学校编码：10384 密级_____
学号：22620091151194

厦门大学

硕士学位论文

海岸带区域决策中的海洋环境质量评价方法研究

Approach and Methodology of Marine Environmental Quality Assessment in Coastal Decision-Making Process

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论文提交日期：2012 年 6 月
论文答辩时间：2012 年 6 月

2012年6月

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摘　要

环境质量评价是按照一定的评价标准和评价方法对一定区域范围内的环境质量进行说明、评定。目前国内的环境质量评价中，监测与评价存在明显脱节，针对区域决策的环境质量评价方法缺少系统性研究，其评价结果也较难为区域决策提供明确的结果。而海岸带作为海陆作用明显的区域，其生态系统面临人类开发活动带来的巨大压力。故针对海岸带区域决策的海洋环境质量评价方法需要进行充分研究，以避免决策失误而带来严重的后果。

国外的海洋环境质量评价主要有欧盟《水框架指令》和 OSPAR（Oslo Convention and Paris Convention，以下简称“OSPAR”）协议、英国《环境标准及条件》、美国《近岸状况报告》和《营养状况评价》、澳大利亚《国家水质管理战略》等研究，总体发展趋势为开始考虑生态系统差异和区域差异性，逐渐开始运用决策树法，重视数据的保证率，评价结果以明确的等级表示等新的评价技术路线和方法，从而支持决策。

本文通过对国内外环境质量评价技术路线及方法进行比较，总结了环境质量评价的研究进展、发展趋势和存在问题。通过海岸带区域的特性明确海岸带区域决策对环境质量评价的需求，针对现有评价存在难以支持决策的问题，构建了海岸带区域决策的海洋环境质量评价方法。在方法构建中，参考国外的环境质量评价的发展趋势，构建以决策树为基础的环境质量评价方法；基于海岸带区域特性，设计了一种新的以多维决策为基础的环境质量评价方法，运用专家评判法，基于对各因子的评价得到各要素及子要素的评价结果，最终得到总体的环境质量评价结果。本文将两种方法同时应用于海岸带主体功能区划项目的厦门湾和罗源湾案例中，通过应用过程和评价结果对两种方法进行比较研究。

通过比较研究，基于决策树和多维决策的两种海岸带区域决策中的海洋环境质量评价方法主要有以下差别：

从评价过程上来看，在评价参数上，决策树评价法仍使用因子筛选的指数计算，而专家评判-多维决策法则收集所有能收集到的数据并用现行最成熟的方法进行基础评价，确保了决策信息的完整性；在数据需求上，尽管数据信息量越大

对决策的支持越好，但专家评判-多维决策法对数据的要求较低，在任意数据情况下都可以利用专家评判法进行评判，而决策树评价法在某些主要数据欠缺时则无法开展评价；在数据处理上，决策树评价法主要基于现状评价，专家评判-多维决策法则包括现状评价、回顾评价及专家评判综合定性分析；在评价流程上，决策树评价法基于评判标准对各要素进行定性评判，专家评判-多维决策法则是在基础评价的基础上完全依照专家评判法评价各要素及其综合结果；在决策方案比选上，专家评判-多维决策法可操作性相对更强。

从评价结果上来看，通过与公众参与结果、专家评判结果的比较，决策树评价法在案例研究中的评价结果存在一定偏差；通过决策支持结果的比较，决策树评价法对决策的支持程度劣于专家评判-多维决策法。

本研究建立的以决策树为基础和以多维决策为基础的海岸带区域决策中的海洋环境质量评价技术路线和方法，打破了传统评价模式，并且能够通过决策树和多维决策分析有效支持决策。通过方法比较研究，专家评判-多维决策法更适用于海岸带区域决策中的海洋环境质量评价。决策树评价法在仅有单一决策方案或备选方案较少的情况下较为适用，但在数据资料欠缺时可能无法评价；专家评判-多维决策法在任意数据文献资料的情况下都可以开展评价，但要求评判专家有质量和数量的保证，在有多种决策备选方案的情况下更具有普遍适用性。

关键词：环境质量评价；多维决策；决策树；海岸带；主体功能区划

Abstract

Environmental quality assessment is a process that describes environmental quality in an area compliant with some environmental standards. In China, there is no systematic research on methods of environmental quality assessment aiming at supporting regional decision-making, and the connection between monitoring and assessment is still insufficient, and the assessment result usually hardly support regional decision-making. The ecosystem of coastal area featuring interaction of ocean and land is confronted with tremendous press from the human activities. Therefore, marine environmental quality assessment approach to support coastal decision-making should be studied to avoid the serious problems caused by decision making errors.

International practice of marine environmental quality assessment mainly includes EU *Water Framework Directive* and OSPAR treaty, *UK Environmental Standards and Conditions*, *Assessment of Estuarine Trophic Status* and *National Coastal Condition Report* of United States, *National Water Quality Management Strategy* of Australia, and so on. Several development trends have been observed as followings: considering the differences of ecosystem and districts, applying the method of decision-tree, paying attention to reliability of data, expressing results in form of levels, and so on.

This paper summarizes the research progress, development trend, and existing problems of environmental quality assessment, by comparing the approaches and methods in and outside China. It builds up the approaches and methods of marine environmental quality assessment in coastal decision-making. In the construction of methods, it builds a method of environmental quality assessment based on decision-tree. Based on features of coastal area, it designs a new approach of environmental quality assessment related to multi-dimension decision-making. This method get the final integrated assessment result by the results of main factors and sub-factors based on assessment of all the indicators. This paper applies both methods

in the projects of coastal principal functional zoning in Xiamen bay and Luoyuan Bay, and compares the two methods by application process and assessment results.

The differences between the two methods of marine environmental quality assessment based on decision-tree and multi-dimension decision-making have been summarized as below:

In the view of assessment process; related to assessment parameters, the method of decision-tree (DT Method) still use calculation of indices with sifting factors, while the method of expert judgment and multi-dimension decision-making (EJ Method) has basic assessment of all the collected data with existing advanced methods to ensure the integrity of decision-making information; in the requirement of data, the EJ Method has low requirement of data so that it can be applied in any condition of data availability, even though large amount of data have better support for decision-making, while the DT Method cannot be applied if some main data is absent; in data processing, the DT Method only has assessment of current status, while the EJ Method covers assessment of current status, retrospective assessment and integrated qualitative analysis; in assessment process, the DT Method has qualitative assessment of each factor according to assessment standard, while the EJ Method assesses different factor and integrated result based on basic assessment according to expert judgment; In the comparison and selection of alternative schemes, the EJ Method is more convenient to operate than the DT Method.

In the view of assessment result, compared to the result of public involvement and expert-judgment, the DT Method has low accuracy than the EJ Method; by comparison of results of decision support, the DT Method has less support than the EJ Method.

The advantages of the approaches and methods of marine environmental quality assessment in coastal decision-making based on decision-tree and multi-dimension decision-making over traditional assessment ways of Multi-criteria Decision-making (MCDM), Driver-Press-State-Impact-Response (DPSIR) and so on, is that it can also support decision-making. Through the research of methods comparison, the method of expert judgment and multi-dimension decision-making is more suitable for marine

environmental quality assessment in coastal decision-making. The DT Method can be well applied in the condition that there are fewer or single alternative(s); The EJ Method can be applied based on any amount of data with the condition that the number and qualification of experts should be ensured, and while there are many alternatives, the EJ Method can be better applied in coastal decision-making.

Key words: Environmental Quality Assessment; Multi-dimension Decision-making; Decision-Tree; Coastal Area; Principal Function Zoning

图表索引