

Long Term Planning For Integrated Solid Waste Management under Uncertainty

By

Amitabh Kumar Srivastava
Department of Civil Engineering

Submitted

In fulfillment of the requirements for the degree of

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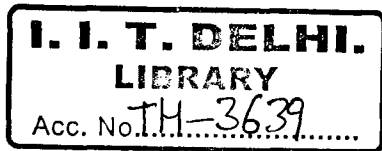
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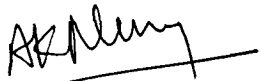
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CERTIFICATE

This is to certify that the thesis entitled “Long Term Planning for Integrated Solid Waste Management System under Uncertainty”, being submitted by Mr. Amitabh Kumar Srivastava, to the Indian Institute of Technology Delhi for the award of ‘Doctor of Philosophy’ in Civil Engineering is a record of the bonafied research work carried out by him under my supervision and guidance. He has fulfilled the requirements for the submission of this thesis, which to the best of my knowledge has reached the requisite standard.

The material contained in the thesis has not been submitted in part or full to any other university or institute for the award of any degree or diploma.

July 2007


(Arvind K. Nema)
Civil Engineering Department
Indian Institute of Technology Delhi
New Delhi – 110016, India

**Dedicated
To
My Parents**

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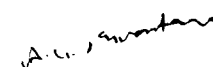
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ABSTRACT

Solid waste management is increasingly becoming a challenging task for the municipal authorities due to increasing waste quantities, changing waste composition, decreasing land availability for waste disposal sites and increasing awareness about the environmental risk associated with the waste management facilities.

The present study focuses on the optimum selection of the treatment and disposal facilities, their capacity planning and waste allocation under uncertainty associated with the long-term planning for solid waste management. The fuzzy parametric programming model is based on a multi-objective, multi- period system for integrated planning for solid waste management. The model dynamically locates the facilities and allocates the waste considering fuzzy waste quantity and capacity of waste management facility. The model addresses uncertainty in waste quantity as well as uncertainties in the operating capacities of waste management facilities simultaneously.

An example problem has been presented to demonstrate the usefulness of the proposed methodology and the model in making the planning decisions related to solid waste management and achieving a robust and optimum plan. The model is solved at different levels of membership function, for the alternative solutions with respect to different objectives. It was observed that uncertainty in waste quantity is likely to affect the planning for waste treatment/ disposal facilities more as compared with the uncertainty in the capacities of the waste management facilities. The relationship between increase in waste quantity and increase in the total cost/ risk

involved in waste management is found to be nonlinear. Therefore, it is possible that a marginal change in waste quantity could increase the total cost/ risk substantially.

The information obtained from the analysis of modeling results can be effectively used for understanding the effect of changing the priorities and objectives of planning decisions on facility selections and waste diversions. The fuzzy multi-period planning for solid waste management is especially relevant in case of rapidly growing urban centers of developing countries due to great possibility of fluctuating parameters. As demonstrated using the example problem, the multi-objective, multi-period planning model can be a very helpful tool for the decision makers especially for addressing location-allocation problem of waste disposal facilities with fluctuating parameters.

Keywords: Solid Waste Management, Integrated solid waste management system, Long term planning, Multi-objective and Multi-period planning, Fuzzy parametric programming

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