Green Reverse Supply Chain Models With Fuzzy Stochastic Re-manufacturing Capacity

Raosaheb Latpate[a,*], Maruti Bhosale[b], Sandesh Kurade[c]

[a]*Department of Statistics, Savitribai Phule Pune University, Pune-411007, India*
[b]*Department of Statistics, Shri Shahu Mandir Mahavidyalaya, Parvati, Pune-411009*
[c]*Department of Statistics, MES Abasaheb Garware College, Pune-411004*

Abstract

Now a days, world faces the challenge of environmental pollution. The sources of environmental pollution are climate change, increase in CO_2 and CO level, wastage of electronic material in industries, pollution due to sound and vehicles, etc. It leads to environmental degradation. Wastage material in automobile industries is also creates environmental pollution. It is necessary to bring these wastage material in to the re-manufacturing process. The re-manufacturing process will help to decrease the environmental pollution and reuse in reproduction. The Government of India have launched voluntary scrappage policy to reduce the wastage of inventory and to protect the environment from hazardous material. Thus, a green reverse single stage supply chain model for re-manufacturing the obsolete product is developed with fuzzy stochastic re-manufacturing capacity by giving the optimum reward to the customer for returning the obsolete product to the manufacturer. There is no past information about remanufacturing item. Thus, we used fuzzy stochastic modelling. The expected manufacturer profit is highly non-linear hence it is solved by using Newton-Raphson method. For the applicability of the fuzzy stochastic re-manufacturing supply chain model, a real world numerical case study viz, *SM Tech* industry is considered and obtained the profit for this industry. *SM Tech* manufacturer produces four wheeler vehicles for commercial and private purpose across South-East Asia, mostly in India and South Africa. The impact of acceptance and recovery rate on manufacturer profit is analyzed using sensitivity analysis. The proposed reward function and recovery rate affected on the optimum profit inversely.

Keywords: Fuzzy stochastic, manufacturer profit, obsolete product, reverse supply chain, reward function, triangular fuzzy number.

1. Introduction

Government of India (GOI) launched new scrappage policy while presenting the budget of 2021. The prime objective of voluntary scrappage policy is to scrap the vehicles with age more than 15 years. There are more than five million vehicles are outdated i.e. they are not fit for use. Also, GOI decided to launch new fuel efficient vehicles and electric cars. It has a direct impact on reduction in oil import funds and 25% of reduction in air pollution. The proposed re-manufacturing policy supports the Government of India's expectation. In this policy, the new vehicles will be provided to the customers which is fuel effect, less cost with advanced technology. The main components of old vehicles are remanufactured with less cost. The new vehicles are more eco-friendly as compared to the old ones. It saves huge inventory of country. Now a day, Economic growth and facility of community goes on rapidly increases. It leads to increase in pollution. The main sources of pollution are climate change, increase in CO_2 and CO level, wastage of electronic material in industries, pollution due to sound and vehicles, etc. Also, pollution level increases due to defective products, obsolete product and wastage of raw material. Therefore, there is necessary to make the proper utilization of the unused and not for fit vehicles. The process of moving the manufactured product

---

*Corresponding author
Email addresses: rvl@unipune.ac.in (Raosaheb Latpate), marutibhosalestats@gmail.com (Maruti Bhosale), sandeshkurade@gmail.com (Sandesh Kurade)