

Sustainability Indicators For Fishery Management In Songkhla Lake, Thailand¹

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ABSTRACT

This paper describes the development of a set of indicators for monitoring sustainable fishery management in Songkhla Lake, Thailand. Data and information for developing these indicators were collected through questionnaires administered to fishermen, interviews of other stakeholders, and focus group discussions among experts. The results revealed ten significant monitoring indicators, which are grouped into four categories - five ecological, one economic, two community, and two legal and institutional. They were selected so as to obtain the minimum number of indicators and to obtain indicators that are understandable, applicable, precise, sensitive, and linked to sustainability. They are expected to provide a useful tool for supporting the decision-making process of relevant organizations and achieving sustainable fishery management in Songkhla Lake.

Keywords: Indicators; Sustainable Fishery; Songkhla Lake

1. INTRODUCTION

1.1 Overview

Fishery resources have long been a crucial source of food for hundreds of millions people worldwide. The Food and Agriculture Organization (FAO) of the United Nations reported that in 2005, fish was the sole source of protein for 80-90 million people in developing countries. The global marine catch increased from 16.7 million tons/year in 1950 to 62 million tons/year in 1989 and 84.4 million tons/year in 2002. However, it decreased to 80 million tons/year in 2008. It has become clear that global fishery resources have been overexploited (Hosch et al., 2011; Srinivasan et al., 2012; Ukwe et al., 2006). In fact, the catch has been about 30% over capacity (FAO, 2012). This is attributed to a lack of effective management (Coulthard et al., 2011) and continuing competition for fishery resources (Pomeroya et al., 2007). The marine catch has been intensive, even in the deep sea (Norse et al., 2012). Moreover, fishery resources have also been depleted as a result of household and industrial pollution (Ukwe et al., 2006). World fishery resources are now reaching the tipping point and appear to be unsustainable, and Thailand is no exception. Overfishing of both pelagic and demersal fishes has been observed since 1987 (Tokrisna, 2005).

1.2 Songkhla Lake and Fishery

Songkhla Lake is the largest lagoon lake in Thailand and is located near the east coast of southern Thailand. It has an area of 1,042 km² and consists of four parts: 1) a freshwater lake called Thale Noi in the northern part, 2) Upper Songkhla Lake, 3) Middle Songkhla Lake, and 4) Lower Songkhla Lake which connects to the Gulf of Thailand (Sirichai & Doungsuwan, 2009) (see Figure 1). The marine catch obtained using 15 types of fishing gear totaled 9,634 tons/year in 1995, which was 21.63% less than the catch in 1985 (Choonhapran, 1996). A fish landing survey conducted in 50 ports around Songkhla Lake during 2003-2009 by the National Institute of Coastal

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Aquaculture (NICA) showed that approximately 100 species of fish were landed; the catches of 27 species increased, whereas those of 53 species decreased, and the catches of the other species remained stable. The study revealed that in tonnage, the catch decreased from 1,380,694 Kg in 2003 to 1,013,526 Kg in 2009, a decrease of 26% (NICA, 2010).

The development of indicators for monitoring sustainable fishery management will enhance coordination, information sharing, and conflict resolution among different sectors. Moreover, these indicators can be used by policy-making agencies to formulate strategies for fishery management in Songkhla Lake.

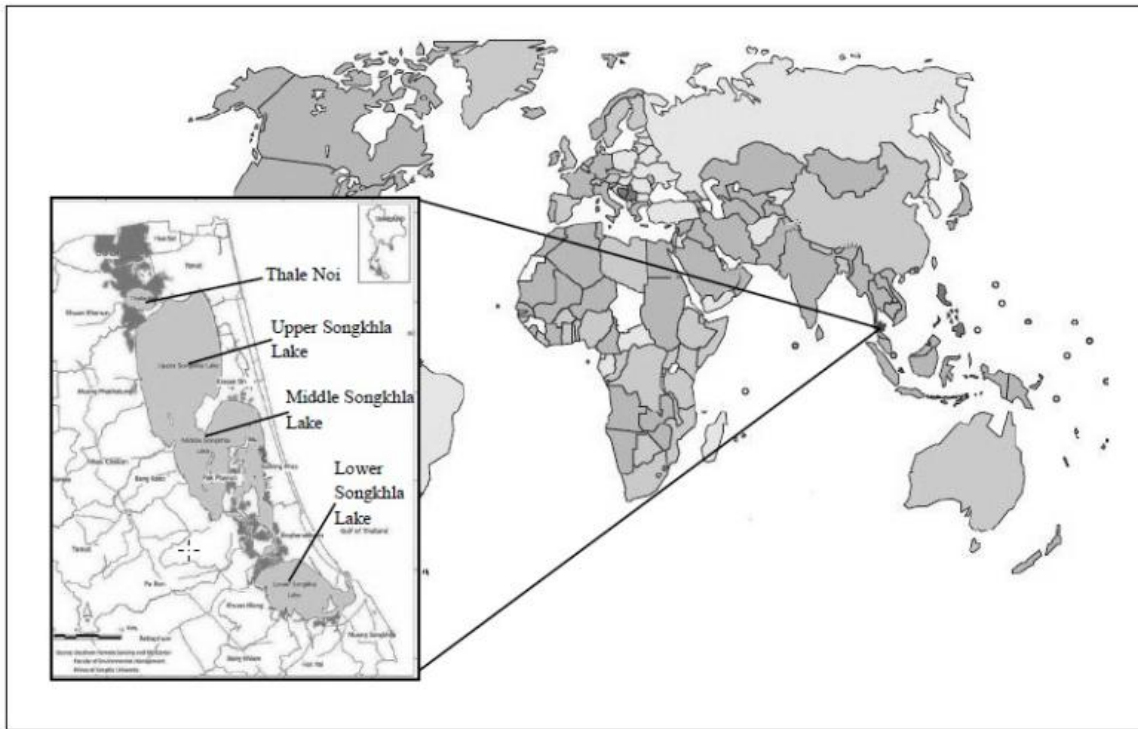


Figure 1: Songkhla Lake’s Four Components

1.3 Sustainable Fisheries

FAO defined fishery sustainability as *"the balance of fishery resource conservation with human needs"* (FAO, 1999). An important framework for sustainable management of fishery resources is the Code of Conduct for Responsible Fisheries, which emphasizes the balance between the environment and human needs. The main components of the framework are fishery management, fishing operations, aquaculture development, integration of fisheries into coastal management, the fishery industry and trade, and fishery research (Garcia & Staples, 2000). Charles (2001) and Fletcher (2002) also noted that sustainability factors for fisheries include the richness of fishery resources, human well-being, and effective management of fishery resources.

1.4 Development of Indicators for a Sustainable Fishery

The indicators for a sustainable fishery should demonstrate causes and effects, the fishery status, and the development of the fishery system. They can be used to assess the quality and efficiency of fishery and aquaculture resource management in order to improve policy-making regarding fishery system management (Gallic, 2002; Zenetos et al., 2002; Raakjaer et al., 2007). They provide a useful tool for assessing the efficiency of policies related to fishery management at all levels, evaluating progress on developing sustainable fishery processes, and increasing the quality of communication, transparency, and responsibility in fishery management, as well as monitoring and assessing fishery sustainability (Vandermeulen, 1998; FAO, 1999; Gallic, 2002; Boyd & Charles, 2006).

Four aspects of fishery sustainability must meet sustainable development requirements - ecosystem, socio-economic, community, and institutional sustainability (Charles, 1994). These aspects were used as the framework for developing the indicators. Important criteria include understandability, ease of measurement, accuracy, reasonableness and practicability, acceptability, and emphasis at the policy level (FAO, 1999; Garcia et al., 2000; Boyd & Charles, 2006; UNESCO, 2006).

The FAO (1999) summarizes a two-step process for developing sustainability indicators. The first step is to determine the scope and identify the measured criteria in general terms. The second step is to develop and apply the indicators. The information used to develop the indicators consists of qualitative and quantitative data from questionnaire surveys, the opinion of experts and stakeholders, and the traditional knowledge of communities.

2. OBJECTIVE AND METHODS

2.1 Objective

This research is aimed at developing indicators of sustainable fishing and to propose policy recommendation for fishery management in Songkhla Lake.

2.2 Methodology

2.2.1 Data Collection

1. Questionnaire surveys of 200 fishing households in 21 sub-districts around Songkhla Lake were conducted in 2010. The interviewees were randomly sampled from 3,326 fisherman households.
2. Semi-structured interviews of 16 representatives of academia, government organizations, non-government organizations, and fisherman mainstays were conducted in 2009. The purpose of these interviews was to gather information concerning the status of the Songkhla Lake fishery, recommendations for fishery management, and sustainability indicators.
3. Three focus group discussions among 18 individuals with expertise in four areas (five experts on environmental issues, two on economic issues, six on socio-community issues, and four on policy and institutional issues) were conducted. The purpose of these discussions was to brainstorm the status of the Songkhla Lake fishery, develop the indicators, verify the indicators and measurement method, and select the indicators.

2.2.2 Analysis and Selection of Indicators

The data collected by the questionnaire survey were analyzed using descriptive statistics. The data collected in interviews and expert meetings were analyzed, interpreted, and summarized and then used to support the selection of the indicators.

The criteria recommended in the expert meetings, together with those from a literature review weighted according to a rubric score (Popham, 1997), were applied to indicator selection, measurement method determination, and application of the indicators in the area. They were also verified through meetings and interviews with fishermen around Songkhla Lake.

3. RESULTS

3.1 Criteria for Establishing Indicators

Recommendation from the experts' focus group discussions suggested that the indicators should be useful for application at local levels and capable of application at the policy level. Therefore, the criteria for the development of the indicators for Songkhla Lake were analyzed and compared to those proposed by the FAO (1999). The criteria are that the number of indicators should be minimal; they should be easy to understand and apply, linked to sustainability, and effective and precise.

3.2 Selection of Songkhla Lake's Indicators

On the basis of the results of the data collection described above, together with the weighting criteria for the selection of Songkhla Lake's indicators, ten significant indicators were identified. They are 1) catch per unit effort (CPUE), 2) salinity, 3) availability of economic aquatic animals, 4) water circulation, 5) water quality, 6) fishery productivity, 7) participation in conservation and restoration of fishery resources, 8) attitude toward fishing, 9) control of destructive fishing gear, and 10) regulation of fishing gear. The list of indicators, the measurement methods, and an explanation of each indicator were verified by fishermen through meetings and grouped into four areas - ecology, economy, community, and policy and institutional. Songkhla Lake's proposed monitoring indicators are described in detail in Table 1.

Table 1: Proposed Indicators for Sustainable Fishery in Songkhla Lake, Thailand

Sustainability Components	Indicators	Operational Definition and Units of Measurement	Data Sources
1. Ecology	1.1 Catch per unit effort (CPUE)	Catch per unit effort by shrimp traps and gill nets -Kg/day/unit of fishing gear	-NICA -MCRRC -Fishermen
	1.2 Salinity	Normal salinity in April (summer) and November (rainy season) in the lower, middle, and upper lake and Thale Noi -Parts per thousand (ppt)	-REO16 -Fishermen
	1.3 Availability of economic aquatic animals	Fishermen can catch economic aquatic animals in the lower, middle, and upper lake and Thale Noi -Number of species and quantity of aquatic animals	-NICA -Fishermen
	1.4 Water circulation	Normal water circulation in Songkhla Lake in April (summer) and November (rainy season) -Flux into and out of Songkhla Lake (m ³ /s)	-REO16 -Fishermen
	1.5 Water quality	Standard classification level of water quality from the Notification of the Ministry of Natural Resources and Environment, Thailand -Dissolved oxygen and biochemical oxygen demand (mg/l), coliform bacteria (MPN/ml)	-REO16 -Fishermen
2. Economic	Fishery productivity	Production from fishing using all fishing gear -kg/day/household	-NICA -Fishermen
3. Community	3.1 Community participation	Fishermen participate in restoration of protected coastal area of Songkhla Lake. -Area (km ²)	-NICA -Fishermen
	3.2 Attitude to fishing as an occupation	Fishermen believe that this occupation is good and want their families to be fishermen. -Percentage of fishermen	-Fishermen
4. Policy and Institutions	4.1 Control of destructive fishing gear	Authorities are ready to control destructive fishing gear, for example, push nets, electrification gear, fish poisons, and surround nets. -Times/week	-NICA -Provincial fishery offices -Fishermen
	4.2 Regulation of fishing gear	Reduced number of shrimp traps and setting of set-bag nets. -Number of shrimp traps and setting of set-bag nets	-Provincial fishery offices

Note: Abbreviation NICA: National Institute of Coastal Aquaculture, Songkhla, Thailand. MCRRC: Marine and Coastal Resource Research Center, Lower Gulf of Thailand. REO16: Regional Environmental Office No. 16

4. DISCUSSION

4.1 Overview

The significant findings of this research, including the key indicators, recommendations, and guidelines for applying these indicators, are proposed to resolve problems and achieve sustainable management of fishing in Songkhla Lake.

4.2 Indicators Specific to Songkhla Lake's Sustainable Fishery

As a result of this research, 10 indicators of sustainable fishing in Songkhla Lake were recommended. Most of them were consistent with indicators suggested by several studies conducted in other countries; for instance, fishery indicators for the Yoron island group in Japan (Adrianto et al., 2005), coastal fishery indicators for Gungliau in Taiwan (Liu, 2005), indicators for monitoring the status of fishery resources in Tam Giang-CauHai Lagoon, Vietnam (Raakjaer et al., 2007), fishery indicators for a coral reef in Kenya (Mangia et al., 2007), and fishery indicators at the community level in Canada (Boyd & Charles, 2006). Only four are specific to Songkhla Lake - the availability of economic aquatic animals, salinity, water circulation, and community participation in conservation and restoration of fishery resources.

4.3 Application of the Indicators

The indicators developed from this research are a useful tool for assessing the fishery in Songkhla Lake at the local level. They were designed to be practicable in the area. The following are the key success factors for applying these indicators.

- Establish a mechanism, such as a Songkhla Lake sustainable fishery development board, to integrate information management, planning, and cooperation among related sectors as well as to monitor fishery management. The board members should be representatives of stakeholders, including local administrative organizations, academicians, government organizations, and fishermen.
- Develop an integrated plan for sustainable fishery management in Songkhla Lake through cooperation among government organizations and related sectors. This integrated plan should consist of two parts: 1) a plan for monitoring sustainability and 2) a plan for the development of a sustainability fishery in Songkhla Lake.

5. SUMMARY

Ten indicators of sustainable fishery management in Songkhla Lake were determined. They are grouped into four categories, as follows:

- *Ecological Indicators:* These describe the physical and biological environmental qualities that support fishery resources in Songkhla Lake. They are the catch per unit effort (CPUE) by shrimp traps and gill nets, the normal salinity in Songkhla Lake, the availability of the economic aquatic animals that fishermen capture in each part of Songkhla Lake, the water quality in and around the lake, and the normal circulation of the lake which mixes freshwater, brackish water, and salt water.
- *Economic Indicators:* The income from fishery production should be sufficient for the basic needs of each fishing household.
- *Community Indicators:* These would demonstrate that fishermen are satisfied with this occupation and would like the next generation to be fishermen. In addition, they should increase their participation in the conservation and restoration of fishery resources in Songkhla Lake by expanding the protected area of the lake.
- *Institutional Indicators:* These describe effective management of fishery resources through control of destructive fishing gear, including push nets, electric fishing, and fish poisons, by appropriate restrictions imposed by the responsible organizations. In addition, the number of shrimp traps and set-bag nets should be reduced.

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