ABSTRACT

CHARACTERIZING URBAN SOLID WASTE MANAGEMENT THROUGH SYSTEM DYNAMICS MODELING AND SIMULATION

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Solid waste (SW) generation bears environmental, social, and economic influences, making a sustainable solid waste management (SWM) system indispensable. Nonetheless, most developing countries lack the financial and technical capability to do traditional solid waste forecasting methods that require thorough data collection. As a result, solid waste management problems continue to beset many local government units in the Philippines; thus affecting the environment. System dynamics modelling and simulation is an appropriate tool to deal with this problem. The study aimed to characterize the dynamics of solid waste generation and management system of an urban area by developing a system dynamics model with STELLA software. Using data and information from published literature, a theoretical model was developed encapsulating interrelationships of waste management, population, city income, commercial activity, and marketability of recovered waste. The theoretical model was tested using two sets of simulations: (1) using a Reference City, made up of Philippine national and aggregate-city data and, (2) using Malolos City as case study. The scenarios using the Reference City demonstrated the potential of improving the waste management system through public awareness and marketability of waste as positive feedback of waste diversion practices, reducing the volume of waste generation and increasing volume of waste diverted. The construction of a Materials Recovery and Composting Facility (MRCF) and adjustments in the allocation of SWM budget could, in a six-year period, save Malolos City P36M while reducing total unmanaged waste by 14,000 tons, despite increased total waste generation of about 7,500 tons; the MRCF returned 100% of investment in 18 months. Reduction in unmanaged waste would be equivalent to lower potential GHG emissions in CH4 emissions from organic waste (less 200 tons), CO2 emissions from paper waste (less 15 tons), and CO2 emissions from plastic waste (less 7,400 tons).

Keywords: urban solid waste management, system dynamics modeling, Malolos City