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Can environment management integrate into supply chain management? Information sharing via shrimp aquaculture cooperatives in northwestern Sri Lanka

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ABSTRACT

This paper examines the effects of information sharing via community cooperatives on supply chain management (SCM) in community-based shrimp aquaculture in northwestern Sri Lanka. Further, it identifies how environment management integrates into SCM. The paper examined shrimp aquaculture operations in northwestern Sri Lanka using the case study approach. Main actors of the shrimp aquaculture supply chain (SC) are: brood-stock suppliers; hatcheries; farmers; collectors; and processing companies. Information shared is: post-larvae prices; feed brands; harvest prices; production quotas; disease spread; farming techniques; and management practices. This paper explores the existing information sharing network. Its findings reveal that community cooperatives play crucial roles within this network while functioning under a mixed governance regime (private; communal; government). Membership gives farmers a mechanism for networking and accessing information. This article discusses how such information can act as commons. An efficient network of information sharing is vital for the community's socio-economic wellbeing, as well as social-ecological sustainability. Sri Lankan shrimp aquaculture exemplifies SCM that integrates environment and commons management.

1. Introduction

Aquaculture performs an emergent role in global food supply chains. Wild fish stock depletion and a growing demand for seafood are major reasons for reliance on aquaculture [1]. Supply chain management (SCM) plays a significant role in getting seafood from pond to place at a reasonable price, with the best quality, and without interruptions. Shrimp aquaculture is a unique sector for SCM because of its high value, production-related uncertainty, and shrimp supply chain (SC) perishability [2,3]. Contrarily, global shrimp aquaculture has a bad reputation in terms of environment and social sustainability [4–7]. Sri Lankan shrimp aquaculture is governed by community cooperatives with minimal adverse environmental impacts [8–10]. This paper examining small-scale shrimp aquaculture communities on the Indian Ocean in northwestern Sri Lanka. Can environment management integrate into shrimp aquaculture SCM? Can effective information sharing on SC be attained through community cooperatives? Such questions have theoretical significance for SCM as well as commons management, and practical importance for sustainable aquaculture. This paper examines the effects of information sharing through community cooperatives on SCM in community-based shrimp aquaculture in northwestern Sri Lanka.

SC is "a network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services delivered to the ultimate consumer" [11: 3]. An SC consists of multiple firms, both upstream (i.e., supply) and downstream (i.e., distribution), and the ultimate consumer. SCM highlights the long-term benefit of the chain's actors [12]. SCM's concern is "how to coordinate the independent players, so that they work together as a unit, in the pursuit of the common goal of changing market conditions" [13: 344]. Collaboration among SC's actors uses limited resources and attempts to coordinate production through the entire SC [14,15]. The "bullwhip effect"—originally applied to information distortion in SC—explains the aggregated impact along the SC [16].

In literature, debates exist about information and knowledge sharing in SC. Knowledge in the SCM context is valuable and

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actionable information [12,17]. Knowledge enables predictions or predictive decisions. Information simply gives us facts. Knowledge's primary elements are data—unrelated facts that have their own values. Data combined and placed in a context create information. When information goes through a critical and creative thought process, it becomes knowledge [12,18]. In a business context, both information and knowledge sharing are combinable and interchangeable. Therefore, this paper used the term "information sharing." Information sharing is a collaborative effort, as communication involves the information provider and seeker [19,20]. Benkler [21] identified information as a public good in a strict economic sense; information is also input into its own production process. Further, Benkler [21] recognized the possibility of communication systems managed as commons.

This article focus on information sharing through community cooperatives for shrimp aquaculture resource management activities affecting SCM. Collectively managed resources can work better than privately or government-managed resources [22,23], and "collective action" can solve commons problems better than individual solutions [23]. Cooperatives are locally/member-owned, collectively managed entities that affect community wellbeing [24,25]. Sri Lankan shrimp aquaculture management relies on community cooperatives and a multi-level institutional structure that serves as the governance system's backbone [8]. Cooperatives are significant components of the community-based management system in northwestern shrimp aquaculture [9], adopting commons and collaborative management approaches for challenges like shrimp disease [9,10].

In theory, commons institutions like community cooperatives can solve the commons problem [8,26]. Such institutions address basic issues, i.e., the "tragedy of commons" [9,26-28], which describes how individual freedom to access the commons causes the system to fail [28]. The tragedy starts in an aquaculture context due to excessive use and/or misuse of environmental resources as inputs and waste discharge (mainly used pond water) to the surrounding environment [9,10,29]. However, the commons' scope is broad [30]. Charlotte Hess [31] identified evolving commons types as "new commons"—cultural; medical and health; neighbourhood; knowledge; markets; and global. Some literature even compares information commons to library commons and/or digital commons [32,33].

SCM integrates environment management into SC, and researchers recognize the best practice called green supply chain integration (GSCI) [34]. Literature acknowledges the significance of combined environment management into SC [34,35]. Community green supply chain integration stems from studies of community stakeholder pressures [34,36,37]. Community GSCI is a strategic collaboration with stakeholders in an SC to manage the SC's operational/environmental impact by orchestrating resources across community stakeholders [34]. Wong et al. [34] highlighted the significance of feedback information of community stakeholders. Further, feedback information is the key resource for community GSCI practices. So far there is no or little evidence available on community GSCI in shrimp aquaculture SC; the Sri Lankan case study could be one to look at.

The dominant aquaculture operation in Sri Lanka involves coastal shrimp [38]. The most common species cultured is black tiger shrimp (*Penaeus monodon*). The industry produces more than 2000 tons annually, with a farm gate value of about $70 million [38]. It provides more than 1000 direct jobs and about 1800 indirect jobs [39]. Export markets are Japan, the U.K., and the U.S. However, local markets are also part of shrimp aquaculture SC. Compared to the global shrimp industry, Sri Lanka leads the world in productivity, with an average yield of more than 4500 kg per hectare [40]. The industry contains medium and small companies [8]. As of 2012, shrimp farming is found mainly in the northwestern and eastern coastal belts, covering more than 5000 hectares [41].

Operations depend on the environment. A particular soil is required to establish a shrimp pond. The soil's rich nutrient content facilitates better algae growth [42], resulting in a healthy aquatic system. Water is an equally important resource. The area's primary water source is the "Dutch canal," which contains brackish water (a mix of salt and fresh water). It runs from south to north and connects several salt water lagoons and fresh water rivers, forming a common water body. Galappaththi and Berkes [9,10] explain how shrimp farmers manage this common water body as commons. Farmers who have no access to this water use pumped salt water from the sea and/or a lagoon and groundwater from tube wells.

2. Methods and study area

The study adopted a qualitative design with a case study approach [43,44] and was conducted in the Muthupanthiya, Koththanthive, and Karamba communities of northwestern Sri Lanka (Fig. 1). Participants were selected using the snowball sampling technique due to the absence of a proper sampling frame. Primary data were collected through: a) questionnaire-based interviews with shrimp farmers and other stakeholders (e.g., feed suppliers, hatchery managers, government aquaculture extension officers); b) key informant interviews; and c) participant observations. The sample contained 53 stakeholders, including 35 shrimp farmers (Muthupanthiya, 11; Koththanthive, 14; Karamba, 10). Five key informant interviews were undertaken for data verification purposes. Primary data collection took place from September 2008 through December 2009. From April to August 2012, the communities were re-visited to gather supplementary data.

3. Results

3.1. Supply chain overview of shrimp aquaculture

Fig. 2 provides an overview of the Sri Lankan shrimp aquaculture SC. Several stages and players are involved. Parent shrimp (i.e., brood stock) of sizes appropriate for breeding are caught from

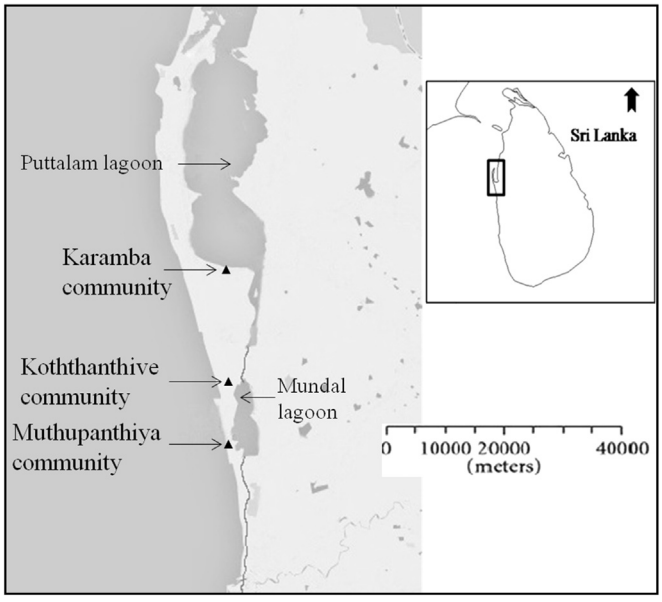

Fig. 1. Study area in northwestern Sri Lanka.