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Analyzing policy impact potential for municipal solid waste management decision-making: A case study of Taiwan

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Abstract

In the past 20 years, municipal solid waste policies have changed in response to societal and environmental changes. Municipal solid waste policies in many countries become more complicated and numerous. This paper reviews several models developed to support decision making in the area of municipal solid waste management (MSWM). It has been discovered that many modern decision-making support systems are already partially considering social factor analysis in addition to expenses and benefits, environmental effects, technical issues, and management aspects. However, questions are raised as to whether these analyses are sufficient and whether they can predict future possible impacts.

This research studies Taiwan's major municipal solid waste policies in the past 10 years and discovers that there is still a great deal of uncertainty associated with policy implementation, even when the effects of factors related to environmental, economic, social, technological, and management aspects have been considered. The purpose of this study is to develop a decision-making model of MSWM to resolve the insufficiencies in policy impact analysis used for decision-making. The policy impact potential analysis method is developed to predict the possible impacts of a policy on

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particular alternatives; subsequently, a novel decision-making model for waste management is formed. A case study of fly ash management in Taiwan is presented to demonstrate the practicality of this model.

Keywords: Municipal solid waste management; Decision making; Policy impact potential; Fly ash

1. Introduction

As municipal solid waste (MSW) problems become more complicated, waste policies also become more numerous and complex. In the past 30 years, MSW decision-making in many countries has also undergone significant change. Earlier MSW management (MSWM) was installed primarily for deciding collection systems or for determining transportation or transfer of solid waste. For example, in the 1970s, the goal of the MSWM model was simple and narrow, aimed at optimizing waste collection routes for vehicles (Truitt et al., 1969) or transfer station sitting (Esmali, 1972; Helms and Clark, 1971). In 1980s, the focus was extended to cover MSWM on the system level, minimizing the total economic cost (Hasit and Warner, 1981; Jenkins, 1982; Perlack and Willis, 1987).

After the 1990s, as MSW policies became more complicated, the factors to be considered also increased; hence, several MSWM models with deeper analysis emerged. The factors considered in MSWM models were mainly economic (e.g., system cost and system benefit), environmental (air emission, water pollution) and technological (the maturity of the technology). Three models have played a major role in the decision making of MSWM: life cycle assessment (LCA), multi objective programming (MOP) and multicriteria decision making (MCDM). Many researchers used LCA to evaluate the environmental impact of the alternatives for MSWM (Barton et al., 1996; Eriksson et al., 2002; Finnveden, 1999; Powell, 2000; Powell et al., 1996). Multiobjective programming is a popular method for solving MSWM problems, such as locating sites and choosing management strategies (Alidi, 1996; Chang and Hwang, 1996; Chang and Wang, 1996; Chang and Wei, 1999). MCDM, which is aimed at choosing the best among several alternatives by considering many criteria, is also widely used. Many techniques are available for solving the environment problem with multiple criteria, including the AHP method (Chiou and Tzeng, 2002; Haastrup et al., 1998; Tran et al., 2002), outranking methods (Brans and Vincke, 1985; Geldermann et al., 2000; Roy, 1991), and the TOPSIS method (Hwang and Yoon, 1981).

It was not until recently that societal acceptance and public participation became significant in the MSWM models. Morrissey and Browne (2004) proposed that a sustainable MSWM model should be not only environmentally effective and economically affordable but also socially acceptable. At present, there are several studies in the literature on the integration of social effects within MSWM models. The factors considered in social effects analysis include social welfare (Hernandez and Martin-Cejas, 2005), public acceptance (Cheng et al., 2002; Skordilis, 2004), social acceptability (Cavallaro and Ciraolo, 2005; Chung and Lo, 2003), social equity (Chung and Lo, 2003), political concerns (Cheng et al., 2002), cultural or heritage issues (Cheng et al., 2002; El-Naqa, 2005), and social cost (Hernandez and Martin-Cejas, 2005; Oliveira and Rosa, 2003). In addition, Hung (Hung et