

## Abstract

Recycling with drop-off centers is an effective approach, but the recycling efficiency may be greatly affected by the locations and the distribution of drop-off centers. In a previous study, an optimization model with the objective to minimize the total service distance had been developed. However, if only the factor of total service distance is considered, some residents who live in unpopulated areas may be served with a long distance to the drop-off center. A drop-off center should be placed within an acceptable distance to the residents it serves. Increasing the number of drop-off centers can improve the recycling service, but the associated installation and operational cost is increased as well.

Three major objectives have been applied to optimize the allocation of drop-off centers in this study: to minimize the maximal service distance, to maximize the service ratio, and to minimize the number of drop-off centers under the constraint on the service ratio, respectively. The performance of the recycling program in each district is frequently evaluated and compared with other districts. Therefore, three scenarios of district-constrained (DC), district-open (DO) and non-district (ND) are analyzed, each with a separate objective function. A study area of sixteen districts in Hsinchu City has been implemented to demonstrate the applicability of the proposed models. Three major factors of service distance, district equity, and service ratio are used to compare the effectiveness of alternatives obtained from the models. The result of the model with the objective minimizing the maximum service distance can cover more residents in unpopulated areas than those obtained by other models, but the service ratio is low for both DC and DO scenarios. The

alternative obtained by the model maximizing the service ratio can serve most residents, but with long service distance for some residents in unpopulated areas. While the number of drop-off centers is small, increasing the number of centers can significantly improve the service ratio, but the incremental improvement is decreasing when the number of centers is large. The policymaker should carefully evaluate the tradeoffs among the recycling efficiency, service quality and cost before a proper number and distribution of drop-off centers are determined.

**Keywords:** Recycling drop-off center, Optimization, Siting analysis, Service ratio, Environmental systems analysis.

