Participatory modeling for razor clam management at Don Hoi Lord Ramsar site, Thailand

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Abstract

Don Hoi Lord site is located at Mae Klong river mouth in the upper gulf of Thailand. The razor clam (*Solen regularis*) population is source of food and income for local fishermen. According to the fishermen, razor clam population is decreasing. The aim of this study is to conduct collective discussion on razor clam fishery and its management plan among stakeholders. Companion modeling approach which includes multi-agent systems (MAS) and role-playing game (RPG) was used for the study. Two rounds of RPG were organized along with MAS simulation to facilitate collective discussion. It was found that both rounds of RPG were efficient to initiate collective learning and discussion among stakeholders. In both rounds, 4 scenarios were played: I) actual harvesting situation, II) rotation of prohibited harvesting zone III) harvesting quota system and IV) maximum harvesting effort. Some scenarios for razor clam management were considered for concrete implementation in the future. Rotation of prohibited harvesting zone should be associated with harvesting quota system for fishermen. Beside, the result of the multi-agent simulation model based on both agreed scenarios indicated that the razor clam population has responded positively to these changes. Finally, these results from the study were presented to provincial administrative organization which is a policy maker for razor clam management and conservation.

KEY WORDS: Companion modeling approach, razor clam (*Solen regularis*), Ramsar site, natural resource management.

Introduction

A wetland is a complex ecosystem. There are many sub communities for all individual in the ecosystem. Generally a wetland can store rainfall, regulate ground water level, prevent seawater invasion and provide nursing ground for aquatic life as well as producing food supply for human. Ramsar Convention was established in 1971 for wetland conservation at international level. Nowadays, 1,617 wetlands are registered as Ramsar site and 10 Ramsar sites are located in Thailand (Ramsar, 2006) especially connected to coastal zone. Since a decade, many wetlands in Thailand were degraded by the effect of unsustainable development in the past.

Don Hoi Lord was registered as international wetland in 2001. Razor clam (*Solen regularis*) Thai name is Hoi Lord. It is the more numerous bivalve in the area and thus the name of this wetland is Don Hoi Lord. The number of razor clam decreases because the pressure of harvesting related to human demands and some developments in this area. There are many researches on razor clam such as life history, environmental condition of Don Hoi Lord and Social awareness for Razor clam. The objectives of all studies emphasize on conservation. Most of studies are reductionistic approaches that do not consider the integration for better problem solving or management. Numerous scientists now believe that the study of ecosystem requires a multi-disciplinary or holistic approach in order to not neglect the behavior of the social component involved in natural resource management. Modeling has become an important tool for the study of ecological system. Models provide an opportunity to explore ideas regarding ecological systems that is not be possible to field-test for logistical, political, or financial reason (Jackson *et al.*, 2000). Thus, the objective of the study was to conduct collective

discussion among stakeholders on razor clam management by using multidisciplinary research as mediation.

In this paper we firstly present the background of the study. Then, we describe the companion modeling process which was employed during the study and the results from participatory discussion. Finally, conclusions of this study are presented with future challenges for razor clam management and conservation.

Methodology

The study site

Don Hoi Lord is the 1099th Ramsar site located in Mae Klong estuary (13º 21'N 099º 59'E) in area of Samut Songkhram province, Thailand. It includes terrestrial, mangrove and water body, covering an area of 87,500 ha. Most area of Don Hoi Lord is coastal wetland and sandbar formed by accumulation of sediment around Mae Klong river mouth. It has rare and unique characteristic of natural wetland in Thailand. Especially, the sandbar near river mouth is the large habitat of razor clam and this is one of the most attractive touristic destinations due to the presence of razor clam. These bring plenty of tourists to visit there and make more demand of razor clam as delicacy for visitors.

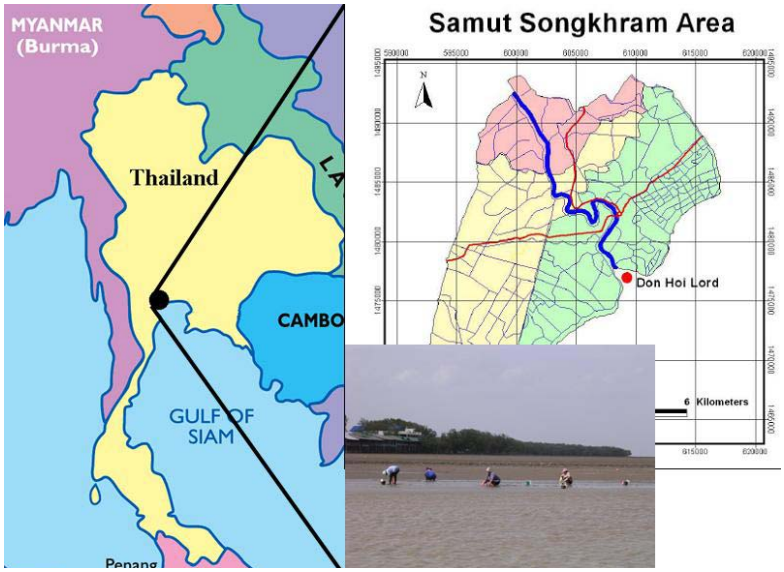

Figure 1: Don Hoi Lord Ramsar site at Samut Songkhram province, Thailand and picture show local fishermen harvesting razor clam on the sandbar.

Companion Modeling (ComMod)

According to Barreteau *et al.* (2003) the approach is based on cycling process between field and modeling studies. There are two main objectives for the approach: to learn on system or support collective decision process and to increase knowledge of stakeholders in the system for resource management.

Tools in companion modeling can accompany the collective decision-making dynamics and make stakeholders understand the studied system. For example Multi-agent systems (MAS), Role-playing game (RPG), Geographic information system (GIS), economic tools, etc. can be tools in companion modeling approach. The tool selection to be used in companion modeling depends on the context. There are some companion modeling related with MAS and RPG such as land-used and land degradation management in northern part of Thailand (Trébuil *et al.*, 2002), farmer decision making to enlarge sugar cane area in northeastern part of Thailand (Suphanchaimart *et al.*, 2003) and water sharing in Bhutan (Gurung, 2004).

Materials and methods

Companion modeling assembles different fields of knowledge to make the system studied more clear and more understandable. Likewise this study assembles razor clam population data and local fishermen behavior in razor clam harvesting. But there were missing knowledge in both components. Thus, field study was conducted to collecting more knowledge.

Field study

Field study was conducted monthly for one year. Line transects and quadrat sampling method (Kreb, 1989) was used to collect data on razor clam population. In addition, the interviewing of stakeholders including local fishermen, trader and local government were conducted simultaneously to explore human activities on razor clam population.

ComMod for Don Hoi Lord

According to the concepts of ComMod, MAS and RPG were carried out in Don Hoi Lord. The overview of ComMod of Don Hoi Lord is showed in Figure 2.

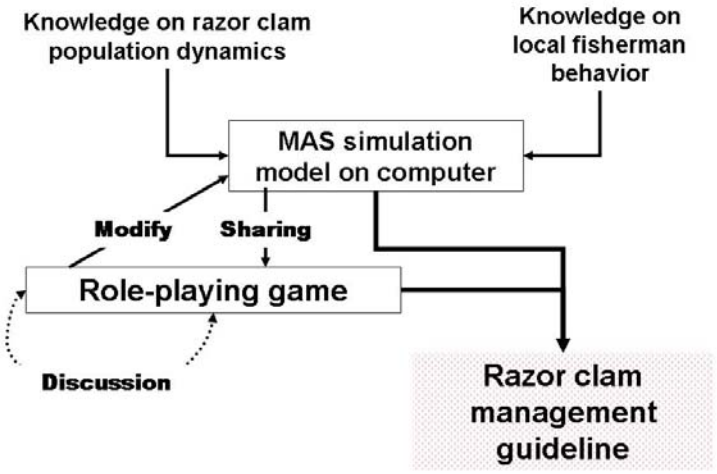

Figure 2: General principle of Don Hoi Lord ComMod.

MAS are represented in computer simulation model constructed from secondary data and data collected on the field. Then, two rounds of RPG were organized; the first RPG aimed at facilitating knowledge sharing and collective discussion among stakeholders while the second RPG aimed at presenting the results of first RPG and extend the process to new stakeholders.

Results

The results are separated in four parts related to the process 1) Multi-agent simulation model, 2) First RPG, 3) Simulation runs on agreed scenario in first RPG and 4) Second RPG.

Multi-agent simulation model

Multi-agent simulation model was constructed by integrating razor clam population data and local fishermen behavior data from interviews. The MAS conceptual model was implemented in CORMAS platform. The main interface of the simulation model shows the razor clam density which is influenced by sand gain size (presented in various colors). The local fisherman can move freely on the virtual sandbar (Figure 3) to harvest razor clam. To study the simulation model, 20 years simulation runs of razor clam density were produced. For sensitivity analysis, the suitable parameters were selected to be compared with previous study results (Pradatsundarasar *et al.,* 1989).

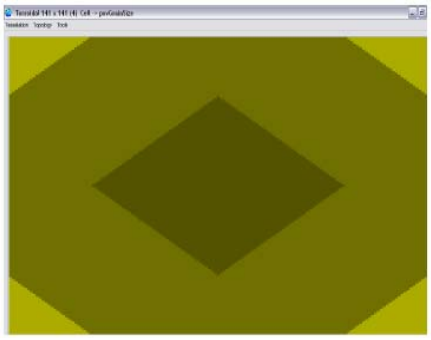

Figure 3: Simulation model interface represented virtual sandbar of Don Hoi Lord

Role-playing game

Two rounds of role-playing game in the study were organized at Chu Chi village which is located near Don Hoi Lord area. Participants in the games were local fishermen, trader, local government officers and fishery officer. In both rounds the game was separated into 2 sessions (morning and afternoon). In the morning session the game starts by playing the game, and continues with free discussion and some element of the game are modified with regards to the discussion. In the afternoon session, few simulations run are shown to stakeholders. Then, collective discussion was conducted regarding razor clam management and conservation based on results from the game.

In the role-playing game, simulation model was used as mediation element in the game. The simulation model was modified based on fisherman understanding: a topology in simulation interface was created following local fisherman harvesting area. In addition, a simulation model was used as a game board in both RPGs.

Figure 4: (A) Simulation interface as a game board, (B) local fishermen playing the game.

First role-playing game

Participants in this game are 12 local fishermen from one village and officers from local government (Tambon (District) Administrative Organization or TAO) participated as observer. Four scenarios were played in this game: first scenario is real situation in current harvesting (freely harvesting) and the other scenarios are about prohibited harvesting zone in rotation scheme in different interval time (3 months/zone, permanent closed for one zone, and 1 year/zone).

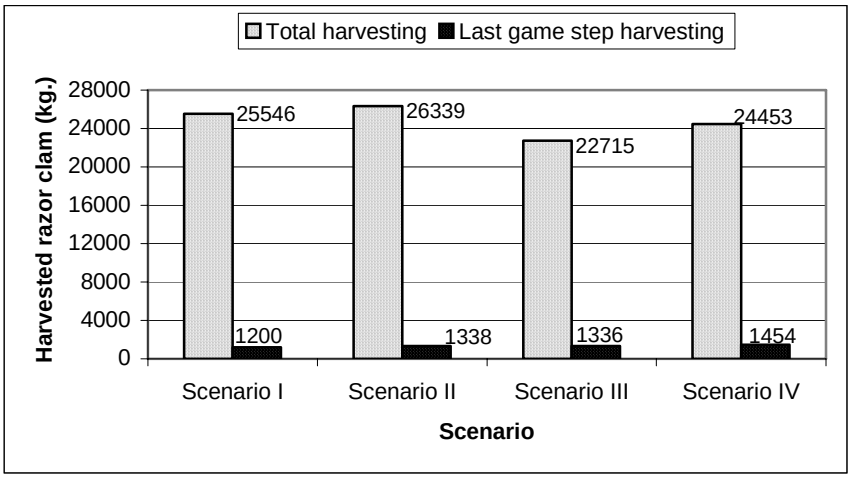

Figure 5: Total harvested razor clam from all scenarios through out the 3 steps of each game and harvested razor clam in last game step in first RPG. (Scenario I: freely harvesting, Scenario II: prohibited harvesting zone 3 months/each, Scenario III: permanent prohibited harvesting for 1 zone, and Scenario IV: prohibited harvesting zone 1 year/each).

From the result of first RPG, harvested razor clam population in scenario II is better than another scenario because each harvesting zone is prohibited for harvesting at appropriate interval time. Thus razor clam population in every area haven't disturbance and can produce offspring effectively. In addition, collective discussion with all participants indicated that scenario II is a regulation to implement in the future. However, some players and local government officer suggested that we should organize the game again and invite more players from another village which harvests razor clam. It might make a better collective discussion because razor clam resource is a free access resource.

Simulation run in relation with first RPG

Scenario II in first RPG was used in simulation run and compared with simulation run in current situation (freely harvesting). The simulation run was carried out for 20 years with various numbers of local fishermen in certain area virtual sandbar. The simulation results in scenario II indicated that razor clam population has responded positively due to consistent dynamic of population (Figure 6).

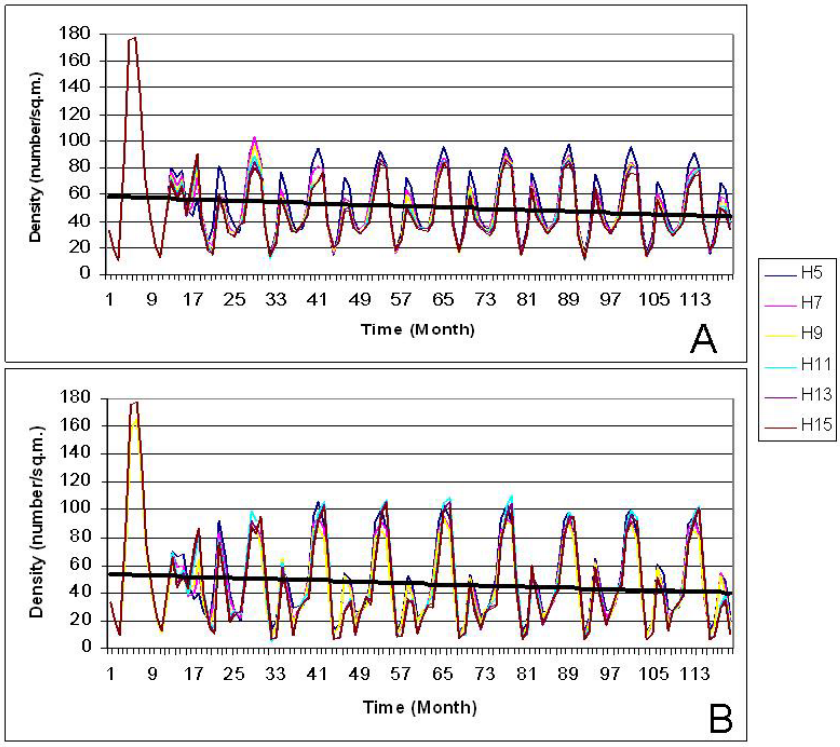

Figure 6: Comparison of simulation run between (A) rotation of prohibited harvesting zone and (B) current harvesting situation presented in density of razor clam/m^2 (H5-15: number of local fisherman 5-15 persons in the simulation).

Second role-playing game

According to a suggestion from first RPG, participants in this game consist of 10 local fishermen from 2 villages, 1 trader who directly buys razor clam from local fisherman. In addition, local government officers from 2 TAO and fishery officer participated as observer. Four scenarios were played in the game: first scenario is real situation in current harvesting (freely harvesting), second scenario was the same scenario II in first RPG, third scenario is harvesting quota system and fourth scenario is maximum harvesting effort.

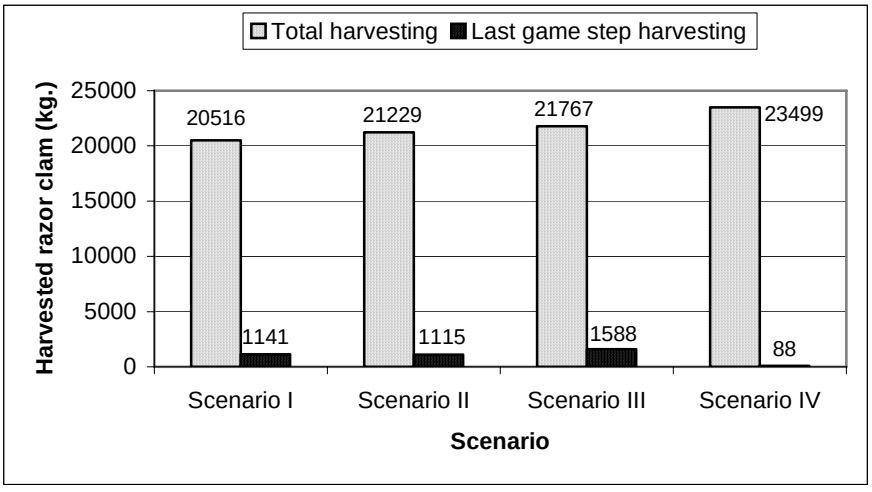

Figure 7: Harvested clam from all scenarios through out the 3 steps of each game and harvested razor clam in last game step in second RPG. (Scenario I: freely harvesting, Scenario II: prohibited harvesting zone 3 months/each, Scenario III: quota system, and Scenario IV: maximum harvesting effort.).

Regarding the results in second RPG with more stakeholders than previous game, scenario II was not more effective because some players admitted that they have learn how to maximize harvesting yield in this scenario. Maximum harvested razor clam in this game was scenario IV but the simulation used in the RPG indicated that there were no more broodstocks for the future. In addition, if the trader buys more razor clam he/she will decreases razor clam pricing that make local fisherman get less income. On the other hand, free discussion led to the agreed scenario III: it is about quota system for every local fisherman along with assuming razor clam pricing at 100 Baht/kg. The results was good for razor clam population in long term but local fishermen requested guarantee razor clam pricing if this scenario is applied in the future. However, local government officers who participated in collective discussion has been agreed in quota system and tried to take response in the way to manage razor clam resource.

Conclusions

Personal interview after second RPG indicated that companion modeling for Don Hoi Lord can make stakeholder realize the resource problem and can conduct collective discussion effectively. Furthermore, the accepted methods for razor clam management and conservation that emerged from both round of RPG is rotation of prohibited harvesting zone associated with establish harvesting quota for local fisherman. Comparing previous study (Trébuil *et al.*, 2002; Gurung, 2004) with this study: these are based on the same idea even if the difference types of resource, race and component but companion modeling can help researcher achieve objectives such as sharing knowledge, collective discussion and identified acceptable or concluded agreement to manage natural resources. During process of the games a lot of knowledge was shared between researcher and stakeholders such as razor clam population dynamics in different perceptions, histories of razor clam harvesting and management by stakeholders from the past.

Recently, research team had an opportunity to present results from this study to provincial administrative organization who is in charge in the area. Now, the policies and plan for razor clam conservation and management are processing by this organization under supporting of the provincial budget.

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