



Title	Roles of mangrove ecosystem in the sustainability of communities in the Vietnamese Mekong Delta : a case study in Soc Trang and Bac Lieu provinces [an abstract of dissertation and a summary of dissertation review]
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学位論文内容の要旨

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Roles of mangrove ecosystem in the sustainability of communities
in the Vietnamese Mekong Delta: a case study in Soc Trang and Bac Lieu provinces
(マングローブ生態系がベトナム・メコンデルタの地域社会の持続可能性に果たす役割：
ソクチャン省とバクリュウ省における事例研究)

Mangrove forests, distributed in tropical and subtropical regions, are considered one of the most productive marine ecosystems on earth. The forests play crucial roles not only in providing unique habitats for many species as well as services for human livelihood in coastal communities, but also in mitigating adverse impacts of natural disasters. However, anthropogenic activities like agriculture and aquaculture have impacted negatively on mangrove forests globally for last decades. In the Vietnamese Mekong Delta (VMD), indeed, brackish shrimp farming has been considered as one of the main drivers causing the rapid mangrove loss and degradation. Consequently, the loss and degradation of mangroves lead to damage of the biodiversity, ecosystem function, livelihoods, food security, and coastal defense in the VMD. The objective of this study is: (1) To assess the spatiotemporal changes in mangrove forests in the southeastern part of the VMD for last 30 years and (2) To assess community awareness of using mangroves for coastal protection and determine economic valuation of mangrove ecosystem services.

In this research, the change in the mangrove forest area in two coastal provinces in VMD, namely Soc Trang and Bac Lieu, was estimated by using medium spatial resolution (Landsat-5 Thematic Mapper (TM) and Landsat-8 Operational Land Imager (OLI)) satellite imagery in four-time intervals ranging from 1988 to 2018. Multi-temporal Landsat data were analyzed to obtain land use and land cover (LULC) classification by using maximum-likelihood classification (MLC) algorithm. In the study area, there were seven major LULC types that include dense mangrove forests, sparse mangrove forests, aquaculture farming, agriculture with crops (cropped agriculture), agriculture without crops (non-cropped agriculture), settlement, and water bodies. The overall accuracy of the LULC maps was 81.2%, 83.3%, 78.3%, and 81.9% in 1988, 1998, 2008, and 2018, respectively. This study reveals that dense and sparse mangrove forests have decreased rapidly from 5,495 ha to 515 ha and

from 14,105 ha to 6,289 ha, respectively from 1998 to 2018. The dense and sparse mangrove area has decreased by approximately 90% and 55%, respectively, while the aquaculture area has increased by 150,720 ha, for the period of 30 years. This study suggests that the rapid growth of aquaculture farming caused the rapid mangrove loss and degradation in the VMD. Furthermore, mangrove forests have been partly converted to agricultural land (8,419 hectares). Agricultural land converted into aquacultural land accounts for more than 150,000 hectares. LULC was useful to map the total area and conditions of mangroves and the density in both the provinces and this is a quantitative information that can be useful for further management and evaluating the mangrove ecosystem services in the study area.

Using data from 300 household surveys, leaders group discussions of conducted across six mangrove sites of six districts in Soc Trang and Bac Lieu and combining these with information on fish catches, forest managers, mangroves-shrimp farms allowed us to make a thorough economic valuation of the mangrove forests. This gave a current value of VMD's mangroves of 73.04 million USD, approximately 5,708 USD per hectare per year. The results revealed that provisioning and regulating services provided by mangrove ecosystem in the VMD were accounted for at least 36.94 million USD and 43.13 million USD per year, respectively. The major source of provisioning services was obtained from mangroves-shrimp farming, fishing, and fuel wood, whereas that of regulating services were derived from coastal protection. In the study area, mangroves-shrimp farmers who possess mangrove forests have higher level of benefits than that of fisherman and timber collectors. Eighty percent of interviewees considered mangrove forests play an importance role in local communities. The results revealed that local livelihood mainly depends on the mangrove forest ecosystem. The mangrove belt in Soc Trang is wider than in Bac Lieu. The dense mangrove forest is mainly distributed in Soc Trang because coastline is accretion zone. In contrast, in Bac Lieu, reforestation is more difficult due to coastal erosion. This leads to mangrove ecosystem values (provisioning services and regulating services) in Soc Trang were higher than in Bac Lieu because these values depend on the existing mangrove areas. In this study, shrimp farms were combined in mangroves with more than 60% mangrove cover. This is the area of mangroves (sparse mangroves are less than 50% of the covered area, or dense mangroves are over 50% of the covered area). Large shrimp farms are belonging to aquaculture areas. The resolution of Landsat data is low (30m), so the detection of small areas was limited. Information on the monetary valuation of mangrove ecosystems can be used as a communication tool to ensure better informed, more balanced decisions concerning trade-offs in land-use planning.