

# Quantifying Land-Based Pollutant Loads in the Coastal Area with Sparse Data: Methodology and Application in China

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Land-based pollution contributes greatly to the degradation of estuarine and coastal water quality. As a developing but booming country, accelerated urbanization processes have taken place especially in the coastal areas of China, which exerts great influence on marine environments. It is necessary to firstly investigate the land-based pollutants loads before any planning is done or any practical steps are taken. However, in many cases, data regarding water quality of effluent and stormwater runoff, streamflow, climate variables and so on in the coastal area were found to be insufficient or inappropriate for the purpose of modeling or accurate direct estimation of land-based pollutant loads, which is especially a big challenge in China.

An approach for quantifying land-based pollutant loads in the coastal area with sparse data by the integration of the Geographic Information System (GIS), Remote Sensing (RS) technology, empirical models (SCS-CN, USLE, pollutant losses equations) and export coefficients was proposed in this study. The suggested approach is based on the following: (i) define boundary of the study areas and delineate sub-catchments and sub-seas; (ii) collect information and establish database in terms of sub-catchments including point source, population, fertilizer use, livestock breeding, sewage treatment condition, soil, land use and land cover, etc; (iii) estimate pollutant loads from point source in terms of sub-catchments; (iv) estimate pollutant loads from livestock breeding, fertilizer use and rural domestic wastewater in terms of sub-catchment; (v) estimate pollutant loads from soil erosion in terms of sub-catchments; (vi) analyze and visualize the statistical source apportionment of land-based pollutant in terms of sub-seas. As compared to conventional source inventories and complex models, this approach offer several advantages: data requirement was less and suitable for the coastal area with sparse data in China; source apportionment can be represented in a simple and intuitive way.



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To illustrate the proposed methodology, land-based pollutant loads and source apportionment in Luoyuan Bay and Xiamen Bay were quantified, respectively. Luoyuan Bay and Xiamen Bay, both located in the coastal area southeast of China, have undergone different natural and urbanization processes. The latter suffered from more intensive urbanization process than that of the former, characterized by more point sources, higher rate of sewage treatment, and less amount of livestock breeding and fertilizer use. The main results obtained in Luoyuan Bay show that land-based pollutant COD is mainly from rural domestic wastewater pollution and soil erosion, accounted for 63% and 22%, respectively, whereas point source only contributes 4%. Soil erosion constitutes the main pollution sources for total nitrogen (TN) and total phosphorus (TP). The main results in Xiamen Bay show that over 55% of land-based pollutant COD, TN and TP emission are caused by nonpoint source pollution, although a little spatial variability of source apportionment exhibits in terms of sub-seas. The applications of the proposed approach on the two study bays result in clear identification of the source apportionment of land-based pollutant loads in a coastal area with sparse data in China.