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Differences in the effects of social network, trust, and co-operation on fishery co-management

Ryutaro Kamiyama[a,*], Tsutom Miyata[a], Alice Joan G. Ferrer[b], Hisashi Kurokura[c], Satoshi Ishikawa[d]

[a] National Research Institute of Fisheries Science, Japan Fisheries Research and Education Agency, 2-12-4 Fukuura, Kanazawa-ku, Yokohama, Kanagawa 236-8648, Japan
[b] Division of Social Sciences, University of the Philippines Visayas, UP Visayas Miagao, 5023 Iloilo, Philippines
[c] Graduate School of Agricultural and Life Sciences, The University of Tokyo, 1-1-1, Yayoi, Bunkyo-ku, Tokyo 113-8657, Japan
[d] Research Institute of Humanity and Nature, 457-4, Motoyama, Kamigamo, Kita-ku, Kyoto 603-8047, Japan

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ABSTRACT

This study empirically analyzed the effects of social network, trust, and co-operation on the fishery management consciousness of small-scale fishers in the Philippines. Data were obtained through a survey of 467 fishing households living in the municipalities of Altavas, Batan, and New Washington around the Batan Estuary in Central Philippines in 2012. Structural equation modeling was applied to estimate the relationship between the social capital variables and fishery management consciousness. Chi-square test and fit indices indicated that the model fitted the data in every municipality. The results showed that network variables had significant effects in Altavas, while trust and co-operation had significant effects in Batan. In New Washington, network, trust, and co-operation all had significant effects. A bridging network demonstrated a significant negative effect in Altavas, which suggested negative effects of social capital in the fishery management context. The differences in the effect of social capital components appear to depend on whether the type of management practiced by the municipality is top-down or bottom-up.

1. Introduction

Co-management has been broadly recognized as an effective regime for fishery management in Southeast Asia. Co-management is defined as "a sharing of responsibility and authority for resource management between the government and the local resource users/community" [1]. Its advantages include the utilization of local or indigenous knowledge to supplement scientific information, help monitor resources, and improve overall management through fishers' participation [1]. Gutiérrez et al. [2] examined the determinants of co-management success through a meta-analysis of 130 co-management cases in 44 countries. They found that social capital is the most important factor to improve co-management performance. Social capital is defined as "features of a social organization, such as networks, norms, and social trust, which facilitate coordination and co-operation for mutual benefit" [3]. Those in a formalized group with high social capital can confidently invest in the collective action of natural resource management, as they know that others in the group will also do so [4].

Conceptual and qualitative studies have reported social capital's important roles in successful fishery management [5–10]. However, qualitative analysis has several limitations, as it cannot clarify which social capital component significantly influences fishery management, or which is the most influential. Therefore, quantitative studies are needed to know whether social capital components play different roles in fishery management, or which to focus on and enhance to improve fishery management.

A limited number of studies have quantitatively analyzed social capital's effects on fishery management. Marín and Berkes [11] analyzed the relationship between social capital and management performances of Chilean fishers' organizations. The ANOVA's result demonstrated that fishers' organizations with high-level social networks have high management performance. However, the effects of trust and norms have not been clarified, as the authors only included social networks in their analysis. Zanetell and Knuth [12] performed a path analysis to investigate factors that affect fishers' willingness to participate in community-based management in a Venezuelan fishing village. Results show that the observed variable "sense of community" has a significant positive effect on fishers' willingness to participate in management.

* Corresponding author.
E-mail addresses: rkamiyama@affrc.go.jp (R. Kamiyama), tmiyata@affrc.go.jp (T. Miyata), agferrer@upv.edu.ph (A.J.G. Ferrer), akrkrh@outlook.jp (H. Kurokura), oounagi@chikyu.ac.jp (S. Ishikawa).

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This sense of community is considered a proxy variable of social capital, as it comprises a common latent factor with other observed variables including social networks and mutual help, according to their factor analysis. Although this approach included social networks and other social capital components, it did not test the differences in each component's effect. Holland et al. [13] examined the relationship between fisheries' economic performance and social capital components, including trust, information sharing, and networks. This study performed a correlation analysis, but did not analyze causal relationships. Hence, social capital's effect on fishery management must be revealed with a study that quantitatively analyzes the causal relationships between fishery management and social capital components, such as networks, trust, and co-operation.

This study aims to clarify the effect of social capital components on fishery management using a quantitative analysis of villages in the Batan Estuary in the Philippines. As no model has been established regarding the relationship between social capital and fishery management, a hypothetical model was constructed based on previous studies. Schumann [14] found that some Chilean shell fishers possess a high sense of responsibility and consciousness for resource conservation, which was acquired through an organization for fishery co-management. Thus, a model based on social capital's enhancement of fishers' management consciousness was assumed. This results in higher compliance and more enthusiasm in management.

Measuring consciousness was difficult, as it is both invisible and unobservable; thus, structural equation modeling (SEM) was considered as a suitable method in our study. This method can assume model's latent variables and analyze the relationship between them, or between them and observed variables. Hence, SEM allows for flexible modeling that reflects the researchers' hypothesis. These advantages enabled us to quantitatively analyze the relationships between fishery management consciousness and social capital variables. No prior study has applied SEM to analyze the relationship between fishery management and social capital.

2. Materials and methods

2.1. Model

Fig. 1 illustrates our hypothetical model. The model shows that social capital enhances fishery management consciousness of fishers, resulting in higher compliance and activity in management, which follows Schumann [14].

Observed social capital variables include the bonding network, bridging network, network quality, trust, and co-operation. According to Grafton [5], social capital has three distinct areas, and each has a different role in fishery management (see Table 1). Social networks are separated into three types: bonding, bridging, and linking networks. Bonding networks involve linkages within groups of like-minded individuals, while bridging networks relate to linkages between groups. Linking networks are another type of bridging network, which refers to the vertical linkages between upper and lower components in a hierarchy. Trust plays a major role in reducing management costs. Civic engagements and co-operation refer to fishers' participation in management and co-operative behavior among them, as well as between fishers and regulators. They contribute to conflict resolution, information sharing, and responsibility devolution in fishery management. Bonding and bridging networks are often measured by counting the number of organizations that study participants belong to and by inquiring as to the frequency of interactions with others. Fiorillo and Sabatini [15] criticized that those variables do not reflect social networks' qualitative aspect, only the quantitative aspect. Moreover, they quantitatively analyzed the effects of networks' qualitative and quantitative factors on human health, and concluded that qualitative factors can be superior predictors. Therefore, network quality was added as another network factor in our model.

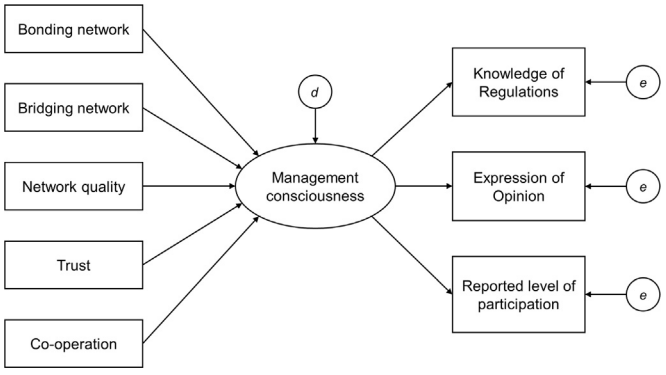

Fig. 1. Structural equation model showing relationships among social capital variables, fishery management consciousness, and observed variables of this consciousness. The rectangles signify the observed variables, and an ellipse denotes a latent variable. e = error; d = disturbance.

Table 1
Areas of social capital and their roles in fishery management.

Area of social capital	Role
Social Networks	
Bonding	• Enhancing trust and civic engagement within a group.
Bridging	• Enhancing information exchanges and co-operation between groups.
Linking	• Enhancing co-operation between fishers and regulators.
Trust	• Reducing the costs of fishery management (e.g., monitoring).
Civic Engagement and Co-operation	• Enhancing the ability to resolve conflicts among fishers. • Increasing the level of information pooling and sharing. • Devolution of the responsibilities between the regulator and fishers.

Note: This table was adapted from Grafton (2005).

Three observed variables of fishery management were included: the reported level of participation in management, the frequency of opinions expressed in management meetings, and knowledge of fishery management regulations. Observed fishery management variables construct the latent variable of fishery management consciousness in our model. This reflects our premise that higher consciousness in fishery management leads to higher activity in management.

2.2. Study site

The Philippines is a major fishing country globally, producing more than 2.3 million tons from capture fisheries in 2012, which was the tenth largest worldwide and the fourth in Southeast Asia (FAO: http://www.fao.org/fishery/statistics/en "Accessed Nov 7, 2016"). One feature of the Philippines' fisheries is the importance of small-scale fisheries in the coastal area's production and livelihood, which is common in developing countries [16]. According to the national statistics (BFAR HP: http://www.bfar.da.gov.ph/publication "Accessed Nov 7, 2016"), 55% of the capture production in 2012 was produced by the small-scale fishery sector, and 99% of the country's 1.4 million fishers were small-scale fishers. Another feature of the Philippines' fisheries is rich experience in fishery co-management, as the Philippines has worked on this since the 1980s [17].

The Batan Estuary is located in the Western Visayas (Fig. 2), which had the largest small-scale fishery production in value terms in the Philippines in 2012, according to national statistics. More than ten types of fishing gears including stationary gears and mobile gears are