



Integrated dynamic policy management methodology and system for strategic environmental assessment of golf course installation policy in Taiwan

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ABSTRACT

Strategic environmental assessment (SEA) focuses primarily on assessing how policies, plans, and programs (PPPs) influence the sustainability of the involved regions. However, the processes of assessing policies and developing management strategies for pollution load and resource use are usually separate in the current SEA system. This study developed a policy management methodology to overcome the defects generated during the above processes. This work first devised a dynamic management framework using the methods of systems thinking, system dynamics, and Managing for Results (MFRs). Furthermore, a driving force–pressure–state–impact–response (DPSIR) indicator system was developed. The golf course installation policy was applied as a case study. Taiwan, counties of Taiwan, and the golf courses within those individual counties were identified as a system, subsystems, and objects, respectively. This study identified an object-linked double-layer framework with multi-stage-option to simultaneously to quantify golf courses in each subsystem and determine ratios of abatement and allocation for pollution load and resource use of each golf course. The DPSIR indicator values for each item of each golf course in each subsystem are calculated based on the options taken in the two decision layers. The summation of indicator values for all items of all golf courses in all subsystems according to various options is defined as the sustainability value of the policy. An optimization model and a system (IDPMS) were developed to obtain the greatest sustainability value of the policy, while golf course quantity, human activity intensity, total quantities of pollution load and resource use are simultaneously obtained. The solution method based on enumeration of multiple bounds for objectives and constraints (EMBOC) was developed for the problem with 1.95×10^{128} combinations of possible options to solve the optimal solution in ten minutes using a personal computer with 3.0 GHz CPU. This study obtain the policy with the optimal environmental sustainability value in Taiwan is 102 golf courses. Human activity intensity and total quantities of pollution load and resource use which are concurrently obtained are less than those of the existing policy and the existing quantities in 2006. The optimal solution remains unchanged under most sensitivity analysis conditions, unless the weights and constraints are extremely changed. The analytical results indicate that the proposed methodology can be used to assist the authorities for simultaneously generating and assessing the policy during the SEA process.

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1. Introduction

Governmental policies, plans, and programs (PPPs) strive to achieve sustainable development in administrative regions. Various countries have established strategic environmental assessment (SEA) systems to assess, modify, and control PPPs. Assessment results provide the basis for

determining whether PPPs should be implemented (Fischer, 2003; Bao et al., 2004; Noble, 2004; Chaker et al., 2006). In Taiwan, a similar system, i.e. the policy environmental impact assessment (PEIA) system, was legislated in 2000. Nine policies of central governments need to be assessed before implementation according to the PEIA system, including industry (installation of industrial parks, energy-intensive fundamental industry policy), mineral (development and supply of sand and gravel), water resource, land use (installation of golf courses, large transformation of the agricultural and conservational lands to non-agricultural use, modification of a tap water quality and volume protection zone, modification of a drinking water quality protection zone, planning or modification of an urban plan more than ten hectares), energy, livestock (breeding of hogs), traffic (important railroad and highway development), waste treatment, and radioactive nuclear waste treatment

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(re-treatment of the nuclear waste generated by nuclear power plant). The Taiwan Environmental Protection Administration (TEPA) reviews the assessment report and proposes its comments to the Executive Yuan (Cabinet of Taiwan). The Executive Yuan will decide whether the policy can be approved or not with the considerations of TEPA's review comments (Chen et al., 2009; Kuo et al., 2005; Liou and Yu, 2004).

Generally, SEA consists of the following steps: identifying goals, screening, setting objectives and targets, scoping, establishing indicators, predicting impacts, comparing alternatives, public participation, decision making, and monitoring (Arce and Gullón, 2000; Finnveden et al., 2003). However, most countries separate the processes of assessing policies and the process of developing management strategies for pollution load and resource use. For example, the golf course installation policy is one of the policies need to be performed an SEA in Taiwan according to the PEIA system. Various quantities of golf courses were first generated during the policy developing process by the National Council on Physical Fitness and Sports (NCPFS). The alternative which could bring higher sustainability than others would be chosen and the acceptable quantity of golf courses were determined during the SEA process. Management strategies for pollution load (including air pollution, water pollution, soil pollution, and waste) and resource use (including water resources, land resources, forest resources, and ecological habitat) would be planned based on the policy after SEA (Chen et al., 2009). However, the policy was not assessed under the consideration of an integral system to find the highest sustainability of this policy.

The authorities can only obtain policy assessment information via the existing SEA process, but cannot generate the management strategies for policy modification. Furthermore, the expected sustainability of the involved regions by implementing the policy can hardly be achieved because the policy can't be integrally developed through the above process. Some studies thought that systematical procedures and methodologies for integration of environmental assessment and decision-making are required for SEA (Scrase and Sheate, 2002; Richardson, 2005; Fischer & Gazzola, 2006; Partidário & Vicente, 2006; Bina, 2007).

The purpose of this work is to develop an integrated dynamic policy management methodology which can be used to simultaneously

develop the policy and its management strategies for pollution load and resource use during the SEA process. Furthermore, this study aims to develop an optimization model and a management system based on the characteristics of the golf course installation policy. A conceptual operation mechanism of SEA (Fig. 1) was proposed and applied for developing the methodology. Authority of PPPs should develop policy for allocating quantities of golf courses and management strategies for managing pollution load and resource use. An internal assessment is simultaneously performed by the authority of PPP. Authority of environmental protection performs an external policy assessment with the related authority involved. When the policy is approved, the total quantities of pollution load and resource use should be simultaneously determined. The projects of related organization should be developed based on the policy and management strategies. In the existing environmental impact assessment (EIA) system, many projects need to be assessed. However, a project may not require an EIA if the total project quantities of pollution load and resource use do not exceed the limits set out in the policy.

Authority of PPPs allocates total quantities of pollution load and resource use to related projects during the implementation stage. Authority of PPPs monitors the relevant values for policy control, including the results of relevant project implementation. Policies and projects can be effectively integrated during the planning, implementation, and control stage. SEA can thus be used to assist the authorities to improve the sustainability of a region by promotion of the policy.

Golf course installation policy in Taiwan was presented as a case study. Analytical results were used to show that the proposed methodology and system can be applied to assist the authorities in determining the optimal quantity of golf courses in each county. The proper quantities of pollution load and resource use of each golf course can simultaneously be determined. Sustainability can therefore be promoted when the assessed policy is implemented.

2. Development of dynamic management framework for PPPs

This study develops a dynamic management framework for PPPs (Fig. 2) by using the methods of systems thinking, system dynamics

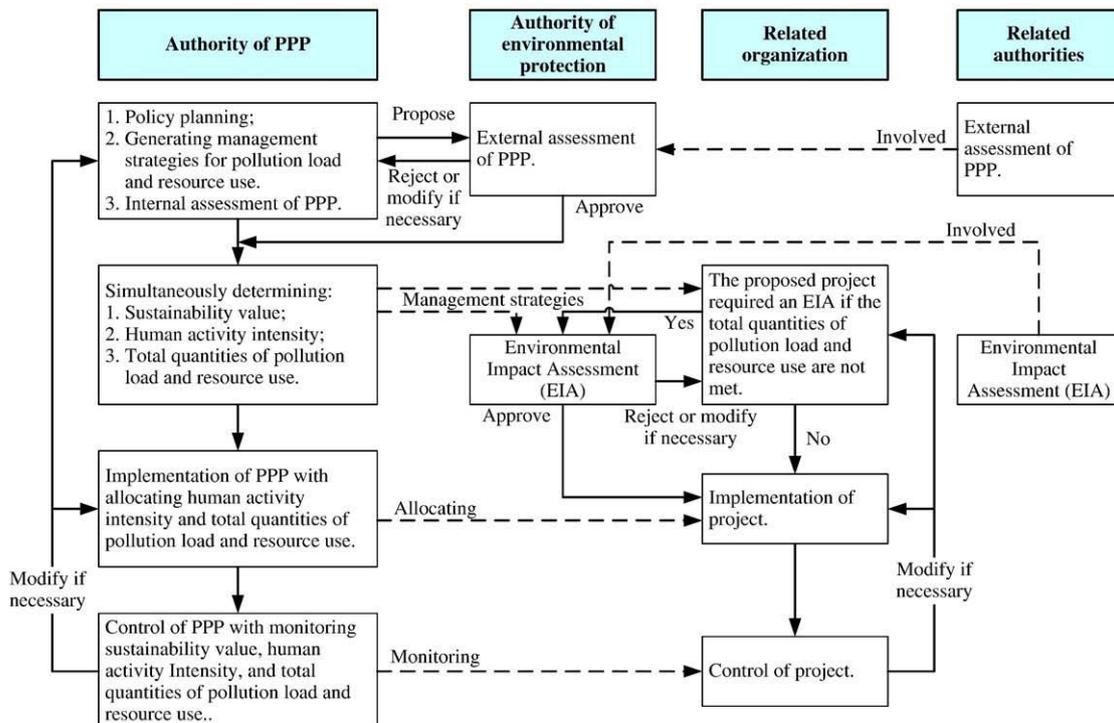


Fig. 1. Conceptual operation mechanism of SEA.

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