

BUILDING UP POLY-AQUACULTURE SYSTEMS IN THE MANGROVE FORESTS IN BEN TRE AND TRA VINH PROVINCES: A BLUE SOLUTION TOWARDS BLUE ECONOMY¹

Mai Sy Tuan

National University of Education, Ha Noi, Vietnam

Abstract The report presented the results, outcomes, impacts and lessons learned from MFF's 10 small grant projects in Ben Tre and Tra Vinh provinces in 2013 and 2014 with a view to gaining renewed interest in mangrove protection from leaders at different levels, and coastal communities, supporting them in forming an important strategy for adapting to climate change and sea level rise, and building resilience in coastal communities. All 10 small grant projects focused on the building of a model for sustainable aquaculture combined with forest protection and planting. Mangroves were protected and new mangroves were planted in farming ponds; reared species were diversified as well. The planted mangroves were *Rhizophora apiculata*, *Rhizophora mucronata* and *Avicennia marina*; in addition, *Scirpus littoralis* Schrad (Cyperaceae: bull rush) was planted in mud crab farming ponds. In addition to shrimp farming, mud crabs, water snail (*Cerithidea obtusa*) or blood cockle (*Anadara granosa*) were raised under forest canopy; fish was stocked as well. Poly-culture enhanced the effectiveness of mangrove-aquaculture systems and at the same time improved income and life of local people. Project results show that the implementation of mangrove based poly-culture model in the coastal districts of two provinces of Ben Tre and Tra Vinh is appropriate, meeting the demand of local people and thereby receiving their consideration and support. Local people's awareness of the importance of mangroves to aquaculture has been improved; they have no longer cut down forest trees and even planted the new ones.

XÂY DỰNG HỆ THỐNG NUÔI ĐA LOÀI TRONG RỪNG NGẬP MẶN TẠI CÁC TỈNH BẾN TRE VÀ TRÀ VINH: MỘT GIẢI PHÁP XANH HƯỚNG TỚI KINH TẾ XANH

Mai Sỹ Tuấn

Trường Đại học Giáo dục Quốc gia, Hà Nội, Việt Nam

Tóm tắt Báo cáo trình bày các kết quả, tác động và bài học kinh nghiệm từ 10 dự án tài trợ nhỏ của MFF thực hiện tại tỉnh Bến Tre và Trà Vinh trong năm 2013 và năm 2014 nhằm thu hút sự quan tâm từ các cấp lãnh đạo và các cộng đồng ven biển trong việc bảo vệ rừng ngập mặn, hỗ trợ việc hình thành một chiến lược quan trọng để đối phó với biến đổi khí hậu và nước biển dâng, và

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xây dựng khả năng phục hồi cho các cộng đồng ven biển. Tất cả 10 dự án này tập trung vào việc xây dựng một mô hình nuôi trồng thủy sản bền vững kết hợp với bảo vệ và trồng rừng. Các khu rừng ngập mặn được bảo vệ và các khu rừng ngập mặn mới với đa dạng loài được trồng tại các ao nuôi. Các loài cây ngập mặn được trồng bao gồm *Rhizophora apiculata*, *Rhizophora mucronata* và *Avicennia marina*, ngoài ra còn có *Scirpus littoralis* Schrad (Cyperaceae) được trồng trong ao nuôi cua. Ngoài nuôi tôm, còn nuôi cua, ốc sên (*Cerithidea obtusa*) hoặc sò huyết (*Anadara granosa*) dưới tán rừng; cá cũng được nuôi tại đây. Việc nuôi đa loài giúp tăng cường hiệu quả của hệ thống kết hợp rừng ngập mặn - nuôi trồng thủy sản và đồng thời cải thiện thu nhập đời sống của người dân địa phương. Kết quả dự án cho thấy rằng việc triển khai mô hình nuôi đa loài kết hợp với rừng ngập mặn tại các huyện ven biển thuộc hai tỉnh Bến Tre và Trà Vinh là phù hợp, đáp ứng được nhu cầu của người dân địa phương và từ đó thu hút được sự quan tâm và hỗ trợ từ họ. Nhận thức của người dân địa phương về tầm quan trọng của rừng ngập mặn đối với nuôi trồng thủy sản đã được cải thiện; họ đã không còn chặt cây rừng mà thậm chí còn trồng những cây mới.

I. INTRODUCTION

Adopting mangrove-aquaculture systems, or integrated mangrove-shrimp, crab, fish, etc. models was considered as effective means to contribute to protection of mangroves, minimization of the impacts from natural hazards and increase of the coastal community resilience to climate change. In the framework of the program of Mangrove and Climate Change (MCC)/ Mangrove for the Future (MFF), 10 small grant projects in Ben Tre and Tra Vinh provinces in 2013 and 2014. The objectives of the projects were:

- Resilience to climate change and natural hazards is strengthened in representative mangrove-dependent coastal communities in Viet Nam using the MFF small grant facility mechanism.

- Governance over coastal resources is improved through specific co-management, PES or similar resource-sharing mechanisms benefitting traditional coastal communities in Viet Nam.

- All countries in the MFF region are better informed about the full range of economic and environmental values of mangroves and have the knowledge to apply models of coastal resources-sharing.

II. STUDY AREA AND STUDY METHOD

1. Study area

The project was implemented in the three coastal districts of Ben Tre province and Duyen Hai district of Tra Vinh province, Viet Nam. Ben Tre province was identified as the main project field location (Fig. 1) because it has three large coastal districts vulnerable to climate change. The coastal zone of all three districts of Ben Tre consists of substantial stretches of mangroves and a buffer zone of mostly extensive shrimp and mangrove-shrimp farms interspersed with areas of horticulture exploiting exposed sand dune areas, some of which are in front of the mangroves along the coastline. The total mangrove coverage in the three districts is approximately 4,000 hectares and be located outside of a coastal sea dyke. In 2010, the tiger prawn farming area of Ben Tre was 30,252 ha (of which intensive and semi-intensive area was 4,299 hectares, accounting for 14.21% of the total tiger shrimp farming area of the province) (DARD of Ben Tre province, 2010).

Duyen Hai district in Tra Vinh province is also a vulnerable coastal district where a high incidence of poverty still persists and where off-farm employment opportunities

are very limited (Fig. 1). In recent years, surface water area for aquaculture has been increased in Duyen Hai from 22,600 hectares (1995) to 29,600 hectares (2011) (Tra Vinh Statistics Sub-department, 2012). However, intensive farming area suffering from losses due to epidemics in 2012 was 77.9%, and semi-intensive and improved extensive

areas were 55.7% and 45.6% respectively. Causes of shrimp death were not surely known, however, seemingly due to environmental degradation. As a consequence, many areas of shrimp farming were subject to continued failure and then left abandoned, resulting in serious socio-economic impacts.

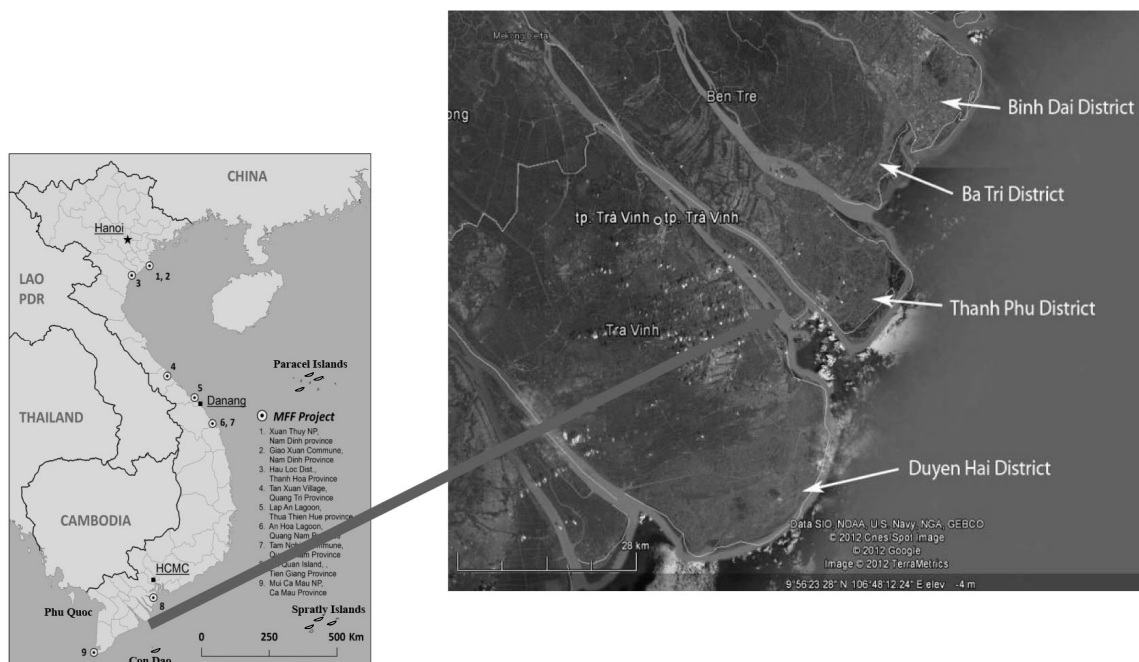


Fig. 1. Project districts in Ben Tre and Tra Vinh provinces (Source: MFF Vietnam)
Hình 1. Các huyện tham gia dự án tại các tỉnh Bến Tre và Trà Vinh (Nguồn: MFF Việt Nam)

2. Study method

10 small grant projects were established to find out a stable model of poly-aquaculture and mangrove protection (Table 1), such as: the project of poly-aquaculture model: shrimp - fish; crab - fish, shrimp - fish - blood cockle (*Anadara granosa*), snail (*Cerithidea obtuse*) - blood cockle and mud clam - (*Geloina coxans*); eco-model of combined crab-shrimp - *Scirpus littoralis* and mangroves; model of shrimp farming under mangrove canopy with the ratio of 10, 20, 30, 40 and 50%; the project of restoration of abandoned shrimp ponds by mangrove planting; the project of macro-algae control in shrimp ponds.

Observation and interview of 200 people in 4 districts were conducted with constructed questionnaire. The questionnaire contained both closed - and open-ended questions and composed of basic information about socio-economics, poly-aquaculture, uses of mangrove, attitude toward mangrove conservation and participation in mangrove conservation. Climate data, including annual average temperature, annual average rainfall and average temperature of the coldest month (January), of each study site were calculated from monthly temperature, rainfall collected from Hydrometeorological Data Center (Ministry of Natural Resources and Environment).

Table 1. The MFF small grant projects implemented in Ben Tre and Tra Vinh provinces
Bảng 1. Các dự án tài trợ nhỏ của MFF được triển khai tại các tỉnh Bến Tre và Trà Vinh

No	Project title	Grantee	Start date	Finish date
1	Community forestry management and improving mangrove based poly-aquaculture model in An Thuy commune, Ba Tri district, Ben Tre province	Ben Tre Forest Protection Unit	25 Aug. 2013	31 Jan. 2015
2	Rehabilitating the dead land form fail intensive shrimp farm through mangrove planting and aquaculture integration	Ben Tre Forest Management Board	June 2014	May 2015
3	Trial to culture snail (<i>Cerithidea obtuse</i>) and blood cockle (<i>Anadara granosa</i>) integrated in mangrove	South-West Forestry Research Center (Ca Mau)	28 April 2014	28 Feb. 2015
4	Community based environmental monitoring system to protect mangrove shrimp aquaculture	Ben Tre Aquaculture Sub-department	May 2014	April 2015
5	Supporting farmers in shrimp-crab poly-aquaculture model integrated in mangrove forest in Tra Vinh province	Tra Vinh Aquaculture Sub-department	25 Aug. 2013	30 Nov. 2014
6	Developing sustainable mangrove based polyculture model shrimp-crab-mud clam (<i>Geloina coaxans</i>) in Duyen Hai district, Tra Vinh province	Research Institute of Aquaculture	1 Aug. 2013	31 Jan. 2015
7	Supporting farmers to develop poly-aquaculture of snail-shrimp-fish and planting <i>Scirpus littoralis</i> Schrad for aquaculture natural feed	Tra Vinh Agriculture and Aquaculture Extension Center	May 2014	April 2015
8	Develop sustainable mud crab aquaculture system with mangrove protection and development for the community in Tra Vinh	Tra Vinh University	30 April 2014	31 March 2015
9	Conversion to mangrove poly-aquaculture systems from failed or extensive shrimp farms	Tra Vinh Aquaculture Association	30 April 2014	31 March 2015
10	Active management of macro-algae and increasing water exchange in extensive shrimp farms	Institute of Tropical Biology	June 2014	May 2015

III. STUDY RESULTS

In the study areas, mangroves were protected and new mangroves were planted in farming ponds; reared species were diversified as well. The planted mangroves were *Rhizophora apiculata*, *Rhizophora mucronata* and *Avicennia marina*; in addition, *Scirpus littoralis* Schrad (Cyperaceae: bull rush) was planted in mud crab farming ponds.

Project results show that the implementation of mangrove based poly-aquaculture model in the coastal districts of two provinces of Ben Tre and Tra Vinh is appropriate, meeting the demand of local people and thereby receiving their consideration and support. Local people's awareness of the importance of mangroves to aquaculture has been improved; they have no longer cut down forest trees and even planted the new ones. Even households not involved in the project learnt experiences from the project and therefore planted more mangroves in their shrimp ponds.

The major success is that all the projects were aimed toward the cooperative work among aquaculture households. Local people took initiatives actively joining in

water exchange activities for disease prevention; they exchanged experience in mangrove planting and seedling supply. The project "Community forestry management and improving mangrove based poly-aquaculture model in An Thuy commune, Ba Tri district, Ben Tre province" is a typical example. Local people have developed and implemented the "commune regulation" for forest protection combined with sustainable aquaculture. The regulation has gained the support from the majority of local people and written agreement by commune and district leadership.

All the projects set a target of increasing mangrove forest coverage to at least 30% and the target has been achieved in all projects. Some ponds had higher forest coverage, up to 50%. Farmed species were diversified in poly-aquaculture form. In addition to shrimp farming, mud crabs, water snail (*Cerithidea obtusa*) or blood cockle (*Anadara granosa*) were raised under forest canopy; fish was stocked as well. Poly-aquaculture enhanced the effectiveness of mangrove-aquaculture systems and at the same time improved income and life of local people (Table 2).

Table 2. Yields and profits in the two study areas
Bảng 2. Năng suất và lợi nhuận tại hai khu vực nghiên cứu

(Calculated for 1 ha of water surface in 2014)

Criteria	Truong Long Hoa commune	Long Vinh commune
Density		
Shrimp (individuals/ha) (Min-Max)	84,195 (55,556-138,889)	44,444 (33,333-60,000)
Crab (individuals/ha) (Min-Max)	10,011 (6,977-15,000)	12,167 (6,000-16,000)
Clam (individuals/ha) (Min-Max)	11,667 (7,000-14,000)	10,267 (5,600-14,000)
Average (kg/ha/year) (Min-Max)	602 (387-742)	1.243 (969-1,383)
Shrimp (kg/ha) (Min-Max)	107 (15-168)	52 (15-168)
Crab (kg/ha) (Min-Max)	171 (51-250)	205 (103-258)
Clam (kg/ha) (Min-Max)	52 (20-100)	526 (267-750)
Natural shrimp (kg/ha) (Min-Max)	137 (83-195)	60 (40-77)
Natural fish (kg/ha) (Min-Max)	135 (105-156)	400 (234-721)

Economic efficiency		
Total revenue (million VND/ha) (Min-Max)	68 (36-100)	110 (82-127)
Shrimp (%/total revenue)	25	20
Crab (%/total revenue)	35	30
Others (%/total revenue)	40	50
Total expenditure (million VND/ha) (Min-Max)	44 (38-49)	40 (38-43)
Profit (million VND/ha) (Min-Max)	25 (24.56-50.75)	71 (43-89)

The project “Active management of macro-algae and increase of water exchange in extensive shrimp farms” done by Institute of Tropical Biology was aimed at enhancing the techniques of water exchange for farming ponds and algal growth control which benefits farming households.

Notably, two projects with the highest perspective covered the rehabilitation of abandoned land or ineffective shrimp farming land by restoring soil, planting mangroves and carrying out mangrove poly-aquaculture systems. They were “Rehabilitating the dead land from failed intensive shrimp farm through mangrove planting and aquaculture integration” implemented by Ben Tre Forest Management Board and “Conversion to mangrove poly-aquaculture systems from failed or extensive shrimp farms” done by Tra Vinh Aquaculture Association.

The project “Supporting farmers to develop poly-aquaculture of snail-shrimp-fish and planting *Scipus littoralis* Schrad for aquaculture natural feed” done by Tra Vinh Agriculture and Aquaculture Extension Center achieved the target set out: increasing productivity of reared shrimp-crab and fish by at least 10%. However, some farming ponds under the project “Active management of macro-algae and increase of water exchange in extensive shrimp farms” were not effective; shrimps were found dead a lot due to epidemics.

Evidence was that the shrimp mortality rate was lower compared to the previous time; no phenomenon of the loss of all reared shrimps has been observed like extensive farming ponds. Harvest time was longer and cost for shrimp feed was lower. In general, the model of aquaculture

combined with forest planting is more stable than intensive farming model. Epidemics are less; the proportion of households suffering from loss is low (interviews show that on average, about 58% of households engaged in intensive farming suffered from loss due to shrimp epidemics while the figure for households engaged in this type of farming model was only about 15-20%). In addition to the earnings from reared species, natural shrimp and fish have also brought income for pond farmers.

The mangrove-based shrimp-crab-clam farming model (Fig. 2) reached 602 kg/ha/year compared to that of 176.45 kg/ha/year prior to their involvement in the project in Long Vinh and Truong Long Hoa communes.

IV. CONCLUSION

Basically, all the above projects had achieved the goals set out in spite of a number of difficulties, especially during the epidemic outbreak in the area. The success rate of each project was different; the project with the highest achievements was “Rehabilitating the dead land from failed intensive shrimp farm through mangrove planting and aquaculture integration” in Ben Tre province. The obvious successful evidence was that the environment of the farming pond had been rehabilitated; an area of 2 ha of mangroves has been newly planted and reared shrimps have reached the harvest size. Restored shrimp ponds were an example model for local households in the surrounding areas to visit and follow.

Project results showed that the building of a poly-aquaculture model – combined

shrimp - crab - fish; shrimp - clam, snail - blood cockle... under mangrove forest canopy in Ben Tre and Tra Vinh provinces is appropriate, increasing income for local people. No farming ponds showed failure and the survival rate of farmed shrimp, crabs and snails was higher compared to the previous time.

Suitable planted mangroves were *Rhizophora apiculata* and *Avicennia marina*. However, each planted species required different planting techniques. *Rhizophora apiculata* normally has thick canopies and high litterfall and therefore, it was advisable not to plant them at a dense density inhibiting sunlight to go through, especially on cold days when sunlight is

very essential to increase water temperature. *Rhizophora apiculata* should not be planted in deeply inundated places while *Avicennia marina* is able to survive in more deeply-inundated places and tolerate high salinity.

Though the results were not quite clear, it can be seen that: ponds with forest coverage of over 30% had better parameters in terms of water regime (the project “Active management of macro-algae and increase of water exchange in extensive shrimp farms” show the same results). Local people believed that the forest coverage should be at least 30%. Therefore, mangroves have been protected and further planted.

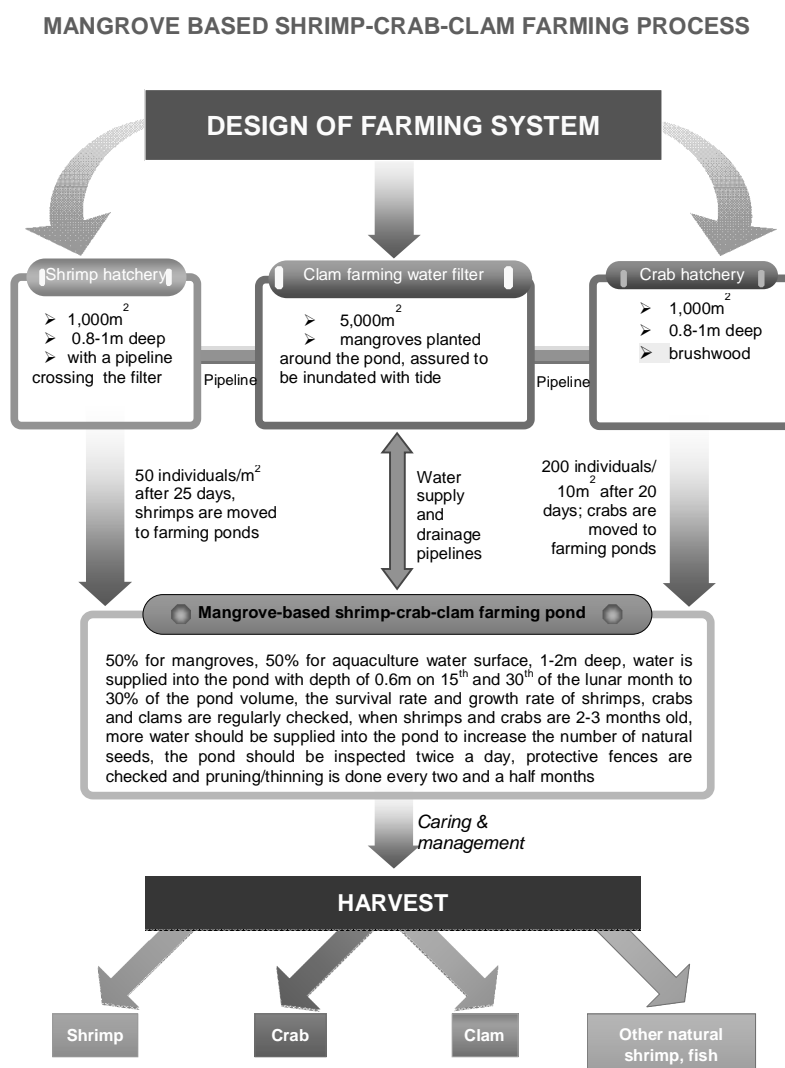


Fig. 2. The model of poly-aquaculture in the mangrove forests
Hình 2. Mô hình nuôi trồng thủy sản đa loài tại các khu rừng ngập mặn

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