

traditional culture of people deeply with appropriate function of material circulation, high productivity and biodiversity under integrated coastal management by mankind.

- The creation of SATO-UMI can be a tool of the participatory and cooperative model for the integrated coastal management, because SATO-UMI is the concept of not only space, but also including human activities and can be gain the continuity if tied to the human habit.

- By material circulation, ecosystem and water amenity (these 3 elements are conserved by SATO-UMI), spot and body of activity, SATO-UMI is categorized into some patterns like Basin type, Fishing Village type and others.

Silvo-aquaculture: an ecosystem based management for sustainable coastal aquaculture in Thailand

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Mangrove forests in Southeast Asia have declined significantly over the past four decades due to many of human activities i.e. population pressure, wood extraction, conversion to agriculture and salt production, tin mining, coastal industrialization and urbanization including the conversion to coastal aquaculture. Silvo-aquaculture is an ecosystem based management for the sustainable used of coastal area for aquaculture that integrates mangrove and aquaculture for produce seafood in coastal areas especially shrimp farm. The large scale of silvo-aquaculture, an integrated 116 ha of shrimp farms with 160 ha mangrove, has been demonstrated at Kung Krabaen Bay, Chantaburi, Thailand. A number of 113 small scale farmers and community were educated in farm management practices based on ecosystem approached including with water irrigation, environmental protection, mangrove sea replantation, seaweeds conservation and fish stock enhancement in the bay. The annual shrimp production from this area was about 11.2 ton/ha/year while mangrove forest has been slowly increased at a rate 1.3 ha/year by natural reproduction and replantation. The study of water quality and nitrogen budget indicated that treatment system and the bay played it role on trapping and utilization of the nutrients from intensive shrimp farm.

The small scale silvo-aquaculture pond (5.2 ha) was demonstrated in the mangrove

(*Rhizophora apiculata*) replanted natural shrimp pond (density about 11 tree/ha or 2,614 kg/ha) located in Nakhonsrithammarat, Thailand. Mud crab (*Scylla serrata*) and black tiger shrimp (*Penaeus monodon*) were stocked to supplement the natural recruitment. Little amount of fresh fish was supplemented as feed to enhance growth of crab. The result suggested that the biomass of mangrove was increased about 10% or about 29-74.49 mgC/m²/d or 0.15-0.37 mgN/m²/d, while the rate of litter fall was about 6.7-32.3 mgC/m²/d or 0.06-0.29 mgN/m²/d. The contribution of the mangrove tree to the production of culture species is comparatively low comparing to the other processors. This is probably due to slow degradation of the litter fall from mangrove tree. In addition, the result from nitrogen budget suggests that mud crab and shrimp are suitable for the silvo-aquaculture pond because they are benthic detritus feeders. The addition management techniques are probably needed in order to utilize/transfer nutrients to the culture species.

Phytoremediation of organically enriched sediment evaluation by a numerical model

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Evaluation of results from field experiments was made by a numerical model. The field experiments were those to remediate shallow enriched sediment by replanting mass-cultured benthic microalgae, *Nitzschia* sp. The observation results have already reported elsewhere, in which organic content of the sediment was significantly decreased and inorganic nutrient concentration was increased. However, the processes which may have occurred in the surface sediment were not clear with only stock data. Then we tried to evaluate how much amount of biophilic elements were cycled in the surface sediments. The model constructed in the present study is consist of 9