



Analysis

Productivity, Social Capital and Perceived Environmental Threats in Small-Island Fisheries: Insights from Indonesia

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ARTICLE INFO

Keywords:

Artisanal Fisheries
 Developing Countries
 Technical Efficiency
 Capacity Utilization
 Indonesia
 Small Islands

ABSTRACT

Small-island communities in developing countries rely heavily on wild fisheries to meet the communities' food and livelihood needs. These communities' remoteness, insularity and the small size of the local economy make the fishery production sensitive to the way in which fishers interact with other community members and to local environmental changes. This paper investigates how social capital and environmental threats to local fishing activities are associated with fishery productivity using the data collected in a small-island fishing community in Indonesia. We estimate the technical efficiency and capacity utilization, and examine how these measures are related to the social capital built around the island community. The impacts of environmental changes that are perceived as threats to local fishing activities are also evaluated. We find that inefficiency in the fisheries' production is correlated with whether fishers are tied to community members outside their own fishing groups and whether they are exposed to environmental threats, the sources of which are internal and external to the fisheries system. The underutilization of existing capacity is evident for fishers who receive government aid for fishing equipment and those who perceive population growth and aquaculture development as a threat to their fishing activities.

1. Introduction

The economic development of small islands is often lagged relative to other regions due to the islands' remoteness and insularity, forcing the island communities to face unique challenges (Briguglio, 1995). In such environments, artisanal fisheries play a crucial role in providing food and income and being a driver for the island economy (Stobutzki et al., 2006; Zeller et al., 2006). Their contribution to food security is well recognized as a large proportion of the catch is not exported but either traded locally or consumed by fishers and their families (Béné et al., 2007; Food and Agriculture Organization [FAO], 2014; World Fish Center, 2011). The small size of the local economy and the isolated location, however, make the fisheries' production sensitive to many factors, including social interactions among community members and environmental threats, such as depletion of fish stocks and the degradation of inshore habitats (Andrew et al., 2007; Béné et al., 2010; Cinner et al., 2012; Lovatelli et al., 2004).

The influence of social relations, particularly in the form of social capital, on success in community governance and resource management

has long been studied in the literature, including seminal works by Ostrom (1990, 1999), Bowles and Herbert (2002) and Pretty (2003). Despite various definitions and interpretations in the literature, social capital is broadly considered a form of connectedness of individuals to their communities (Dasgupta and Serageldin, 2000). Ostrom and Ahn (2003) suggested that social capital takes three major forms: trustworthiness, networks and institutions that facilitate a set of formal and informal rules shared among community members. In fisheries, Grafton (2005) highlighted the mechanism of how social capital, as represented by connections within fishing communities, helps to promote better fishery management practices. Holland et al. (2013, 2015) derived empirical measures of social capital in the New England groundfish fishery and showed how different forms of social capital relate to the economic performance of the fishery sector. In the context of artisanal fisheries, previous studies showed that social capital can enhance the ability for conflict resolution and self-regulation of fishery resource extraction (Marín et al., 2012; Sekhar, 2007; Yamazaki et al., 2018).

However, these potential benefits may be hindered or lost if resource users face environmental threats. For instance, recent theoretical

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studies, including Fesselmeyer and Santugini (2013), Sakamoto (2014) and Miller and Nkuiya (2016), showed how the threat of stock depletion affects cooperation among resource users and their harvesting behavior. Furthermore, empirical studies, including Ward and Sutinen (1994), Pradhan and Leung (2004) and Smith (2004), have shown a significant negative correlation between the participation rate in the fishery and a decline in the abundance of fisheries resources.

In this paper, we empirically examine how social capital built around the island community and environmental threats is related to the economic performance of individuals in small-island fisheries. Using the data collected through a household survey in the Kei Islands of Indonesia, we constructed five proxies for social capital. Each proxy is related to different forms of trust-cooperative and network relationships that may influence the productivity of fishing operations. We also identified five major environmental threats to local fishing activity through interviews with fishers and other stakeholder groups in the study area. These threats include a factor that occurs within the fishery (i.e., depletion of local fish stocks), as well as those from outside the domain of the fishery (e.g., population growth). Incorporating threats from outside the fishery domain is particularly important for an analysis of artisanal fisheries, because the economic and social issues arising are often characterized by the interface between fisheries and broad factors that come from outside the fishery (Andrew et al., 2007; Cinner et al., 2012; Lovatelli et al., 2004).

We measure the economic performance of the Kei island artisanal fisheries by estimating technical efficiency and capacity utilization based on the catch and input data collected with a household survey. These measures are used to identify individuals who operate at a lower efficiency, relative to others, and those who invest in capacity that is not fully utilized in fishing (i.e., excess capacity). The existence of technical inefficiency and excess capacity represents a form of economic waste as the same level of output can be achieved with a smaller amount of fishing effort or investment in capacity (Grafton et al., 2006; Gréboval and Munro, 1999; Pascoe et al., 2003; Rust et al., 2016). In the literature, indicators of the economic performance of fishing vessels are frequently computed based on revenue, profit or return on capital investment. However, the data necessary to compute these monetary indicators are not readily available for artisanal fisheries. Moreover, these monetary indicators are not necessarily a suitable indicator for evaluating the performance of artisanal fisheries, as in the case of our study area, where a large part of the catch is not traded in a market but is used for subsistence.

The availability of catch and input data is a major obstacle in estimating technical efficiency and capacity utilization, particularly in developing countries where an effective monitoring and reporting system is absent. This limitation is reflected in the general underdevelopment of quantitative research on artisanal fisheries relative to that of large-scale industrial fisheries (Andrew et al., 2007; Schubbauer and Sumaila, 2016). Previous studies estimating efficiency and capacity measures largely focus on industrial-scale fisheries where regulation and monitoring are in place and institutional capacity for collecting and managing data exist (Dupont et al., 2002; Grafton et al., 2000; Kirkley et al., 1995; Lindebo et al., 2007; Pascoe and Tingley, 2006). In contrast, the technical efficiency and capacity utilization in artisanal fisheries are generally estimated using survey data in which the necessary information about output and input quantities are collected through interviews with fishing operators (Kirkley et al., 2003; Lokina, 2008; Salayo et al., 2008; Squires et al., 2003a, 2003b). To the best of our knowledge, however, to date no study has evaluated whether, and to what extent, productivity in artisanal fisheries depend on the way that fishers interact with other community members and how they perceive different types of environmental threats to local fishing activities.

The small-island communities in Indonesia provide an instructive case to develop insights in the area of this study. Marine capture fisheries in Indonesia represent the second largest production in the world, while about 95% of fishery production comes from artisanal fisheries, and many fishing households reside in remote small-island areas (FAO, 2011).

Despite the scale of each fishing operation, however, the fishing households are exposed to the depletion of important fish stocks (Ainsworth et al., 2008; Heazle and Butcher, 2007), and Indonesia has been identified as one of the most vulnerable nations in terms of food security against the degradation of coral reef fisheries (Hughes et al., 2012). It is also known that the local fishers in the Kei Islands make a decision under complex social settings, involving individuals with diverse ethnic and religious backgrounds, and in an institution where marine resources have been managed traditionally through customary law and procedures (Adhuri, 2013; Hoshino et al., 2017). This case study, therefore, provides an ideal opportunity to examine the link between the economic performance of artisanal fishers and the social capital held by individuals in an island community that faces environmental threats.

The rest of the paper is structured as follows. In Section 2, we describe the case study area and the household survey used to collect the data. Section 3 provides the summary statistics of the catch and input data along with the discussion of the characteristics of the artisanal fisheries in the Kei Islands. Section 4 presents a detailed description of the variables used as a proxy for social capital and environmental changes that are perceived by local fishers as a threat to their fishing activities. Using data envelopment analysis (DEA), we estimate the measurement of technical efficiency and capacity utilization. The relationship between these measures and other variables of interest is then assessed by estimating a truncated regression model. The main results are presented in Section 5. Section 6 provides a discussion of the results and concluding remarks.

2. Research Site and Survey

The Kei Islands are situated in a remote location in the southeast region of Maluku province, Indonesia, and form an archipelago of hundreds of small mostly uninhabited islands (Fig. 1). The three main sources of livelihood in the islands are coastal artisanal fisheries, tourism and small-scale agriculture. Each village in the Kei Islands is in close proximity to other villages (< 20 km in diameter). Households are generally clustered by religion and ethnicity at the village level, and the primary source livelihood is similar among individuals within a village. The village also provides the basis for collective decision making for managing and utilizing fishery resources.

Fishing activities undertaken by local households are artisanal in the sense that fishing is predominantly conducted by individuals or small groups within the same village, most fishing boats do not have inboard motors, and boats and other equipment are made by fishing operators themselves using local materials, such as wood, bamboo and coconut leaves. The catch is mainly for local consumption because of the limited harvesting technology, as well as processing and freezing capacity, available in the islands. The isolated location of the Kei Islands, low human capital and lack of bargaining position and power of the fishers' organization further make it difficult to export fish caught by artisanal fishers to other parts of the country or foreign markets. The majority of fishers are engaged in fishing six days a week as fishing is their primary livelihood. However, some fishers are involved in fishing less frequently during particular times of the year for various reasons, including adverse weather conditions (e.g., monsoons), planting and harvest times for their crops and changes in the price of other commodities (e.g., seaweed). Although all households share the same climate and marine conditions and are engaged in similar daily activities, there is variation in the way that individuals perceive changes in the fishery conditions and how individuals form a social relationship with other community members (Section 4).

We conducted a household survey in November to December 2013 to collect cross-sectional data about fishing households in the Kei Islands. A sample of 304 households from four fishing villages was randomly selected based on a list of households maintained by village leaders. Face-to-face interviews with a structured questionnaire were undertaken by trained enumerators from the University of Pattimura which is in the provincial capital of Maluku (Fig. 1). For each household, the main fisher

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