



## Research article

# Integrated and ecosystemic approaches for bridging the gap between environmental management and port management



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## ARTICLE INFO

## Article history:

Received 6 June 2017

Received in revised form

19 September 2017

Accepted 2 November 2017

## Keywords:

Environmental management  
Port management  
Ecosystem-based management  
Integrated coastal zone management  
Ecosystem services  
DPSIR

## ABSTRACT

The rapid exploitation of coastal and marine ecosystemic capital is on course to reach a critical point. The difficulty of implementing Integrated and ecosystem based management models, taking into account the great complexity of the marine socio-ecological systems, has resulted in a significant gap between theory and practice. The majority of authors emphasize difficulties in engaging and convincing private stakeholders and a number of economic sectors involved in these processes. This reticence is traditionally more pronounced in the port sector, despite their important role in the transformation of coastal and marine areas. This paper seeks to establish bridges between the Environmental Management systems and Tools (EMT) of economic sectors and the Integrated and Ecosystem Based Management models (IEBM). To achieve this goal, an effort has been made to rethink concepts and principles traditionally used in EMT to bring them into line with those of IEBM. A DPSIR adapted framework is proposed and applied in a conceptual model, where the necessary elements for environmental management tools and ecosystemic models coexist. The logic of ecosystem services has been included, with special attention to the variable of human behaviour. How the proposals fit into the reality of the maritime-port sector was analysed in a transversal way, seeking Socio-Ecological Port System (SEPS) perspectives. This made it possible to move from Environmental Management Systems to an **Integrated and Ecosystem Based Port Environmental Management System (PEMS-IEB)**. From a managerial perspective, it was also suggested that an additional DPSIR framework should be applied to the “response” component, the management system itself, understood as a system with its own elements, processes and interrelations.

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## 1. Introduction

The great appeal of coastal-marine areas is causing a global situation of “littoralisation” that threatens the welfare of coastal societies through ecosystem degradation (Barragán and de Andrés, 2015; Martínez et al., 2007). There is a paradox, as its exceptional ecosystemic capital is leading coastal areas to a crisis situation, causing a perverse autophagic cycle (Barragán, 2014; Costanza et al., 2014, 1997, De Groot et al., 2012, 2010). This loss of ecosystem services and assets has been observed at different scales

on coast and oceans (UNEP, 2012, 2006; United Nations, 2016).

While, lack of success in the implementation of integrated coastal zone management initiatives (ICZM) raises the need to provide new strategies that facilitate better inclusion of private stakeholders, who compete for territorial advantages. It also seems pertinent to do so with economic sectors that have traditionally lacked involvement in these initiatives, such as ports (EC, 1999a; Nebot et al., 2017). The maritime-port sector is of great strategic relevance for world trade, but with a significant unresolved structural impact on the areas in which they are located (Clark, 1994; Cunha, 2006; OECD, 2011).

There is an urgent need to improve the implementation of planning, management and regulation measures without necessarily implying a slowdown to the economic impetus. There are two ways of approaching these objectives. One is to be implemented by

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private agents and specific economic sectors and industry (hereinafter called economic agents) through their strategic and operational Environmental Management Tools (EMT). These tools are of compulsory or voluntary nature, such as environmental impact assessment, environmental management systems, strategic environmental plans. Another approach is that implemented by public stakeholders, starting from policies, plans and programs associated with more general and comprehensive measures. In the latter case, the key examples are the Ecosystem-Based Management (EBM), Integrated Coastal Zone Management (ICZM) and Marine Spatial Planning (MSP), all enriched in the last decade with the incorporation of the concept of ecosystem services. These approaches share fundamental principles (CBD, 2004; Douvère, 2008; Ehler and Douvère, 2009; GESAMP, 1996; Haines-Young and Potschin, 2011; IBERMAR, 2012; McLeod et al., 2005; Pérez Cayeiro, 2013) and will be jointly addressed in this paper, referred to as Integrated and Ecosystem Based Management Models (IEBM).

However, given the socio-ecological and legal-administrative complexity of the coastal areas, the IEIBMs also share great difficulties in their implementation, resulting in a significant gap between theory and practice (Dickey-Collas, 2014; IBERMAR, 2012; Jones et al., 2016; Link and Browman, 2014; Sardà et al., 2014; Walther and Mollmann, 2014; Wilson et al., 2014). Most authors stress the difficulties of convincing and engaging the various economic stakeholders involved in the transformation of coastal-marine areas, something that was already highlighted in the EU Demonstration Programme on Integrated Coastal Zone Management (DPICZM-EU), carried out by the European Commission in 1999 (EC, 1999a).

According to Tallis et al. (2010), among the disadvantages stated by stakeholders to resist the change proposed by IEIBM are excessive cost, the need to collect large amounts of information, long implementation periods, and even the need for mature and stable legal-administrative systems. Issues such as conflict resolution between multiple inter and intra-sectorial interests or the necessary involvement of different agents in decision-making adds a complex sociological component to IEIBM (DeLauer et al., 2014). The common temporal and spatial decoupling between sectorial administrations, or the aforementioned tradition of autonomy of some sectors such as ports, do not make it any easier (EC, 1999a). As a consequence, these difficulties reluctance exists, which means that changes are not always demanded in general or that some agents resist to them due to entrenched sectorial interests (Murawski, 2007, p. 681), hindering a consensual political commitment.

In order to reverse this dynamic, in the last decade new conceptual frameworks and tools have been developed to support governance systems for public administrations, trying to integrate the multiple intersectorial interests to better implement the IEIBM. However, there are fewer adaptation efforts observed in EMTs to be used directly by those economic agents. It is not easy to find examples or references of the incorporation of IEIBM principles on these sectorial tools (EMT). In other words, passive integration can be found, but few instances of active inclusion.

This paper explores ways to help active inclusion. An adaptation of existing environmental management tools, normally employed by economic stakeholders, should facilitate to engage the various private agents and specific economic sectors and industry in the implementation process of an Integrated and Ecosystem Based Management Model (IEIBM). To achieve this, the main goal of its research is to seek to establish bridges between the environmental management systems and tools of economic agents (EMTs) and the integrated and ecosystem based management models (IEIBMs), tracing paths from the first to the second one.

Thus, traditional vision and concepts used on the EMTs were

confronted with new approaches found through a broad literature review of both EMT and IEIBM (objective one). The consequent proposals of this revision allowed to construct a conceptual model, for addressing tensions among different stakeholders by making economic agents more aware of its interaction with the surrounding socio-ecological system (objective two). In order to proof the validity of that model (objective three), this construction was accompanied, on the one hand, by a transversal analysis of how the proposals fit with the reality of the maritime-port sector, chosen for its unique role in the coastal and marine areas and the relative homogeneity of the EMT employed by them. On the other hand, the theoretical effort has been applied to a real case, and the analysis of the **port of Imbituba**, in the state of Santa Catarina (southern Brazil), has been carried out, for the construction of an **Integrated and Ecosystem Based Port Environmental Management System (PEMS-IEB)**. A summary is shown in the [Supplementary Material SM1](#).

## 2. General conceptual overview

One of the main difficulties identified when implementing the ecosystem or the integrated approaches into management processes lies in the gap between science and society. As a result, many sectors plan their activities as a closed system with respect to their natural environment. For example, ports define their zones of influence (umland, foreland and hinterland) based on economic and functional criteria associated with their interests (Barragán, 1987). On the other hand, the navigation channels where vessels pass to reach a port are seen, from a sectorial point of view, as mere technical support infrastructures (Cunha et al., 2013; EC, 1999a). However, these same waters can be utilised for other activities such as fishing, which understands marine space as an ecosystem provider of living resources.

In order to resolve these conflicts, environmental management tends to regulate this use, but does not solve the initial interpretation, hindering the effectiveness of more strategic environmental tools.

The ecosystem approach, on the other hand, recognizes that human well-being and the health of ecosystems are strongly linked. Humans and nature are indivisibly interrelated by processes and cultural dynamics and flows of services, risks and pressures (Agardy et al., 2011; CBD, 2000; MEA, 2005; UNEP, 2006). For this reason environmental science must also focus, for the design of management tools, on the concept of socio-ecological system (Martín-López et al., 2012, p. 19) when referring to coastal and marine environments. This socio-ecological system is made up of environmental units (e.g., ecosystems) and socio-ecological processes (e.g., ecosystem services and pressures), stakeholders and associated governance (Ostrom, 2009).

This systemic vision increases the focus of attention on those relationships, where conflicts occur (Cunha, 2006). It helps clarify the relationship of an activity with the surrounding environment (in both directions), helping stakeholders to see more clearly their role of co-responsibility (Barragán and de Andrés, 2016).

The ecosystem approach allows for a more holistic view, facilitating the organization of system elements and processes to be managed (Scherer and Asmus, 2016). This would contrast with the traditional analysis that develops a segmented description of the physical, biological and socioeconomic components, requiring further, and always difficult, integration (Agardy et al., 2011; Murawski, 2007). Therefore, in a more integrative and ecosystemic analysis, ports could be understood as operational systems, constituted by limits, elements, processes, external sources, loss and internal and external controls (Cunha et al., 2013). However, they are part of a set that contains macro elements and processes

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