Case Study 13: Mangrove Rehabilitation after Shrimp Aquaculture: A Case Study in Progress at the Don Sak National Forest Reserve, Surat Thani, Southern Thailand

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Introduction

Recent decades have seen a rapid development of aquaculture along the coasts of Thailand. Although originally practiced only around Bangkok and only extensively for subsistence and local market demands, aquaculture has expanded enormously during the past two decades and shifted towards the highly intensive culture of the black tiger prawn *Penaeus monodon* for export.

During the past 35 years, most of Thailand's mangrove forest area was given into concession to logging companies for charcoal production. Unsustainable logging practices by many of the concessionaires and later rapid development of intensive aquaculture have been identified as the two main causes for the loss of over 54% of Thailand's mangroves in less than three decades. The shrimp farming sector, though yielding very high short-term financial profits, has contributed to environmental problems related to water pollution and sludge disposal and is plagued by viral diseases, acid sulfate soils and dropping production figures throughout the country.

In many cases, intensive shrimp farming has been characterized by a boom-and-bust cycle of rapid expansion followed by a crash. As a result the farmers migrated from the Inner Gulf of Thailand down south. This shifting cultivation, combined with degradation from unsustainable logging practices, have left behind large areas of abandoned ponds and degraded wasteland. In many areas the price for this economic development was paid by the local communities, who in the process lost their resource base on which their subsistence livelihood depended. The ownership and user right of the "land of the commons" appeared negotiable for influential individuals and the status of a forest reserve or logging concession area could change overnight into a privately "owned" shrimp farm.

Coastal areas within Don Sak district of Surat Thani Province are a typical example of the processes described above. Specifically within the Don Sak National Forest Reserve the 2,400 ha (15,000 rai) of mangrove forest that originally occurred here has been reduce to approximately 160 ha (1,000 rai), whereas the remaining 2,240 ha (14,000 Rai) consists largely of abandoned ponds, clearfelled (degraded) wasteland and a limited number of active shrimp ponds. A total of 1,967 ha of this 2,240 ha are publicly owned land within the boundaries of the Reserve. The local community in the adjacent villages has lost a highly productive natural resource base and there is no sense of resource ownership.

The Mangrove Forest Management Unit of the Royal Forest Department in Surat Thani, keen to restore the mangroves in this area, has developed a good relationship with the local communities. Local written arrangements have been negotiated by the forestry officials and village headmen with some of the former ("illegal") land-owners to surrender the abandoned pond lands back to the government for replanting. The RFD, The Surat Thani Shrimp Farmers Association, a group dedicated to sustainable shrimp aquaculture, and Wetlands International-Thailand Programme in conjunction with Lewis Environmental Services, Inc., are proposing to apply the current state-of-the-art hydrologic restoration planning to apply the most cost-effective technology to the

mangrove restoration projects proposed here. A small grant from the Rockefeller Brothers Fund in June of 1999 has allowed this preliminary report to be prepared.

The benefits from the proposed mangrove rehabilitation programme to the marginalised local communities would significantly improve if accompanied by the development of income-generating activities, particularly through the development of small-scale silvo-fisheries, crab-culture, bee-keeping and other mangrove-related livelihood activities. An appropriate mechanism should be designed for the sustainable financing of such community development initiatives, e.g. through micro-credit schemes or a revolving fund.

Investment by the shrimp farmers of part of their profits in restoration of environmental damage would certainly contribute to a greener image of their industry. If combined with measures and technologies to achieve a greener production process, the local shrimp farmers - through their well-established association - may not only boost their environmentally sensitive image but ultimately qualify for an eco-label of their shrimp products that may have major competitive advantages on the international export market. The involvement of a large international environmental organization (Wetlands International) in the project could give the necessary support and publicity that may accelerate the process of such a label (formally or even informally). Certain consumer associations in the US, Europe and Japan have even indicated to be interested in informally established shrimp product certifications and would be prepared to pay a higher price for eco-labeled shrimp. A formal Thai Green Label Scheme was launched in August 1994 by the Thailand Environment Institute (TEI) in association with the Ministry of Industry, but this scheme has so far only awarded environmental certification to specific products and services, not including foods, drinks and pharmaceuticals. At various international forums related to the shrimp industry, however, such eco-labeling is placed high on the discussion agenda and often leads to heated debates between industry representatives and environmentalists.

Background

Regional Setting

The Don Sak National Forest Reserve (99^{o} 40' East, 9^{o} 19' North) is located in Surat Thani Province in the Upper South Region of Thailand just east of Ban Don Bay and southwest of Ko Samui Island in the Gulf of Thailand (Figures 1, 2, and 3).

The regional watershed of the study area is the Tapi-Phum Duang River headwaters and covers 11,585 km^2. Several smaller local watersheds, including that of the Don Sak River drain directly into the study area. The coastline of the wider study area is deeply indented with numerous bays and estuaries. The largest and most important is Ban Don Bay which has previously been studied by Paw et al. (1988) and its migratory shorebird use has been documented by Tunhikorn and Round (1996).

The study area has a sub-tropical monsoonal maritime climate with an annual average temperature of 31°C. The coldest month is January, the warmest May. The average annual number of hours of sunshine is approximately 2,000. Rainfall is seasonal and

varies considerably between years, 1,500-2,500 mm/year. Most of the precipitation occurs during the fall monsoon, when the coastal area is also subject to typhoons. The tropical climate and the extensive coastline with its numerous sheltered bays and muddy inlets create ideal conditions for the development of mangrove forests. This area historically had one of the most extensive and richest variety of mangrove forests along the Gulf coast of Southern Thailand, although it is much reduced today (Figures 2 and 3), due to conversion to other uses such as shrimp farms or salt ponds, and erosion due to the overall reduction in total area and thus the ability of the total system to function as a means of coastal erosion control.

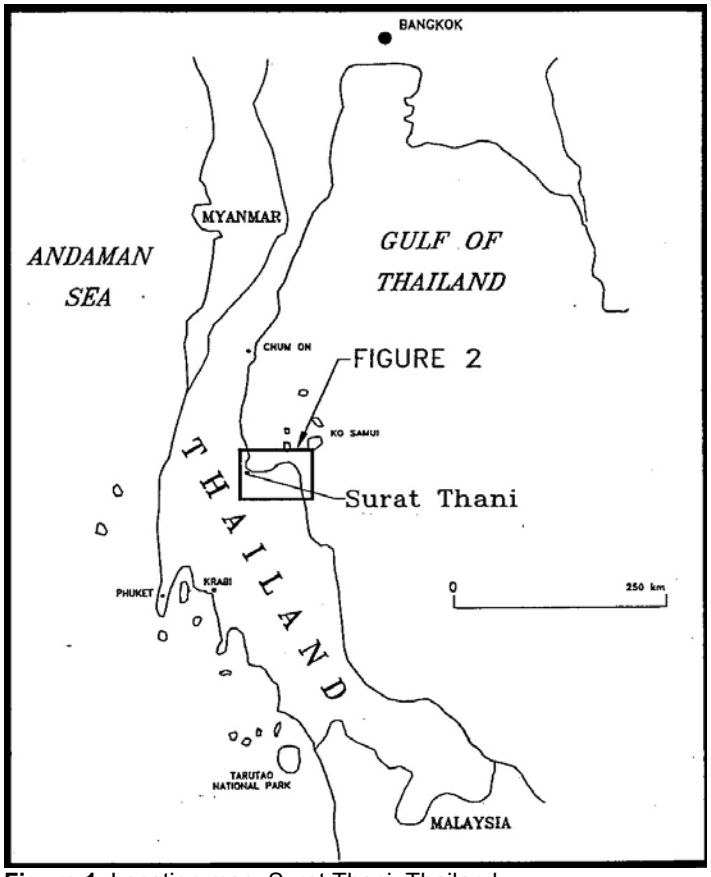

Figure 1. Location map, Surat Thani, Thailand.

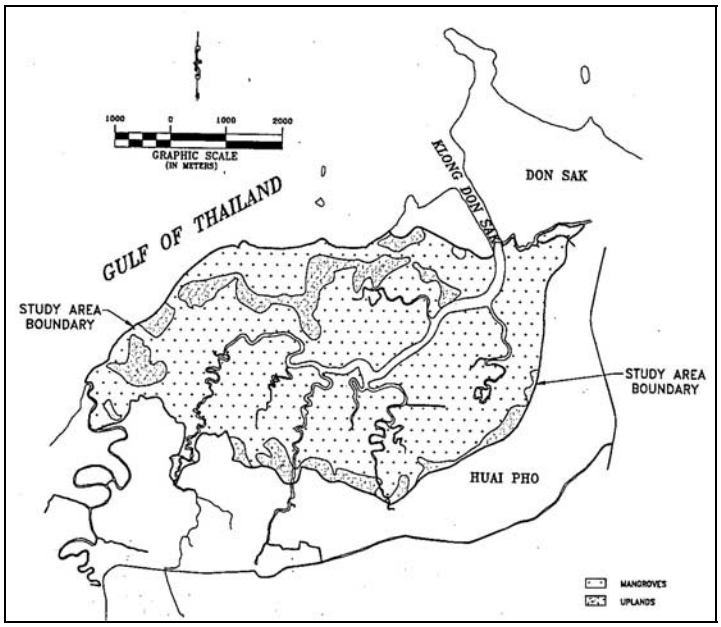

Figure 2. Historical distribution of mangroves in the Don Sak National Forest Reserve, 1971.

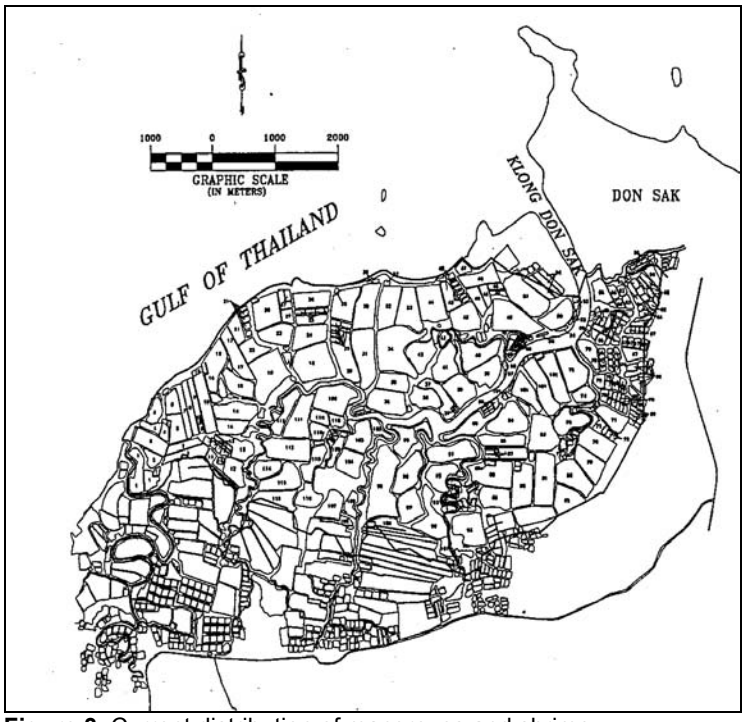

Figure 3. Current distribution of mangroves and shrimp aquaculture ponds in the Don Sak National Forest Reserve (1999).

Socio-Economic Data

Surat Thani Province consists of 19 districts with 1,012 villages over an area of 12,891 km2. The 1997 population was 861,233, up from 583,137 in 1979.

The Provincial government is under an appointed Governor, with some government agencies having District offices, such as the Fisheries Office. The economy is resource based, with agriculture and aquaculture the dominant industries. Table 1 lists the important export and import items for the Province.

Table 1: Import/Exports for Surat Thani in 1998 (Provincial Statistics Office Annual Report, 1999)

Item	Value (US$)
Exports	
Aquaculture Products	63,878,058
Palm Oil, Coconuts	46,581,475
Minerals	19,041,124
Rubber	14,560,993
Asphalt	475,694
Total	**144,537,544**
Imports	
Diesel	11,067,078
Benzene	2,210,329
Ammonia	1,025,517
General Cargo	618,226
Other	83,280
Total	**15,004,430**

The Don Sak District has 35 villages with a total population of 33,680. It is the second largest shrimp-producing district in the Province.

Land Use

Land use in the Don Sak District is dominated by rubber plantations, rice paddies, coconut plantations and shrimp farms (Sawangphol and Wattayakorn 2000). Shrimp farms have increased from 249.6 ha in 1977 to 8,088 ha in 1998.

Throughout the study area much of the coastal zone is very heavily used. In many areas mangroves and other forests have been depleted over the years and replaced with large-scale agricultural land and aquaculture ponds. Since then most of the former coastal plain (the area between the present day mangroves and the bottom of the plateau escarpment) was used for irrigated rice and small-scale vegetable farming. Fruit farming and forestry are practiced on the upper plateau. In most cases the agriculture is very intensive and very little land is set aside for other activities.

Aquaculture development in the coastal zone is also very intensive and highly developed. Along the coast in the study area aquaculture is the dominant land use. Large fish and shrimp farms (100-150 ha in size) have been constructed in the former intertidal zone, most of which are currently abandoned. Meanwhile on higher grounds, intensive shrimp farms have been constructed, the further development and operation of which is still continuing at a fast pace in the wider Surat Thani region. Investment in development of intensive aquaculture ponds is high as the ponds need intense management including a heavy lime application to reduce the effects of high acidity from the acid-sulfate soils. In many other sites along the east coast of the study area, aquaculture development in the

former intertidal zone has led to acute development of acid-sulfate soils and regular flushing, draining, liming and plowing of aquaculture ponds is necessary. In an attempt to combat high acidity, the trend in recent years has been to site aquaculture ponds further inland. This has created problems for water supply and loss of agricultural land.

In many areas traditional techniques of extensive aquaculture in mangrove areas and harvesting fish and shellfish at netted sluice gates on the falling tide was used. Many of these extensive ponds have been abandoned in recent years, after their brief use for intensive shrimp production failed, due to disease problems and water pollution problems.

Natural Resources

The Don Sak area has a tropical monsoonal climate. Other climatic and geological factors such as relatively high rainfall, suitable soils and an indented, sheltered coastline ensure that the intertidal communities are rich in biodiversity and variety.

Because the Don Sak area and other parts of the Southern Thailand coastline are just 9° north of the equator and the forested intertidal ecosystem is therefore species rich and complex as with true tropical mangrove forests in the Pacific. The establishment and growth of mangroves in southern Thailand is luxuriant due to moderate winter air and water temperatures, high annual average rainfall (2,000 mm). A total of 51 species of mangroves and associated vegetation occur in Southern Thailand (Aksornkoae *et al*. 1992). The mangrove forests in the Don Sak area are dominated by *Avicennia marina*, *Avicennia alba*, *Sonneratia alba, Xylocarpus granatum, X. moluccensis, Bruguiera sexangula, B. cylindrica, B. parviflora, B. gymnorrhiza, Rhizophora apiculata, R. mucronata, Ceriops tagal and Excoecaria agallocha*

Mangrove forests and their intertidal sand- and mudflats have traditionally provided a wide range of values and functions for the communities along these coasts. These include innumerable products for exploitation by man such as food stuffs (fish, shellfish, molluscs, fruits, etc); timber, fuel wood and construction materials; medicines, fish poisons and dyes. They function to prevent saltwater intrusions in coastal areas (maintaining freshwater drinking supplies for communities and irrigation waters). They also provide coastal protection (from storm waves and strong winds), provide important nursery and spawning areas for innumerable species of commercially important fish and shellfish, process biodegradable matter to support nutrient inputs and filter pollutants to prevent degradation to offshore fisheries, sea grass and coral reef communities (Platong 1998).

During storms and typhoon events the mangroves absorb much of the wave action and power, providing protection for the landward edge. Research has shown that mangrove forests can absorb up to 80% of the wave energy during storm events.

Coastal wetlands are very biologically diverse areas due to the wide range of available habitats and ecosystems for the development of life. In tropical and sub-tropical areas this is even more so where mangroves and their associated intertidal flats are the most

biologically diverse coastal ecosystems. The warm inshore waters and submerged reefs provide habitats for many fish and shellfish, a huge variety of other marine invertebrates and plants such as seagrasses and seaweeds. In southern Thai waters nearly 300 species of coastal and estuarine fish have been recorded - these include mangrove/mudflat dependent families such as *Gobiidae*, *Scatoplagidae* and *Engraulidae*. Nearly 2,000 species of mangrove and mudflat invertebrates including 50 species of crabs occur in the region and many of these are also commercially important. The intertidal flats of southern Thailand also support a very high diversity of invertebrates and are critical staging and feeding areas at least 63 species of migratory shorebirds including the Red-necked Stint, Long-toed Stint, Marsh Sandpiper, Curlew Sandpiper, Pacific Golden Plover and Lesser Plover (Tunhikorn and Round 1996). However, poaching of birds for food and other purposes is reportedly common.

The sheltered environment of the mangrove forest and its high and diverse nutrient supply also support a large number of other species many of which have high economic value. These include species of fish, prawns, shellfish, crabs and mantis shrimp which breed and live in the mangrove habitat and adjacent mudflats as well as species which migrate off-shore to spawn and feed.

Mangrove forests are of vital importance for the maintenance of coastal and near-shore fisheries production, and for the supply of nutrients, fish- and shrimp seed to coastal aquaculture. Some 11 species of high economic value, including eel, octopus, three shrimp species, 19 species of molluscs, and 7 species of grapsid crabs are reported from the study area. Food chain species include 26 zooplankton species, 97 phytoplankton species, 159 diatom species and 133 insect species.

Subsistence fisheries and non-timber forest products which remain un-recorded in the official statistics include “low” quality fish such as mudskippers, bivalve molluscs, gastropods, brachiopods, and many crustaceans (Table 2).

In recent years these resources have become an important means of supplementary income for villagers (women in particular) as they can sell surplus harvests on the open market. In coastal areas of Southern Thailand, women and children specialize in harvesting one or more of 19 species of edible molluscs collected from mangroves and mudflats (Plathong and Sitthirach 1998).

Table 2: Some coastal fauna of subsistence importance in the Don Sak District.

Molluscs	
Glauconome chinensis	Razor shell *Pharella acuminata*
Geloina erosa	*Tellina* spp.
Meretrix meretrix	*Mactra* spp.
Fan mussels *Pinna* spp.	Pacific cup oyster *Crassostrea gigas* (cultivated)
Gastropods	**Brachiopods**
Ellobium polita	*Lingula lingula*
Natica maculosa	
Crustaceans	**Benthic worms**
Mangrove crab *Scylla serrata*	*Siphunculus nudus*
Mantis shrimp *Harpiosquilla spp.*	

Honey and bees wax production in mangroves is another important economic value of these forests. When *Aegiceras corniculatum* are in bloom (March-May) local farmers and villagers set up their bee-hives adjacent to the mangroves.

Despite these important functions and values, mangroves have been under constant pressure for development and over-utilisation since the early 1960s. At that time, Thailand still had 376,900 ha of mangrove forests. By 1996, this area has dwindled to 167,582 ha, a 55.5% decrease (Charuppat and Charuppat 1997). For Southern Thailand, the area of mangroves has decreased from 334,000 ha in 1961 to 161,674 ha in 1996 (-48.3%). For Surat Thani Province, the area of mangrove has decreased from 25,600 ha in 1961 to 2,204 ha in 1993 (Plathong 1998), a 93% decrease.

Management Issues

Historical Land Use in the Don Sak National Forest Reserve

Wongbandit (2000) has reviewed the historical land use patterns and laws relating to the changing land use patterns in the Reserve. In that review it is noted that the Reserve was established in 1964 under the National Forest Reserve Act.

Following that action, concessions were given by the government for cutting of mangroves for charcoal production. This probably led to the first large scale removal of mangroves from the Reserve. Although replanting was required as part of the concession, it apparently did not occur. Another concession was granted, and the now degraded forest was illegally sold to new investors interested in conversion of the forest to shrimp aquaculture ponds.

Realizing that aquaculture within the Reserve might require a permit, the new "landowners" applied for permits to construct ponds. When the permit process became bogged down, they built them anyway. Attempts to then enforce the existing regulations

by RFD were then met with "strong protests" and to quote Wongbandit "as a result, most part of the Don Sak mangrove forest was converted into shrimp ponds as it is today…In 1991, a legal blow hit the illegal shrimp farmers…when the Cabinet issued a resolution (23 July 1991 order to the National Forest Policy Committee) …This made RFD refuse to give permission to the illegal shrimp farmers in conducting shrimp aquaculture…some farmers still ignored the government policy and the RFD's legal position, but when the shrimp price in the world market had gone down, many of them left their business." The abandonment of many of these ponds has also been caused by increasing incidences of viral diseases and water quality problems, driving the risks involved in shrimp business in this area beyond acceptable limits.

While shrimp prices have increased in recent years, the illegal aquaculture has not returned to the Reserve largely through the efforts of local villages efforts to protect what was left (Sathirathai 1998), and by RFD enforcing the law, not by arresting violators, but by stopping heavy equipment from entering the forest as per the 1991 Cabinet Resolution. Without the equipment to maintain dikes, potential illegal operators are stymied. Subsistence use and low production extensive aquaculture still persist, and an investigative committee report by RFD in 1996 produced the attached Figure 4. Most of the abandoned and disused ponds look like that pictured in Figure 5, but some are undergoing restoration as shown in Figure 6.

Mangrove Restoration in Southern Thailand

Plathong (1998) discusses mangrove restoration efforts in Southern Thailand in Chapter 6 (pages 58-68) of that publication. According to the cabinet decision of 1991, mangrove forest restoration was supported as a project of the RFD as part of the CRMP and given a budget of US$ 30 million. The goal was to restore 40,000 ha between 1992-1996, 81.4% of this (32,544 ha) in Southern Thailand. This effort was primarily to be accomplished through planting of mangrove seedlings in clear-cut forests and on unvegetated mudflats in front of existing remnant fringes of mangroves.

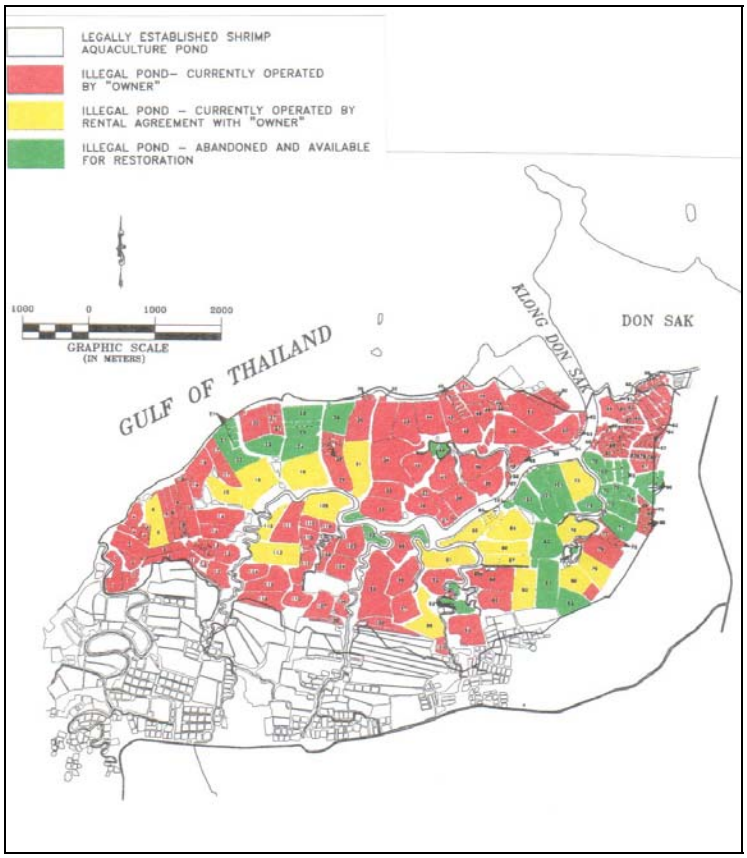

Figure 4. Status of aquaculture ponds in the Don Sak National Forest as of 17 November 1996. showing areas of ponds in four categories: (1) white = legal ponds; (2) red = illegal but in current operation by an “owner”; (3) yellow = illegal but operated by rental agreement and (4) green = illegal and apparently abandoned and therefore subject to rehabilitation or restoration.

Figure 5. Typical view of an abandoned shrimp aquaculture pond in the Don Sak National Forest Reserve.

Figure 6. Successful plantings of *Rhizophora apiculata* propagules at the Don Sak National Forest Reserve restoration project after three years of growth.

Mangrove restoration activities have been largely concentrated on the direct planting of the nursery grown seedlings or elongate propagules of *Rhizophora* spp. on unvegetated mudflats. It is difficult to determine how much of this goal was actually accomplished. Plathong (1998) states that the RFD reported 11,009 ha planted in Southern Thailand (Table 3). Additional data is difficult to locate. As Plathong (1998) notes that RFD "is unable to justify the success of the plan because the replanted mangrove areas are just in seedling stage. There is no report that replanting mangroves are survived or destroyed by natural factors and human. The data being recorded are only the planted area and the amount of areas planned to be replanted" (p. 59).

Table 3. Mangrove planting in Southern Thailand (1991-1995)(hectares).

Province	1991	1992	1993	1994	1995	Total
Chumporn	-	160	-	272	224	656
Surat Thani	112	256		362	160	890
Nakhon Sri Thammarat	112	104	320	400	373	1,308
Phatthalung	-	-	-	-	-	-
Songkhla	-	-	-	-	-	-
Pattani	-	-	32	-	-	32
Phang Nga	-	343	35	189	488	1,098
Phuket	-	-	136	80	19	235
Krabi	-	110	184	240	-	534
Trang	-	267	208	256	403	1,134
Satun	-	293	272	384	157	1,106
Ranong	-	-	160	303	480	943
Totals	**224**	**2,136**	**2,067**	**3,382**	**3,200**	**11,009**

(Plathong 1998)

In addition "the Agriculture Department joined with the private sector in a mangrove replanting project for the King's 50th anniversary jubilee…The target was 31,724 Rai (5,076 ha) in 57 areas. The Petrolium Authority of Thailand (PTT) replanted mangrove forest in Southern Thailand…between 1995-1997 about 11,062 rai (1,770 ha)…" It is not easily to compare the success of mangrove replanting…because they are not the same scale e.g. species, number of areas, location, timing and budget for maintenance after replanting." We would add that even the use of different terms and confusion in their meaning also adds to the confusion about which of these projects actually succeeded in restoring a previously existing mangrove forest, or converting a natural mudflat into mangroves. For example the terms "replanting" and "reafforestation" are commonly used. "Replanting" would seem to mean planting a second time after an initial "planting". Similarly, "reafforestation" would seem to mean planting a second time after a first effort at "afforestation". Afforestation is a widely used term in forestry and refers to planting of trees in areas that have not previously been forested.

Concerning afforestation, it is questionable whether the widespread attempts to convert existing natural mudflats to mangrove forests, even if they succeeded, represent ecologically sound restoration. Similar efforts in the Philippines, as reported by Custodio (1996), under "Threats fo Shorebirds and their Habitats", state that "Habitat alteration in the wake of unabated increase in human population is still the most important threat to shorebirds in the Philippines. Some of the alteration, however, has been due to activities which were of good intention. An example of this is the mangrove 'reforestation' programme which covered the feeding grounds of shorebirds in Puerto Rivas (Bataan) and parts of Olango Island" (p. 166). With these words in mind, it is worthwhile to note that Tunhikorn and Round (1996) state that "…Thailand is a major wintering and passage

area for Palaeartic waterbirds. Large numbers of shorebirds are found both along its coastline, in mudflat and mangrove habitat..."" and describe the intertidal mudflats, onshore prawn ponds, salt-pans and some remaining areas of mangroves along the Gulf of Thailand as "(P)probably the single most important site for shorebirds in the country" (p. 123). Finally they describe the major threat to wintering shorebirds at Khao Sam Roi Yot National Park in Prachuap Khiri Khan province as modifications to "the hydrology and topography of coastal areas … by intensive prawn farming during 1988-1993" (p. 124). In their review article on this matter, Erftemeijer and Lewis (2000) further commented that "planting mangroves on mudflats would represent habitat conversion" rather than habitat restoration, and strongly caution against the ecological wisdom of doing this.

Status of Restoration Efforts in the Reserve

Preliminary field work and review of RFD reports indicate that several of the numbered ponds in Figure 3 have undergone some mangrove restoration efforts. Pond # 81 was opened to tidal connection and planted with *R. apiculata* propagules in 1997. There is some discrepancy in the records about its size, but it appears to be about 25 ha. An unnumbered pond south of Pond # 81 was planted in 1995 as part of the King's Centennial Celebration. Pond # 83, and the two ponds # 101b and c have been planted with *R. apiculata* propagules in 1998-99 but are not freely connected to tidal action (Only a single gated tidal opening exists). They total about 50 ha in size. Ponds # 25 and # 27 were being planted when visited in September of 1999. Total size for the two was about 20 ha. No visible tidal connections were seen at that time. Thus at least 95 ha of ponds have undergone some level of rehabilitation, although only 25 ha of this area appears to be properly connected to tidal influence to insure the best ecological restoration.

Records in English are not available and the exact hectarage of planted mangrove areas is thus difficult to determine. The Royal Forest Department indicates that their records show that 190.4 hectares of mangrove plantings took place between 1995-1999 in the Reserve, and that another 104 hectares is being planted in 1999-2000. Thus up to 300 hectares may have been planted to date. No monitoring reports are available, so the success or failure of these plantings is unknown. Visually, some of the ponds show high survival of *Rhizophora* propagule plantings (Figure 6).

Future Restoration Efforts

All of the above has guided our proposed mangrove forest restoration towards "hydrologic restoration" as described by Turner and Lewis (1997), Lewis (1998), Lewis and Marshall (1998), and Stevenson *et al.* (1999).

Hydrologic restoration of mangroves implies the use of the five sequential steps to successful mangrove restoration as described by Lewis (1998):

1. Understand the autecology (individual species' ecology) of your target restoration species
2. Determine the normal hydrology of those species
3. Determine if that hydrology has been modified and how it was modified
4. Restore normal hydrology

5. Only plant mangroves if natural secondary succession by mangroves does not occur at a rate or density sufficient to satisfy predetermined success goals

The success of this approach is quantitatively described by Lewis and Marshall (1998) and Stevenson et al. (1999) in the natural recovery and revegetation of an abandoned shrimp pond in Costa Rica after natural breaching of its outer dikes. Additional examples are also shown from abandoned ponds in the Philippines.

The application of the basic principles of hydrologic restoration to restoration of abandoned shrimp ponds in the Don Sak National Forest Reserve is expected to result in better fisheries and wildlife habitat restoration at a cost of 50% to 66% less than current costs, and similar reductions in the time required to complete restoration projects.

Current cost estimates provided by the RFD are that excavation of dike openings and plantings, of primarily *Rhizophora apiculata* unrooted propagules is 4,200 baht/rai or US$691/ha (at 38 baht/US$1) It is proposed to design the future restoration project to emphasize optimum placement of excavated openings in both the upland edge and the seaward edge of the ponds to reconstruct the historical tidal creek system of the forest. A 1971 vertical black and white aerial photograph and similar maps are available to use as templates for the restoration. It is estimated that the cost of restoration could therefore be reduced to US$200-300/ha, since natural propagule recruitment would replace active planting. Stevenson et al. (1999) have shown that natural propagule recruitment in an abandoned shrimp aquaculture pond in Costa Rica resulted in the same species mix, and 64.2% of the basal area of a control forest within 10 years of pond opening and without planting. This approach to pond restoration would also provide for a diverse species assemblage of mangroves rather than a monoculture.

Restoration of abandoned ponds would also facilitate their role as biofilters for the effluents from shrimp farms located upstream of the restored areas in less sensitive habitats. Several authors have discussed the role of mangroves as biofilters for shrimp aquaculture effluents (Robertson and Phillips 1995, Rivera-Monroy et al. 1999) and estimates for the amount of needed biofilter area of mangroves for 1 hectare of intensive shrimp aquaculture range from 0.04 to 22 ha.

Proposed Programme

Short-Term Objectives

The short-term objectives of the proposed programme are:

1. Strengthen the capacity of RFD staff and related agencies in managing and protecting the mangroves of the study area by training relevant government personnel for the conservation and management of mangroves.
2. Enhance the extension tasks of RFD to undertake conservation education programmes amongst local communities, by developing conservation education and awareness programmes among coastal communities on mangrove ecosystem conservation and its importance in supporting coastal communities.

3. Manage the coastal natural resources through community participation and enhance agricultural production.
4. Rehabilitate degraded patches of mangrove forests for protection against coastal storms, tidal stream erosion, protection and improvement of water quality and thus the protection of agriculture and fisheries activities, by hydrologic restoration of 800 ha of mangrove forest.
5. Enhance the capacity of RFD to deal with potential aquaculture and mangrove management conflicts through improved community involvement.
6. Establish models of sustainable natural resource exploitation to generate income for reserve management activities, by working out with local families as the main stakeholders a modality of effective mangrove forest protection and management, with unambiguous identification of shared responsibilities and benefits.
7. Investigate coastal pollution and determine if mangrove restoration can help alleviate this problem.

Long-Term Objectives

The long-term objectives (goals) of the proposed programme are:

1. Establish an effective natural protection belt against destructive storm surges and typhoons of the coastline of the study area in order to protect the coastline, fishponds, agricultural land and settlements from typhoon damages.
2. Improve the socio-economic conditions of the coastal communities, thereby contributing to poverty alleviation by enhancing the productivity of the coastal mangrove ecosystem in terms of fisheries and aquaculture.
3. Expand the study area under mangrove forest and enhance its management by establishing The Surat Thani Community Forest, to include the Don Sak National Forest Reserve and adjacent publicly owned lands currently existing as disused or abandoned shrimp aquaculture ponds constructed in former mangrove forests, with a total area of 22,000 ha, including 15,000 ha of mangrove and 7,000 ha of tidal streams and intertidal mudflats.

Implementation

The first phase of the project will be completed in June of 2000 with the submission of the final project report to the Rockefeller Brothers Foundation. This report will summarise all activities to date and include the Phase 2 proposal for general consideration for funding by a number of funding organisations.

The Phase 2 program proposal is being co-ordinated with Wetlands International, the RFD, the new Songkla University campus in Surat Thani and the Surat Thani Shrimp Farmer's Association. In addition, a proposed program entitled "Reducing loss of mangrove forests and biodiversity through promotion of sustainable and environmentally sound shrimp farming" was prepared by the United Nations Environment Program (UNEP), East Asia Seas Regional Coordination Unit (EAS/RCU) in Bangkok for funding

by the Global Environmental Facility and is currently under consideration. Funding will be sought to assist in the implementation and documentation of this Phase 2 program as appropriate as this UNEP program proceeds.

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