing its roles within communities (Siregar & Crane, 2011). Scholars such as Putnam (1993) underscored the significance of social capital, which can be defined as the norms and trust that enable members of a community to collaborate (Bowles & Gintis, 2001). Established social norms within a community can shape behaviors and attitudes, potentially enhancing economic efficiency by reducing transaction costs, bridging knowledge gaps, and fostering support for addressing social issues—often referred to as "cognitive social capital" (Grootaert & van Bastelaer, 2002).

Social networks, exemplified by friends and family, play a crucial role in influencing farmers' attitudes towards climate change adaptation (Nam et al., 2012). These networks contribute to enhancing farmers' knowledge of adaptation strategies (Fankhauser et al., 1999), influencing their willingness to incur adaptation costs and improving their ability to estimate potential risks and damages associated with climate change (Kane & Shogren, 2000). Globally, there is recognition that heavily engineered coastal defenses are both financially and environmentally unsustainable. Jones et al.'s (2015) research represents one of the initial analyses exploring the impact of social capital parameters—social trust, institutional trust, social reciprocity, and social networks—on the willingness to pay for the maintenance of coastal defenses. In the context of climate change, Shaffril et al.'s (2017) study on small-scale fishermen reveals that a key adaptation strategy involves strengthening social relationships. This highlights the essential nature of robust social connections for fishermen in adapting to the challenges posed by climate change.

To adapt to climate change, society needs to be resilient and resourceful (Sakuntaladewi & Sylviani, 2014). Our adaptation strategies must be sustainable: for example, through women empowerment (Jorstad & Webersik, 2016), risk mitigations, capacity building, and access to information on climate change and relevant skills (Shaffrill et al., 2017). Particularly, social capital can be a sustainable approach to natural resource management because it can enhance collective behavior (Adhikari & Goldey, 2010); hence, social capital can encourage collective action in the management of natural resources (Ishihara & Pascual, 2009). Although social capital has been widely studied, its role in climate change mitigation among fishermen is yet to be sought after. This study aims to fill in this knowledge gap. We surveyed fishermen in Lamongan, Indonesia, and analyzed the impacts of social capital on the farmers' willingness to pay for climate change mitigation in the fisheries sector.

Methodology

Study Site

This study was carried out in Lamongan, Indonesia, where climate change has had a significant effect on the fishing industry. Lamongan Regency in East Java is one of Indonesia's largest fish suppliers. This region supplies 20.29% of the fish produced in East Java and its neighboring regions.

The Lamongan Regency is worthy of becoming a model for how the fisheries sub-sector efficiently utilizes available natural resources. With only a coastline of 47 km, the stakeholders in the Lamongan Regency's capture fisheries sector, reinforced by approximately 20,000 fishermen, were able to produce 79.8 thousand tons of various types of fish in 2020. Capturing fisheries is an endeavor that requires interconnection among components, and if the conditions for capturing fisheries are not met, the resulting production will not be optimal. The components playing roles in the capture fisheries system include the community, production facilities, production processes, port infrastructure, fish resources, processing, marketing, and legal aspects (Kusnadi, 2009). This indicates that the relationships among these indicators are crucial for the success of capture fisheries.

One of the socioeconomic characteristics of fishermen in the Lamongan Regency is their low income and social status. According to the Social and Economic Survey (SUSENAS), in 2017, 11.34% of people in the fisheries sector (fishermen) were classified as poor (Pasaribu & Harianja, 2023). The low social status of fishermen in the Lamongan Regency is attributed to limitations in human resource quality, access and mastery of technology, markets, and capital. If the productivity of fish catch is high, the income level of fishermen will also increase. Conversely, if fish productivity is low, the income of fishermen will decrease. The income of fishermen is not solely derived from fishing; it also comes from other economic activities (part-time jobs) to fill leisure time. Additionally, the role of wives and children is crucial in supporting work to increase income. Government intervention is also essential in addressing income-related issues for fishermen, such as creating work programs and providing assistance in the form of boats, engines, and fishing equipment.

The livelihood of coastal fishermen in the Lamongan Regency is highly dependent on the income level. If the income obtained in two to three days at sea is considered insufficient, they must end their fishing period. Almost all coastal areas in the Lamongan Regency are vulnerable to natural disasters and climate change, which can affect their catch. Storms or high waves make it difficult for fishermen in the Lamongan Regency to go to sea and get sufficient catch. Climate change, causing changes in seawater temperature and seasons, can also impact the abundance of fish in the sea, affecting the economy and welfare of fishermen in the Lamongan Regency. Despite being recognized as the regency in East Java with the highest fisheries production, contributing 18.6% to the total fish production in East Java, the socioeconomic conditions of fishermen in the Lamongan Regency are still relatively low.

In comparison to coastal areas in Tuban Regency, most of the population there also works as fishermen with uncertain catch results. Despite this, the fishing communities continue to survive in the area with an economy that can be considered insufficient to meet their daily needs. Poverty among Tuban's fishing communities has long been felt due to frequent declines in catch results caused by factors such as fishing gear. Initially, fishermen used traditional capture tools powered by human labor, but now they are gradually shifting to more modern and sophisticated tools, such as motorized boats. This change is experienced by Tuban's fishermen, leading to better income compared to before and slowly transforming the socioeconomic conditions of fishermen in Tuban. Besides similar socioeconomic issues, such as low welfare among fishermen, their catch results are still far behind those of Lamongan Regency.

Figure 1 illustrates the map of Lamongan Regency, highlighting the surveyed regions. The surveyed locations are denoted by black circles, specifically covering the coastal areas or regions directly adjacent to the sea in Lamongan Regency. The survey encompasses Paciran Subdistrict and Brondong Subdistrict. In Paciran Subdistrict, which encompasses 17 villages, the study is conducted in the following villages: Paciran, Tunggul, Kranji, Banjarwati, Kemantren, and Paloh. Similarly, in the Brondong Subdistrict, consisting of 10 villages, the research is carried out in the following villages: Lohgung, Labuhan, Sedayulawas, and Brondong.

Climate change has shifted both fishing timing and types of available fish in the region. Changes in wind

Figure 1. Lamongan Map

Note: *Circle: Sampling location*
Square: Capital City of Lamongan Regency

patterns and high waves may also pose a high risk to sailing fishermen (Read, 2010). Adaptation to climate change is imperative for fishermen to sustain their livelihoods, but many fishermen in Southeast Asia face low adaptation capacity and low awareness of climate change owing to their low education opportunities (Ahmed et al., 2013; Salik et al., 2015).

Survey Design and Administration

We surveyed fishermen in the Lamongan Regency by using the contingent valuation method (Amponin et al., 2007; Haab & McConnell, 2002; Zhongmin et al., 2003) to elicit their willingness to pay for climate change adaptation. The contingent valuation results were used as a proxy for assessing the potential economic benefits to fishermen and whether they support climate change adaptation. The contingent valuation survey was designed based on a payment vehicle of an environmental tax referendum. Our survey asked, "If the Indonesian government poses x amount of environmental tax to implement climate change adaptation, would you agree or disagree?". The bid ranged from IDR 15,000 (USD 1.07) to IDR 3,500,000 (USD 250). The bidding started with the lowest bid, and the amount of the bid increased until fishermen rejected the increased amount. In addition, the survey results served as an indicator for estimating the number of fishermen with sufficient funding resources and whether these fishermen were prepared to participate in climate change adaptation.

The final survey questionnaire consisted of seven sections. The first section of the questionnaire mapped out the sociodemographic characteristics of the fishermen, such as age, family size, and literation. The second section identified the fishermen's assets. The third section observed location characteristics. The fourth section asked about the social capital characteristics, including trust, community participation, and the

number of non-village relatives. Characteristics of social capital include trust in people, households' participation in the community, and the number of close relatives outside one's village (Dakhli & De Clercq, 2004; Jones et al., 2009; Jones et al., 2010; Macias & Williams, 2014; Polyzou et al., 2011). The fifth section analyzed the climate change characteristics, such as the frequency of high waves, the catch, the location, and the type of fish. The final section examined the location characteristics, including distance from home to sea and city.

To minimize bias in sample selection, we establish clear criteria for the inclusion and exclusion of participants. We also ensure that the sample selection is based on characteristics that are truly relevant to the research objectives. Therefore, a total of 400 households working as fishermen were surveyed using the purposive sampling method. This method is chosen because it allows the researcher to selectively choose participants who are considered most relevant or possess specific desired characteristics. This can save time and resources, especially when dealing with a large and diverse population. Furthermore, this method is viewed as flexible in selecting participants with specific characteristics or experiences relevant to the research objectives. Researchers can tailor their sample to the needs of the study. Finally, purposive sampling is suitable for research focusing on rare or specific cases where the researcher is interested in unique characteristics or occurrences that may be challenging to find within specific strata. The required sample size was calculated using the Slovin formula. The survey was conducted in a face-to-face manner (Lee & Han, 2002; Togridou et al., 2006).

Econometric Model

The contingent valuation method (CVM) is a technique employed to gauge individuals' willingness to pay for goods or services. Specifically, it is widely used to assess individuals' willingness to pay (WTP) for non-market goods and services (Ruiz & Simon, 2004). This method involves scrutinizing individuals' responses to hypothetical questionnaire items that inquire about their preferences and willingness to pay. A pivotal question arises: "How many fishermen are willing to pay to adapt to climate change?" Originally developed to measure the benefits of pure public goods and services without existing markets, such as environmental goods (Shono et al., 2014), the CVM has become a prevalent method due to its versatility, including the estimation of the price of goods that may not currently be available but could be utilized in the future (Baker et al., 2014).

Given the absence of a market for goods and services in the CVM, the focus shifts to individuals measuring their values to ascertain the worth of their preferences, which results from changes in the quality of non-market goods. This enables the estimation of the values of these goods through the creation of contingent markets, leading to the CVM also being referred to as the preference method (Lang, 2010). The sum of each individual's WTP is considered the societal benefit of the intervention. Among various methods for measuring WTP, the CVM is a flexible approach that provides a conceptually correct and comprehensive measure of WTP (Lin et al., 2014). Hence, in this study, we adopt the CV method and survey the fishermen to solicit respondents' WTP (Tambor et al., 2014).

To bolster the validity of a CV study, Mitchell and Carson (2013) emphasized the importance of scenario elements being understandable, meaningful, and plausible. This entails ensuring that WTP questions are clear and unambiguous, respondents are familiar with the commodity being valued, and respondents have had prior valuation and choice experience for consumption levels of the commodity (Mitchell & Carson, 2013; Asgary et al., 2004). The CV method employs survey questions to discern people's preferences for public goods by ascertaining what they would be willing to pay for specified improvements (Mataria et al., 2006). This aims to elicit their WTP in dollar amounts, overcoming the absence of markets for public goods by presenting hypothetical markets in which consumers could purchase the goods in question (Cai & Zheng, 2007).

The hypothetical market may model either a private goods market or a political market. Because elicited WTP values depend on the specific hypothetical market described to the respondent, this approach is termed the contingent valuation method (Mitchell & Carson, 2013; Lang, 2010). Respondents are typically presented with material, often in a face-to-face personal interview (Fu et al., 2011). However, it is important to note that our estimation may be conservative, as the WTP value in a hypothetical situation may be lower than the WTP in a real situation (Baker et al., 2014). General criticisms of CVM include the distinction between WTP and actual payment (Shono et al., 2014) and the consideration

that WTP is not a monetary value but rather a sense of satisfaction (referred to as warm glow) when paying (Gyrd-Hansen, 2003; Getzen, 2007).

To determine which factors influence fishermen's willingness to pay for climate change adaptation, a contingent valuation model is established below,

$$WTP = \beta_1 + \beta_2 age + \beta_3 famsize + \beta_4 literate + \beta_5 asset + \beta_6 distsea + \beta_7 distcity + \beta_8 trust + \beta_9 comm + \beta_{10} outrelative + \beta_{11} highwave + \beta_{12} fishcatch + \beta_{12} fishcatch +$$

where WTP is the willingness to pay that is derived from the hypothetical question in the questionnaire; β is a parameter to estimate, and ϵ is an error term. In our model, sociodemographic factors include the age of the household head (*age*), family size denoted by *famsize*, and literacy status represented by the dummy variable *literate*. Additionally, we incorporate the control variable asset to account for household assets (*asset*). Location-related variables encompass *distsea* (distance from home to the sea) and *distcity* (distance from home to a city). Social capital is gauged through *trust* (a dummy variable indicating trust in people), *comm* (household participation in the community), and *outrelative* (the number of relatives residing outside the village). Lastly, climate change indicators involve *highwave* (frequency of high sea waves per week), *fishcatch* (whether fishermen experienced a decline in fish catches), *fishloc* (changes in fishing location), and *fishtype* (whether there is a reduction in the variety of caught fish).

Results and Discussion

Table 1 presents the summary statistics of the surveyed participants. On average, fishermen express

Table 1. Descriptive Statistics of the Survey Participants (n = 400)

Variables	Mean	Std.
Value of climate change adaptation		
Willingness to pay (IDR per year)	626,632.5	696,863.4
Sociodemographic characteristics		
Age of household head (years old)	43.637	10.221
Family size	2.265	1.632
Literacy of the household head (1: yes, 0: no)	0.952	0.213
Assets		
Household assets (million IDR)	3.422	0.840
Location Characteristics		
Distance to sea from home (meters)	123.087	102.483
Distance to a city from home (kilometers)	25.555	5.019
Social capital characteristics		
Trust in people (1: yes, 0: no)	0.745	0.436
Household participation in the community (1: yes, 0: no)	0.947	0.711
Number of relatives outside the village (no.)	5.427	4.252
Climate change characteristics		
Frequency of high sea waves per week (no.)	15.382	7.164
Decrease in fish catches (1: yes, 0: no)	0.620	0.486
Change of a fishing location (1: yes, 0: no)	0.865	0.342
Decrease in types of caught fish (1: yes, 0: no)	0.860	0.347

Note: Authors' calculation

Table 2. *Regression Results*

Dependent Variable: WTP for climate change adaptation	Coefficient (S.E)
Sociodemographic	
Age of household head	7,491.4** (0.011)
Family size	− 79,869.3*** (0.000)
Literacy of the household head	7,512.2 (0.956)
Household asset	2,196.7 (0.949)
Distance to sea	− 616.94 ** (0.030)
Distance to a city	−3,407.9 (0.552)
Social capital	
Trust in people	249,764.9 *** (0.000)
Household participation in community	114,303.9 *** (0.005)
Number of relatives outside this village	110,114.4 (0.105)
Climate change	
Frequency of high sea waves per week	15,127.4 *** (0.000)
Decrease in fish catches	486,684.7 *** (0.000)
Change of a fishing location	77,766.5 (0.358)
Decrease in types of caught fishes	20,106.8 (0.811)
Nagelkerke R Square	0.364
p-value	0.000

****significant at α = 1%; **significant at α = 5%; *significant at α = 10%*
p-value in parenthesis

a willingness to pay IDR 626,632.5 (USD 40) annually for climate change adaptation. The average age of the household head is 43 years, with an average family size of approximately two individuals, and an impressive literacy rate of 95%. Typical fisherman households possess assets valued at IDR 3.42 million (USD 217). Respondents reside, on average, 123 meters from the seashore and approximately 25 kilometers from a city. A substantial majority of fishermen, accounting for 74.5%, express trust in people, whereas an impressive 94.7% actively participate in community activities, and, on average, they have five relatives residing outside the village. In the context of climate change, an average of 15 high sea waves are observed weekly.

Approximately 62% of fishermen report a decline in fish catches, with 86.5% changing their fishing location and 86% experiencing a reduction in the variety of caught fish.

Of the sociodemographic characteristics in Table 2, age had a positive impact, indicating that the older the farmers, the more they support adaptation to climate change. By contrast, the family size had a negative impact on their support for the adaptation. Moreover, fishermen's literacy and assets had no significant impact. Among the climate change characteristics, the location of fish catches and the fish types had no significant impacts. However, fishermen who experienced more high sea waves expressed stronger support for the adaptation, and those experiencing a decrease in fish catch also supported the adaptation. These results imply that those fishermen would provide more support for the adaptation if they experienced changes in these fishing conditions, potentially due to climate change. Of the location characteristics, the proximity from home to the sea had a negative impact, but the proximity to the city had no impact.

Our study results imply a policy implication that social capital, particularly if it is an integral part of society, may be an alternative and effective approach to environmental management. For example, the Indonesian Sectoral Roadmap on Climate Change (ICCSR) successfully used social capital to socialize and implement new technologies among fishermen. The environmental management policy will succeed if its implementation can reflect local community interests—including their social capital, such as complying with local wisdom. Local societies, as stated by Agrawal (1996), build more contextualized and efficient rules to enforce these rules effectively because they have first-hand experience. Moreover, these results imply the potential that improving social capital might be an effective policy implication related to the National Action Plan on Adaptation to Climate Change (RAN-API) and promoting new fisheries technologies among fishermen. In this manner, our study findings emphasize the potential of social capital to influence individuals in the capture fisheries sector (Dunham et al., 2013; Holland et al., 2013), which is particularly vulnerable to climate change (Brander, 2010; Barange et al., 2014).

Conclusion

This study examines the role of social capital on the fishermen's support for adaptation to climate change. We surveyed fishermen in Lamongan, Indonesia, who faced increased risks of climate change. The findings showed that the fishermen were willing to pay IDR 626,632 (USD 45) on average for climate change adaptation. Our study results highlight that fishermen's support for the adaptation becomes stronger when they have better social capital, such as greater trust in people and high community involvement. Nevertheless, our study is not without its limitations, particularly in the use of contingency valuation to estimate willingness to pay. The availability of information about offers made by previous respondents may influence the offers of subsequent respondents. This can create a sensitization effect on the offers and impact the research results. The setting of an initial price or minimum demand in the bidding game may influence respondents' offers. Respondents may be inclined to start from that figure without considering the actual value.

Furthermore, our findings suggest that in a country like Indonesia, where social capital is rooted in its populations, the strategy to mitigate climate change could capitalize on it. The findings imply a policy implication that social capital can be an effective approach to improving the National Action Plan on Adaptation to Climate Change (RAN-API), the Indonesian Climate Change Sector Roadmap (ICCSR), and promoting new fisheries technologies among fishermen. The findings should inform policymaking to mitigate the risks of climate change in the capture fisheries sector. Future work will benefit from investigating the role of social capital in other provinces of Indonesia, as well as in other countries, as results may vary across different social and cultural contexts.

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