

Monetary Evaluation on Damage of Coastal Ecosystem Services Caused by Sea Reclamation: Concept, Methodology and Case Study

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In order to resolve the conflict between economic development and land shortage, reclaiming land from sea has become increasingly intense in many coastal cities in China since 1980s. The total reclamation area reached 540 km² by the end of 2007. While expanding land areas for production and construction for increasing economic benefits, sea reclamation activities, have nevertheless caused a series of negative effects on coastal ecosystems. Unfortunately, some decision-makers or developers often pay more attention to short-term direct economic benefits, and ignore the ecological damages and environmental degradation resulted from sea reclamation. An important reason is that coastal ecosystem services are not fully 'captured' in commercial markets, which has left them largely as open access resources to be exploited by anyone. Obviously, there is a gap between market valuation and the economic value of ecosystem services. To fill this gap, ecosystem services must first be identified and then where possible, costed (monetized).

Therefore, it is necessary to determine the monetary value associated with the depletion of coastal ecosystem services as a result of sea reclamation and to integrate the information into the exploitation and management decisions of coastal zone. The paper takes a closer look at the necessity and importance of studying the monetary evaluation of the negative ecological impacts caused by sea reclamation in the context of sustainable development. It reviews existing classification of coastal ecosystem services, summarizes the different methodologies available to monetarily evaluate the depletion of coastal ecosystem services. It discusses the formulation of a fundamental procedure framework for selecting feasible monetary evaluation approaches according to the respective characteristics of different ecosystem services for building relevant



models using Conventional Market Approach, Replacement Value Approach, Experimental Market Approach, and Benefit Transfer Approach. Finally, the paper highlights Tong'an Bay, Xiamen as the case study area by focusing on some sea reclamation planning projects in the bay. The probable negative impacts of respective scheme on the ecosystems were analyzed and predicted by means of multi-disciplinary methods, and the damage of ecosystem services incurred by each scheme was evaluated using the established evaluation models.

The results show that the ecological losses caused by scheme 1 to scheme 4 will be $\text{¥ } 1.36 \times 10^8 \text{ a}^{-1}$, $\text{¥ } 5.44 \times 10^8 \text{ a}^{-1}$, $\text{¥ } 6.79 \times 10^8 \text{ a}^{-1}$ and $\text{¥ } 1.48 \times 10^9 \text{ a}^{-1}$ respectively, and the ecological losses per unit area will be $\text{¥ } 68.65 \text{ m}^{-2}\text{a}^{-1}$, $\text{¥ } 70.36 \text{ m}^{-2}\text{a}^{-1}$, $\text{¥ } 72.43 \text{ m}^{-2}\text{a}^{-1}$, and $\text{¥ } 76.84 \text{ m}^{-2}\text{a}^{-1}$ respectively. According to the evaluation results, some relevant suggestions are also put forward.