ABSTRACT

As proved by the recent flooding in the United States, Pakistan, Germany and China, a climate change can have a devastating impact on our daily lives and the lives of future generations. Climate change is often caused by the strengthening greenhouse effect that raises temperature in the Earth by trapping high-energy gases from the sun. These gases are created by carbon dioxide emitted from our daily or supply chain activities involving manufacturing and logistics. To slow down the climate change (e.g., global warming), gas emissions have to be controlled by reducing wasteful supply chain activities and changing business practices. Recognizing the importance of this concept, many companies take the initiatives to handle their reverse logistics (RL) flows in such a way that they reduce environmental degradation.

However, managing end-of-use products can be extremely challenging due to the inherent complexity in collection, sorting, transshipment, and processing these products. Despite numerous challenges, the efficient handling of these products can be a source of competitive advantages. Since the integrated logistic systems play a vital role in today’s managerial decisions, an integrated location-routing approach may help the
firm develop more efficient networks by avoiding sub-optimization. While reviewing the available literature, it has become more evident that very few attempts were made on the location routing problem (LRP) in the RL context. In order to fill up the void created by the earlier studies, this thesis proposes the following models in the RL context: (i) Spatial consolidation based model for solving the Capacitated Routing and Allocation with Balancing-Single Product (CRAB-SP) problem, (ii) The combined location-routing model for solving CRAB-SP, and (iii) The combined location-routing model for solving Capacitated Routing and Allocation with Balancing-Multi Product (CRAB-MP) problem.

Major contributions of this thesis to the LRP in the RL context are as follows:

(i) Proposes three models to solve the CRAB-SP and the CRAB-MP
(ii) Proposes a decomposed methodology to solve CRAB-SP which considers location, allocation and routing decisions sequentially, (iii) Proposes an integrated methodology to solve the CRAB-SP and the CRAB-MP which consider the location, allocation and routing decisions simultaneously, (iv) Tackles the combined location-routing problem under capacity restrictions with the use of the capacitated clustering procedure (CCP) (v) Avoids the workload disparities among the Centralized Return Center (CRC) s through balanced allocation, (vi) Adopts the incentive-based product collection system
with the help of the randomized inspection of product quality levels, and
(vi) Performance of the proposed models and methodologies is validated with
the use of a case study conducted in an Indian recycling company.