

# **SUSTAINABLE SUPPLY CHAIN MANAGEMENT: EVOLUTION, IMPACT AND APPLICATION**

## **Abstract**

With growing market demand for various products in the latter half of the 20<sup>th</sup> century, many organizations ventured into risky but, frugally profitable mode of production thus compromising the long term impact on society as well as environment. However, subsequently over a period of time, world has faced some of the most disastrous industrial accidents. This has forced the stakeholders like regulatory authorities, manufacturers, customers, and society, to reconsider economic business model concepts and question the implications of the business on society and environment. Increasing rates of pollution and environmental calamities caused by industrial production have urged several researchers and industry experts to work on Sustainable Production and Consumption issues within the context of Sustainable Supply Chain Management (SSCM). Hence, this study attempts to understand and contribute to the sustainable supply chain literature from three broad perspectives of evolution, impact and application.

In the first part of the study (Chapter 2), a comprehensive thematic analysis is performed on 1068 studies over the time period 2000-2015, to understand the evolution of sustainability issues by analysing trends over the time, across industries, economies, and use of methodologies during the evolution of SSCM. The study also proposes a conceptual framework to classify various factors along triple bottom line pillars of sustainability issues in the context of supply chains. In-depth study is conducted on 190 articles which focuses on all pillars of sustainability (as per the proposed conceptual framework) on SSCM across

different economies to identify publication trend, industry specific studies, and methodological approaches used. It was observed that the studies focusing on all three dimensions of sustainability are comparatively scarce and more focus on industry specific studies is required. The study propose future avenues to extend research in the SSCM domain.

In the second part of the study (Chapter 3), a detailed literature review of sustainability research in chemical industry supply chain was done, considering the impact of chemical industries on sustainability. Thematic and content analysis was done on 145 selected articles to identify the trend, methodology used, industries studied and its distribution in various economies. Based on the insights received from both the literature reviews, multiple gaps in literature were identified and subsequent studies were done to address some of the selected issues. There was potential for more studies based on primary data from developing countries, which will provide an impetus to the motive of improving standard of living as well as reduce greenhouse emission in such economies. It was observed that, dynamic modelling methodologies were less used for studying sustainability issues along the supply chain in the emerging economies. Also, there is high potential for study of SSCM practices /issues/ models on most polluting industries like fertilizers /pesticides etc. across the world, owing to the high impact of such industries on economy, society and environment.

In the third part of the study (Chapter 4), the impact of various sustainability practices on firm performance is analysed using meta-analysis. In recent years, there have been a large number of studies linking supply chain sustainability practices to firm performance, as more and more firms are implementing sustainable practices in manufacturing / services supply chains. The study uses

natural resource based view and stakeholder theory lenses to examine research on sustainable supply chain practices using meta-analysis. Various sub-factors which impact this relationship are also identified and explained using multiple theoretical perspectives. The results confirm that the relationship between sustainable supply chain practices and firm performance is positive in nature. It also suggests that, the sustainable supply chain practices and firm performance relationships are stronger in the case of manufacturing industries and developing economies compared to that of service industries and developed economies respectively. Also the strength of sustainable supply chain practices and firm performance relationship was observed to be increasing over time. Outcomes of the research necessitate the need for studying the sustainability and performance relationships in manufacturing industry in developing economies which was done in the subsequent study.

In the fourth part of the study (Chapter 5), a framework based on multi criteria based decision making tool was developed to rank the triple bottom line performance of Indian manufacturing industries based on the adoption and impact of various sustainable supply chain processes on their triple bottom line performance. Taking into consideration the Stakeholder Theory and the Resource Based View, this study identifies 17 sustainable supply chain processes (SSCPs) which are further classified into six broad categories. Multiple structured interviews of stakeholders were conducted in major Indian cities to understand the critical SSCP processes of eight industries. Based on the survey, five important SSCP processes were identified and top three industries were ranked, based on the identified SSCP processes, by integrating Group Decision Making (GDM) and Multi-Criteria Decision Making (MCDM) models. To handle uncertainties due to

GDM, Fuzzy MCDM models have been applied and compared to understand their relative triple bottom line performance in Indian context. Thus the study provides a framework to compare the sustainability of industries, in emerging economies like India.

In the fifth part of the study (Chapter 6), we developed a system dynamic model for agro-chemical supply chains in Indian context, to analyse the impact of policies on adoption of sustainable alternatives and its impact on supply chain sustainability. Based on inputs from various stakeholders within the agro-chemical industry, variables and causal relation between them are identified. Subsequently causal loop was converted to stock and flow simulation model for testing and validation. Post testing, various strategies are applied on variables like, agricultural product minimum support price, subsidy on chemical fertilizer, subsidy on bio-fertilizer etc., and its impact on triple bottom line performance of the supply chain is studied. Further, Design of Experiments was applied to identify the critical factors in the model which impacts the triple bottom line performance with the help of Taguchi arrays. The model is applied on data obtained from a Kerala based bio-fertilizers company. The model is first of its kind simulation model in the agro-chemical industry which simultaneously takes in to account economic, social and environmental aspects in the context of agro-chemical supply chain from systems perspective.