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Ecological Economics

journal homepage: www.elsevier.com/locate/ecocon

Methodological and Ideological Options

Addressing Maladaptive Coping Strategies of Local Communities to Changes in Ecosystem Service Provisions Using the DPSIR Framework

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ARTICLE INFO

Keywords:

DPSIR framework
Maladaptive coping strategy
Nested spatial domains
Ecosystem services

ABSTRACT

The *Driver-Pressure-State-Impact-Response* (DPSIR) framework has been applied to various environmental problems at multiple spatial and temporal scales and attempts have been made to conceptually improve the framework to encompass various stakeholder perspectives. However, recent literature experiences in the field have challenged the inclusive character of the framework applications. In particular, the framework's inability to incorporate the aggregated informal *responses* of people affected by changes in ecosystem service provisions has not been fully addressed. This limits the framework's validity in categorizing and disseminating information for addressing particular environmental challenges. Herein, we address this problem by analyzing a case study of deforestation and its impact on non-timber forest product collections by rural residents in Cambodia. We incorporate the concept of *maladaptive coping strategies* into the DPSIR framework and then further elaborate Ness et al.'s (2010) approach of merging the DPSIR framework with Hägerstrand's (2001) *system of nested spatial domains*. This conceptualizes the incorporation of the aggregated informal *responses* into the system, as exemplified in the case study.

1. Introduction

Environment and development discourses face serious and multi-dimensional issues. Various questions, such as how changes in ecosystems affect human well-being and what actions are required for the sustainable use of ecosystems to enhance our quality of life, need to be addressed in order to achieve sustainable development and eradicate poverty. To address these questions, the Millennium Ecosystem Assessment (MEA) focuses on the relationship between ecosystems and human society (MEA, 2005). Based on the perspective that ecosystems provide human society with several “services”, the MEA assessed the status and possible changes of ecosystems' functions. This perspective is currently broadly used by scientists and policy makers (Carpenter et al., 2009; Daily and Matson, 2008).

Ecosystem services (ES) are defined as “the benefits people obtain

from ecosystems” and can be classified into provisioning, regulating, supporting, and cultural services (MEA, 2005). These services can be categorized based on their importance such as those that are fundamental for our survival, such as food and water, and those with a discretionary degree of importance depending on the societal and individual value of recreation and religion.

As ES are literally services, ES never exist without the people that use them (Fisher et al., 2009). To examine the way for the sustainable use of ecosystems to enhance our quality of life, it is essential to capture not only the ecosystem's structure and processes, but also the interplay between ecosystems and people who define them as services. In other words, ES cannot be defined a priori by certain physical changes in ecosystems but are context- and user-dependent. To understand the interplay, increasing attention is being given to the *Driver-Pressure-State-Impact-Response* (DPSIR) framework to facilitate communication

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<https://doi.org/10.1016/j.ecolecon.2018.03.008>

Received 7 June 2016; Received in revised form 2 March 2018; Accepted 10 March 2018

Available online 05 April 2018

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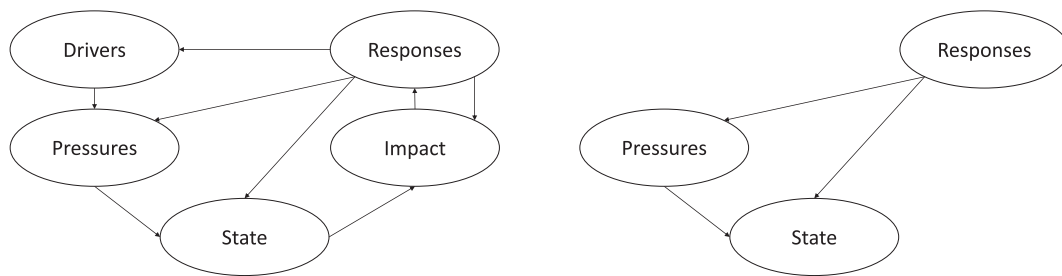


Fig. 1. DPSIR Framework adopted from Smeets and Weterings (1999) and the Pressure-State-Response (PSR) Framework.

among decision makers, policy makers, local residents, and other stakeholders.

The DPSIR framework (Fig. 1) allows us to describe and clarify the relationships between a society and its ecosystem in a simple manner. The DPSIR framework has been defined in various ways: “a conceptual framework for the description of the environmental problems and of their relationships with the socio-economic domain, in a policy meaningful way” (Maxim et al., 2009); “a functional analysis scheme for structuring the cause-effect relationships in connection with environmental and natural resource management problems” (Ness et al., 2010); “a means of structuring and organizing indicators in a way that is meaningful to decision makers” (Tscherning et al., 2012).

According to the European Environment Agency (EEA), one of the aims of the development of the DPSIR framework is “(to) structure thinking about the interplay between the environment and socio-economic activities” (EEA, 2014). EEA uses the framework “to help design assessments, identify indicators, and communicate results and can support improved environmental monitoring and information collection” (Stanners et al., 2007). The framework concept comprises five components. Direct pressure to the environment and society is triggered by social and economic development labeled as *drivers*. *Drivers* and *pressure* are also referred to as indirect drivers and direct drivers, respectively, under the MEA definitions (Rounsevell et al., 2010; Maxim et al., 2009; Pintér et al., 2008; Anastasopoulou et al., 2007). *Pressure* causes changes in the *state* of the environment. This *state* may refer to natural systems alone, such as a description of the quantity and quality of physical, biological and chemical variables in a given area (EEA, 2014), or to ES and/or benefits (Albert et al., 2014; Poppy et al., 2014; Carvalho-Santos et al., 2014), or to people's livelihoods, socio-economic conditions, and societal system (Nassl and Löffler, 2015; Suckall et al., 2014; UNCSD, 2001). This creates *impacts* on people's health, ecosystem functioning, and the economy. Finally, societal and political *responses* affect the four components of the system, directly or indirectly (EEA, 2014).

The DPSIR framework has its origins in the State-Response framework developed by Statistics Canada in the late 1970s (Svarstad et al., 2008). This was later developed into the PSR framework (Fig. 1) by the Organization for Economic Co-operation and Development and the United Nations Environment Programme (UNEP/RIVM, 1994; Hammond et al., 1995). Because of the shortcomings in the PSR framework focused too heavily on direct anthropogenic pressures and lacked consideration for their drivers as well as the dual aspect of impacts (both positive and negative) on humans, it was further developed into the DPSIR framework (Lin et al., 2009; Niemeijer and de Groot, 2008). Fuller mapping of DPSIR to this and other frameworks is given by Cooper (2013).

The DPSIR framework is currently used for various environmental issues with a wide range of spatial scales, such as in studies supporting policy-making, development of interdisciplinary indicators for environmental problems (EEA, 2014; UNEP, 2012), conceptualization of the system, assessment studies, and developing case studies (Wolfslehner and Vacik, 2011; Bezlepikina et al., 2014), and urban contexts (Kohsaka, 2010). The relevant indicators to monitor the relationships between ecosystems and human society that are considered

in the DPSIR concepts can facilitate the communication among stakeholders and their conservation activities (Uchiyama et al., 2015) in different regions of the world, including Japan with the *Satoyama* rich-biodiversity landscape (Kohsaka et al., 2013). The five strategic goals of the Aichi Target under the Convention on Biological Diversity also reflect the DPSIR concepts (SCBD, 2010; da Silva et al., 2015).

The DPSIR framework has been used for various purposes due to its simple and easy-to-understand characteristics. However, its practical application has been criticized, particularly its inability to capture complex interrelationships within the DPSIR (Rekolainen et al., 2003; Maxim et al., 2009). The debate on the purpose of its usage and efficacy is ongoing. For example, Rekolainen et al. (2003) questioned the efficacy of the DPSIR framework as a cause and effect model because of its inability to capture and handle system dynamics or to produce complete cause-consequence relationships and suggested linear unidirectional causal chains. Carr et al. (2007) argued that raising these points as limitations of the DPSIR framework is misguided, given that the original purpose of the framework was not to provide a cause and effect model. They argued that the framework is useful as “a means of categorizing and disseminating information related to particular environmental challenges” and to understand place-specific multiple concerns of stakeholders (Carr et al., 2007). Carr et al. (2007), in agreement with Karageorgis et al. (2006) and supported by Rehr et al. (2012), argued that researchers must apply models to understand the links between each of the categories of DPSIR. Given the fact that the framework has already been applied to various environmental problems at multiple spatial scales, our aim is to explore how to make this conceptual framework a better tool for “categorizing and disseminating information related to particular environmental challenges” (Carr et al., 2007) for decision makers and policy makers who seek tools for inclusive, logical, and evidence-based policy process with wide spectrum.

To achieve this aim, the present study is structured into two parts. First, we review the literature and argue that a) there are only a limited number of studies that identify segments of society particularly vulnerable to *pressure* and associated changes in ES provisions, b) only a few consider the *maladaptive coping strategies* of Suckall et al. (2014) taken by local residents, c) there is a lack of studies that have applied a short timescale such as five years for their analyses, and d) there are no studies that elaborate further on the ideas of Ness et al. (2010) that combine Hägerstrand's (2001) *system of nested spatial domains* with the DPSIR framework.

Second, using a case study of forest conservation for sustainable non-timber forest product (NTFP) collections in Cambodia, wherein differentiated policy measures tailored for local residents who take *maladaptive coping strategies* and those who do not, we describe the method to conceptually incorporate the aggregated individual *responses* into the DPSIR framework by identifying the social-ecological conditions or the *state* to which people likely to be affected by changes in ES belong. This incorporation will be achieved by merging two key ideas that have been proposed by two author groups, as follows: *maladaptive coping strategies* and the proposal of Ness et al. (2010) that combines Hägerstrand's (2001) *system of nested spatial domains* with the DPSIR framework.

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