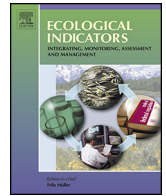




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# Regional sustainability assessment framework for integrated coastal zone management: Satoumi, ecosystem services approach, and inclusive wealth

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### ABSTRACT

This study proposes a novel regional sustainability assessment framework for integrated coastal zone management (ICZM). Various ICZM indicators have been developed, but their management insights are not always clear. Our framework integrates three separately developed approaches with an explicit reflection of stakeholders' values: Satoumi (a Japanese concept of socio-ecological production landscapes, SEPLs), ecosystem services approach (ESA), and inclusive wealth (IW). We suggest that the integration of Satoumi, a uniquely Japanese concept, with the ESA and IW complements each other and increases the effectiveness of all three approaches when applied to ICZM and decision making. Satoumi describes the desired state of a coastal zone. The ESA translates Satoumi into IW and helps explain which changes to ecosystems contribute to the asset quality (i.e., shadow prices). As a sustainability indicator, IW differs from other ecological indicators because it comprises human, natural, and manufactured capital assets and incorporates shadow prices to weigh the contribution of each asset to the present value of social welfare. Shadow prices may capture the quality of capital assets in terms of how much people value them, and can therefore be a direct management target for realizing a desired coastal zone. We propose adding two sustainability criteria, desired state and strong sustainability, to the original IW to make it operational. The framework was tested in Japan's Seto Inland Sea, and the results were analyzed in depth. Based on the outcomes, we discuss the insights for ICZM and future research. While Satoumi is a Japanese concept, the framework could be applied to other countries where similar SEPLs exist.

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## 1. Introduction

The goal of this study is to advance methodology for development of a regional sustainability assessment framework for integrated coastal zone management (ICZM or ICM). ICZM has been globally adopted. The European Commission adopted a new initiative on ICM on March 12, 2013 (European Commission, n.d.). The Japanese Basic Act on Ocean Policy (Act No. 33; April 27, 2007) stipulates that a state shall adopt ICZM. The aim of ICZM is to coordinate the application of different policies and activities affecting coastal zones, which covers coastal sea and land areas, in order to develop the coastal zones in a sustainable manner; it respects the limits of natural resources and ecosystems and involves transdisciplinary knowledge and all stakeholders across the different sectors

(European Commission, n.d.; Japanese Basic Act on Ocean Policy: Act No. 33, April 27, 2007; Maccarrone et al., 2014).

These ambitious aims provide much scope for improving ICZM. The European Commission, for example, conducted a formal evaluation of ICZM efforts across Europe and suggested the need to make ICZM more operational (Ballinger et al., 2010). Syme et al. (2012) point out that there is a gap between science and coastal management, and it is unclear how to integrate research outcomes into coastal management schemes. We need to develop methodologies for addressing a variety of difficulties including a lack of engagement between scientists, practitioners, and policy makers, a lack of data, uncertainty, contrasting terminologies, and the need to integrate results from a broad spectrum of methodologies and disciplines (Reis et al., 2014).

This study presents a novel sustainability assessment framework that uses indicators to bridge this gap. Indicators for ICZM have been in increasing demand and most of the existing best practices for ICZM outline their use (Maccarrone et al., 2014). Various

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social and ecological indicators have been developed (Duraiappah et al., 2012; Hattam et al., 2015; Turner et al., 2014); however, shortcomings remain. For example, Maccarrone et al. (2014) raise four principal shortcomings of ICZM indicators: lack of reflection of socio-ecological interactions, lack of feedback from the responses to previously adopted management actions, lack of consistency with the ICZM objectives, and lack of the availability and homogeneity of the indicator set. Current indicators often lack practical ICZM insights but provide a description of a state or the past; their contributions to sustainability are often not explicitly explained but implicit. Our proposed framework attempts to overcome some of these shortcomings.

Our framework is systematic, not *ad hoc*, and transdisciplinary; it integrates three separately developed approaches that explicitly reflect stakeholders' values: Satoumi (the Japanese concept of socio-ecological production landscapes (SEPLs)), the ecosystem services approach (ESA), and inclusive wealth (IW). Each approach makes a different contribution to sustainability assessment, and their integration is complementary and makes the assessment framework credible and operational. *Ad hoc* approaches (Harris and Pearson, 2004) or a lack of theoretical foundation (Kulig et al., 2010) has hindered the development of a sustainable assessment framework. Without a theoretical or systematic foundation, it is difficult to validate and further develop the framework. IW is grounded in neoclassical growth theory but can be extended beyond the neoclassical framework. IW is realistic as it allows for an imperfect economy in which government maximizes intergenerational social welfare (Arrow et al., 2003). It integrates environmental, economic, and social aspects through capital assets, which contrasts with most attempts to measure sustainability (Singh et al., 2012). The integration is transdisciplinary in that it is intended to construct an issue-oriented, interdisciplinary, and participatory assessment framework.<sup>1</sup> The transdisciplinary design of the framework makes it operational, in that it provides practical inputs to ICZM to attain or sustain a desired coastal zone. The actual practice of this type of research "has long lagged behind theory" (Fischer et al., 2015, p.146).

The framework was tested in Japan's Seto Inland Sea (SIS) and analyzed in detail. We discuss the outcomes' insights for ICZM of the SIS and future research needed to further develop the framework. This case study makes an important contribution to the scientific literature, which comprises predominantly European and North American cases and comparatively few Japanese examples (see Liqueste et al. (2013) for a review). The case study aims to provide sufficient guidance for readers to apply the framework to their areas of interest.

## 2. Regional sustainability assessment framework

Our framework comprises three approaches with seven steps (Fig. 1). It extends IW to compute a sustainable development path index by adding sustainability conditions, and adopts Satoumi and the ESA to make IW credible and operational as a regional sustainability assessment tool. Satoumi, ESA, and IW play different but partially overlapping or related roles. Their integration is complementary and increases the effectiveness of all three approaches when applied to coastal zone management and decision making.

IW is calculated as the sum of the net present value of social welfare which is provided by the product of capital assets (i.e., productive base) and the assets' shadow prices (i.e., social welfare weights; Pearson et al., 2013) instead of uniform weights that are commonly used in ecology (Banzhaf and Boyd, 2012). The original

IW, however, does not guide us to choose a desired state of coastal zones, or rank capital assets for the evaluation targets as an input to ICZM. Satoumi pictures the desired state, which helps rank the evaluation and management targets. The ESA can bridge the gap between IW and Satoumi by translating the desired state of coastal zones into a list of capital assets and their shadow prices. Although some researchers claim that the ESA can provide normative knowledge, there is "not a single accepted normative framework" (Abson et al., 2014, p.35) and it cannot be substituted for Satoumi. While Satoumi is a Japanese concept, the framework could be applied to other countries where similar SEPLs exist (Gu and Subramanian, 2014).

The following sections define the three approaches (Approaches 1–3); describe their relative strengths and weaknesses for the sustainable use of coastal zones; and demonstrate their application to the Seto Inland Sea, Japan (Steps 1–7).

### 2.1. Approach 1: Satoumi

Satoumi<sup>2</sup> can be defined as "a coastal area where biological productivity and biodiversity has increased through human interaction" (Ministry of the Environment Government of Japan, n.d.). This has been generalized into SEPLs, referring to "dynamic mosaics of habitats and land uses that have been shaped over the years by interactions between people and nature in ways that maintain biodiversity and provide humans with goods and services needed for their well-being" (Gu and Subramanian, 2014). Satoumi is a multifaceted concept, and its various aspects have been elucidated since first proposed by Yanagi in 1998 (Yanagi, 2012).<sup>3</sup> Among them, there appear to be three major aspects: normative, managerial, and context-dependent. Firstly, Satoumi is about the normative state of the coastal area; for example, "the state of the coastal sea that the local community desires" (Berque and Matsuda, 2013, p.192), "preferable coastal area environment" (Ministry of the Environment Government of Japan, n.d.), or "the representation of an ideal relationship which should be created between human beings and the sea" (Duraiappah et al., 2012, p.25). Secondly, it is about coastal zone management regimes (Duraiappah et al., 2012) that enable the desired coastal state to be sustained. Satoumi is "managed with a mix of traditional knowledge and modern science" (Duraiappah et al., 2012, p.26) and involves local communities (Berque and Matsuda, 2013). While Satoumi utilizes traditional knowledge, it adopts a form of adaptive co-management that is adaptive to changes in socio-ecological contexts (Henocque, 2013) (arrow from Step 7 to Satoumi in Fig. 1). In Satoumi, management involves various stakeholders such as the community, and municipal, prefectural, and national administrations, each of which makes different contributions (Hidaka, 2016). Thirdly, Satoumi reflects socio-ecological contexts (Duraiappah et al., 2012; Hidaka, 2016), thereby varying according to place and time. Although the term is relatively new, Komatsu and Yanagi (2015) found examples of Satoumi since at least the Edo period (1620 CE–1850). Since Satoumi is, in a sense, based on local memory, the desired state and management are not fashioned anew but can give them a certain transparency (i.e., familiarity). The transparent presentation of the values ensures the credibility and robustness of the sustainability assessment methods (Sala et al., 2015).

The main contribution of Satoumi to the framework is to picture a stakeholder-engaged and socio-ecological view of a desired coastal area that helps rank capital assets for IW to assess the sustainability of the coastal area and elicit insights for ICZM. This

<sup>1</sup> See Common and Stagl (2005) for the connotations of transdisciplinarity.

<sup>2</sup> "sato" means a local community or village where people live their life and "umi" is the most common word meaning the sea" (Shimizu et al., 2014, p.209)

<sup>3</sup> Hidaka (2016) summarizes various definitions of Satoumi.

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