

Marine protected areas for resilience and economic development



In this research, we attempt to give a comparative analysis of the space allocation of multiple-use marine protected areas (MPAs) including but not limited to the introduction of aquaculture in the area. Specifically, we consider the case where there is a need to develop MPAs for the conservation of the environment and ecological diversity. There is also a prevailing call for the establishment of aquaculture activities within the area to meet societal demands. Although aquaculture has negative externalities on MPAs, it helps to reduce the pressure on the capture fishery and increases the supply of fish. We develop a deterministic bioeconomic model that describes the transition dynamics and interrelationships of the systems. We find an optimal aquaculture size relative to the optimal size of MPAs that maximizes the overall economic and ecological benefits. Using numerical methods we determine the trajectory of optimal solutions, the recovery rate of the stocks in and outside the MPAs, and the expansion rate of the aquaculture.

Sensitivity analysis was also performed to see the effect of a change in the parameters on the optimal solutions. The numerical results show that MPAs are resilient after the implementation of aquaculture. Moreover, the effectiveness of the optimized management system mainly depends on the cooperative planning between the capture fishery and aquaculture managers.

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