

The Dpsir Framework for Integrating the Ecosystem Services in River Nestos Lagoons-Greece

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Abstract

It is well documented that conservation and management of water resources are directly related to the sustainable living, i.e. to social, economic and environmental aspects. There has been much effort by the European research community to provide tools to support the implementation of freshwater sustainability and management policy instruments. In this context the DPSIR model was used as an analytical framework for determining pressures and impacts under the WFD as it is considered as an effective tool for both society and policy makers concerning water resources management. There is also an increasing interest about the importance of key ecosystem services in maintaining of human well being sustaining also water related services. Thus, there is much political and scientific drive to embrace the “Ecosystem Services” (ES) based approach. Based on the linking of these processes we present an integration of the DPSIR model with the ES concept using as case-study the River Nestos lagoons (Greece). According to the DPSIR approach the major driving forces leading to pressures were the agriculture, the irrigation, the unrestrained livestock, the industry and the urban wastewater. We outline the main changes in the State and in the Ecosystem Services which are essential to support sustainability. Our results show that integrating pressure analysis with Ecosystem Services we provide a useful tool for implementing management policies.

Keywords: *DPSIR, Ecosystem Services, Nestos lagoons*

1. Introduction

Aquatic ecosystems support the delivery of crucial ecosystem services, such as fish production, water provisioning and recreation. Key ecosystem services are connected to the hydrological cycle in the river basin (Grizzetti et al., 2016). Europe's waters are affected by several pressures, including water pollution, water scarcity and floods. Major modifications to water bodies also affect morphology and water flow. To maintain and improve the essential ecosystem services of our water ecosystems, we need to manage them well. The DPSIR model is an analytical framework for determining pressures and impacts applied also in the Water Framework Directive (WFD, 2000/60/EC) - (WFD Guidance Document No. 3 2002; Borja et al. 2006), thus is considered as an additional tool for both society and policy makers (Giupponi 2007). The Ecosystem Services

(ES) concept is becoming more and more acknowledged in science and decision making, resulting in several applications in environmental management, but still it is developing (Kandziora et al., 2013). Understanding which ES are delivered and their connection to human activities is the main clue of the integrated ES approach (Pinto et al., 2013). There is a need to merge ecosystem services with the DPSIR model in order to broaden its applicability (Lewison et al., 2016). The objective of the present paper is to present an integration of the DPSIR model with the concept of the ES in River Nestos Lagoons.

2. Methodology

The DPSIR was used as a framework to integrate the impacts with the concept of the ES. Influenced by the DPSEI concept of Keble et al. (2013), who replaced Impacts with ES, we correlated Impacts with affected ES in order to incorporate both the negative and the positive changes resulting in the ecosystem forming the Ecosystem Based Management. The ES classification of this study was with respect to the 4 major categories and subcategories propose by the Millennium Ecosystem Assessment (2005). The research study area is River Nestos estuaries and the two adjacent lagoon systems, located in Northern Greece in a total area of 41 km². It is an area of high scientific interest due to its special hydro-morphological characteristics and its multiple protection status (Ramsar and Natura 2000). As for data sources, the National Statistical Agency provided the main data form which the livestock population derived and the River Basin Management Plan (RBMP) described the industrial and agricultural activity. Official land improvement organizations (TOEV) provided irrigation data and the Environment and Climate Change Ministry's data pertained to the urban wastewater were also exploited.

3. Results

3.1. Driving Forces and Pressures

In Nestos River Basin, the major economic activities include livestock, agriculture, industry and urbanization. The agricultural activity is examined for the type of crops and the areas under cultivation. Nutrients release (N & P) is referred as one of the major pressures in this study. According to the RBMP, within the catchment area there

is a poultry farm with a capacity of 57,500 animals and 11 pig farms, with a varied capacity of 10-800 animals. The main pollutants related to unrestrained livestock are nitrogen, phosphorus and BOD₅. Connected to rural development, irrigation is intensively practiced in the catchment area and takes place through surface networks, earthworks and injection wells. Industrialization in Nestos valley can be described as relatively moderate, including the operation of one petrol industry and a slaughterhouse, which falls under the IPCC protocol. One direct impact of urbanization is the production of pollution loads from human activity. In the Municipality of Nestos there is a Wastewater Treatment Plant (WWTP) in operation with a capacity of 16,000 PE, where the average daily incoming load is 576 kg BOD₅.

3.2. State, Impacts connection with the Ecosystem Services and Responses

The evaluation of both the ecological and the chemical status of the water bodies in the study area was based on the data derived from the RBMP. The outcome of the study pointed that the ecological status in all water bodies

within the catchment area has been evaluated as “moderate”, while the chemical status has been characterized as “bad”. The integration of the ES in the DPSIR framework is presented in Figure 1, as well as the proposed actions according to the guidelines of the WFD and the current status.

4. Conclusions

In conclusion, this multi-provisioning valuable ecosystem under pressure is at risk to lose WFD goal despite its protection status. Incorporation of ES within DPSIR is a useful additional management tool and linkage of Impacts with related ES highlights the threat for both human and environment. A broadened Δ-DPSER, meaning re-analyzing in a certain time-step (Δ) the same parameters of the Driving forces, Pressures, State, Ecosystem services/Impacts and Responses (DPSER), fused with indices would be a management and research asset for many case studies.

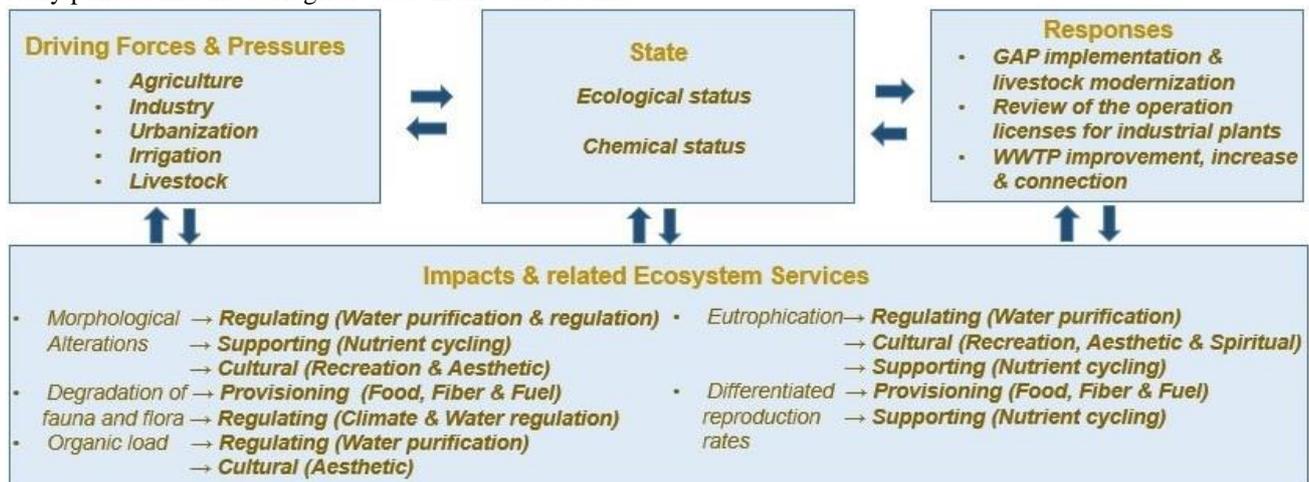


Figure 1. The integrated model in the study area

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