Allocate Pollution Loads to Various Sources into Semi-Enclosed Bays: A Practical Approach in China

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One critical limitation in existing marine environmental planning of semi-enclosed bay is the mismatch between science and management, i.e., science typically focuses on modeling the total maximum pollution load in a sea area, yet environmental management objectives typically relate to pollution sources. Without considering the features of pollution sources and finally dividing the pollution load to specific outfalls and various sources, marine environmental management schemes will be destined to failure.

In this study, we proposed a practical approach aiming at allocating pollution loads among various sources after comprehensively quantifying pollution sources baseline and numerically modeling the maximum pollution loads in different sea areas. The practical approach is generally comprised of two steps of reservation and optimization.

At the first step, the pollution sources were classified to uncontrollable, general and controllable sources according to their controllability (e.g., non-point source pollution and point-source pollution, outside source pollution and inside source pollution has different controllability). The pollution loads were reserved to those uncontrollable sources to ensure seawater environmental quality; meanwhile, the pollution loads were also reserved to those necessary demands (e.g., Margin of Safety under the precautionary principle, quota for future development under the principle of sustainable development).

At the second step, a multi-objective programming model was developed to optimize the pollution load allocation among different industries e.g. manufacturing industry, harbor and shipping, coastal tourism, and marine aquaculture etc. The multiple objectives include: 1) management efficiency characterized by the Response Coefficient (RC) (according to the 3-D numerical model, different pollution outfalls have different RC to seawater quality at the concerned sites, the outfalls with greater RCs will be controlled first); 2) economic efficiency

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characterized by the cost-effectiveness (pollution from different industries has different cost-effectiveness of pollution load use), and 3) social equity (urban planning were integrated into the final allocation scheme).

This 2-step process for pollution loads allocation has been implemented in Xiangshan Bay, Zhejiang Province, Luoyuan Bay, Fujian Province and Xiamen Bay, Fujian Province, where the results facilitate local marine environmental management. It features pollution source characters, and takes account of both efficiency and equity in the final allocation scheme; therefore, provides scientific basis for marine environmental management in practice.