Impacts on the ecosystem and human well-being of the marine protected area in Cu Lao Cham, Vietnam

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ABSTRACT

Biodiversity conservation can alter the ecosystems and ecosystem services that are vital for human well-being. Understanding this linkage is essential for management planning to enhance the conservation and sustainable use of ecosystems and their values to human well-being. This study evaluates the impacts of coral reef conservation and marine protected areas (MPAs) on the well-being of fishing communities in Central Vietnam. The Cu Lao Cham MPA is chosen as the case study. Coral reef health and four aspects of human well-being (i.e., catch rate [also related to food security], access to the resource, employment, and income) are investigated following the protection in this MPA. Data on the four different aspects were gathered from different sources. The results show that there is good evidence for how coral reef conservation can transfer the flow of benefits from the ecosystem to local people. However, trade-offs also occur as a result of the development of tourism, including the degradation of fish resources and the environment. The managers of the MPA and the community should take into account trade-offs in resource management and should focus on appropriate MPA planning and fisheries management outside the MPA to achieve better outcomes for coral reef ecosystems and the present and future needs of the local community.

1. Introduction

The identification and evaluation of the linkage between biodiversity conservation, ecosystem services and human well-being are becoming important components of ecosystem management. Better communication of this kind of information can help to respond to the needs of policy makers and ensure ecosystem sustainability. Among different types of ecosystems, coral reefs support the highest marine biodiversity in the world [18]. Coral reefs are home to 25% of marine life and this ecosystem provide directly food security, income and variety of benefits to people [18,21]. Understanding the crucial linkage between conservation efforts and changes in coral reef services that contribute into well-being can help conserve the reef ecosystems, the services they provide and improve human well-being and sustainable development.

Coral reefs in Vietnam are diverse ecosystems that support valuable ecosystem goods including marine products and services such as fisheries habitat, tourism, and coastal protection. Services from coral reef ecosystem support people are identified by stakeholders who encompass all four types of ecosystem services including support, provisioning (food), regulating (climate, food regulation), and cultural. The annual value of goods and services produced by coral reefs in Vietnam is estimated to be about USD 100 million. Fish equivalent to a value of USD 10,000 [35] can be provided by just 1 km² of coral reef. However, of the 1300 km² of coral reef found along the coast of Vietnam, only 1% is in good condition. Coral coverage has declined to only 30% in some areas in the period 1993–2004 [35].

Marine protected areas (MPAs), which limits or prohibits people’s extractive activities inside their boundaries, are considered to be a resource management tool that can be used to slow down and eventually reverse the degradation of coral reef and coastal ecosystems. Globally, scientists have recognized the value of MPAs, especially no-take marine reserves, in improving marine ecosystem health, including the viability of fisheries [27]. Furthermore, MPAs can help to support alternative livelihoods by promoting the sustainable use of coastal resources [1]. Science-based MPA planning is underway in many countries, with positive results for communities and the ecosystems on which they depend [38].

Vietnam approved a plan to establish a network of 16 MPAs with a total area of 270,000 ha from north to south of the country which aims to address the Biodiversity Action Plans. Currently, Vietnam has a total of nine MPAs. The main objectives of these MPAs are to conserve biodiversity and to improve the livelihoods of local people. Almost all MPAs aim to conserve coral reef and sea grass. However, despite the 15-year history of MPAs in Vietnam, there have been a limited number of separate assessments of their biological and social perspectives, and
there have not been any comprehensive evaluations of the management effectiveness of MPAs and the contribution of coral reef conservation to human well-being [29]. The impact of coral reef conservation and MPAs on human well-being is a scientific question of critical policy importance. MPAs influence the quantity and type of benefits that flow from coral reef ecosystems, as well as the distribution of these benefits among social groups [22]. These effects include the abundance and diversity of fish, the amount of fish caught and the associated level of effort, the income earned by fishers from fishing and by other social groups that do not harvest fish, and the distribution of benefits within and amongst user groups [13,14].

Coral reef conservation and MPAs should be evaluated both in terms of their contribution to improving ecological function and human well-being. This incorporates the relationships between MPA implementation, coral reef health, fisher responses, and consequential impacts on the geographical distribution of fishing activities and fishing income. In this study, the effectiveness of enforcement of MPA regulation is also investigated. As such, it is important to address some key but basic questions: i) How does biodiversity conservation by MPAs affect coral reef health? ii) How does the MPA affects the well-being of local fishers? iii) What is the impact of the MPA on ecological and socio-economic benefits under fishers' perception?

To evaluate ecological and social impacts of MPAs, this paper uses Cu Lao Cham MPA as a case study. Cu Lao Cham MPA is a good model for management and conservation of biodiversity and is the pilot project for other MPAs in Vietnam. Cu Lao Cham MPA and Hoi An city were also recognized by the UNESCO as a world biosphere reserve in 2009 because of the city's unique relationship with the estuary and its reliance on local mangrove, seagrass, and coral reef habitats.

Small-scale fisheries in Cu Lao Cham Island will be investigated, which are of the most relevance to the coastal poor and provides valuable protein and livelihood options and economic opportunities for local people. Fisheries are an important component of economic wealth and can have an important role in economic growth and poverty alleviation.

The study is organized as follows: Section 2 provides the policy contexts for coral reef conservation and MPA. Section 3 describes the linkage between coral reefs and human well-being and the analytical framework of the study. Section 4 describes the methodology. Section 5 presents the key results. Finally, Section 6 concludes with a discussion of implication of the findings for management of MPA and coral reefs.

2. Policy contexts

Thanks to the richness of biodiversity, Vietnam is recognized as one of the countries where the biodiversity conservation should be prioritized. Vietnam became a signatory to the United Nations Convention on Biological Diversity (CBD) in 1994. The Government of Vietnam has made a substantial investment of both human and financial resources to implement its commitments and obligations under the Convention.

Vietnam's first National Biodiversity Action Plan (NBAP) was approved by the Prime Minister in 1995. This was followed by the National Biodiversity Strategy 2010–2020, which was intended to be the means of implementing the Convention on Biodiversity and the Cartagena Protocol on Biosafety, which was approved by the Prime Minister on 31 May 2007. Its targets were considered consistent with the nation's socioeconomic development at that time. On 31 July 2013, the Prime Minister approved Decision No. 1250/Q.TK. Ngoc

of both Ministries and agencies will be vital for long-term biodiversity conservation.

One of the targets of NBSAP 2013 is to expand and improve the quality of management of terrestrial protected areas (TPAs) and marine protected areas (MPAs), and to conserve ecosystems that are of national and international importance. In order to achieve this target, NBSAP 2013 suggests specific action plans, which include (1) conducting research; (2) developing guidelines and piloting the economic valuation of biodiversity and ecosystem services; and (3) determining the size, scope and implementation of measures to protect and restore the ecosystems of coral reefs on a national scale, with the aim of restoring at least 15% of degraded critical ecosystems.

3. Analytical framework

3.1. Well-being from a fisheries perspective

Improving the well-being of fishing communities is a key objective of fisheries governance [9,25]. Human well-being, as defined in the [26], has five interrelated dimensions: access to basic materials, freedom and choice, human health, social relations and social capital, and security. The MEA framework also provides the ways that ecosystem services support human well-being. In assessing the well-being of fishing communities, broad-based outcomes are considered, which focus on material goals and non-material life goals. For material goals, catch, food supplies, and employment are the key indicators. Regarding non-material goals, working conditions, community involvement in fisheries or the preservation of the ecological value of marine and coastal ecosystems can represent well-being [10,12].

The well-being of fishing communities should be studied by integrated assessment frameworks [11] that combine comprehensive concepts ranging from human dimensions to ecological ones and governance within fishery social-ecological systems. By providing a multi-dimensional perspective, well-being assessment can also contribute to fishery governance by informing the implementation of fishery management instruments and improving the assessment of management options.

3.2. Links between coral reef conservation, MPAs, and well-being

Links between coral reef conservation and MPAs can affect the well-being of fishing communities in many ways. By protecting the coral reef from human extraction, coral cover and fish abundance inside MPAs can be maintained or increased, which leads to an increase in fish abundance outside MPAs and higher catches for fishers [2,39]. A larger catch can, in turn, increase fish consumption and income for fishing households. However, MPAs can also impact on fishing behavior due to the fact that the fishers are not allowed to fish inside the MPA so they have to find new places to fish, leading to a decrease in the area they can fish [2,31,39].

In this study, based on [22] and the [26], the ecological and socioeconomic issues related to MPA implementation will be investigated, including coral reef health and the four aspects of human well-being: catch per unit of effort (CPUE) (also related to food security), access to resources (choice of fishing location, effort put into relocation), employment (number of fishers, changing occupation structure), and income (earning capability from fishing) (Fig. 1). These indicators are also considered to be impacts of MPAs through coral reef conservation on human well-being.

4. Methodology

4.1. Background of the study area and its fisheries

Cu Lao Cham in Quang Nam province is located in Central Vietnam. This province covers a large area compared to others in the Central
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