Policy to practice: Enabling extended producer responsibility for plastic packaging

A Thesis

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by

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Dedicated to my dearest parents

for enabling my education throughout childhood and beyond,

instilling in me a sense of curiosity,

a love of reading,

and a passion for life-long learning.

Abstract

As the global economy and human population grow, the waste products of various commodities increase, negatively impacting the environment. Governments worldwide are framing extended producer responsibility (EPR) rules to make manufacturers pay for the waste generated by their goods after they have been used by consumers. EPR is an obligation on manufacturers to ensure environmentally sound management of their goods throughout their product life cycle. Violating these rules may lead to penalties. Our study aims to understand various factors by which manufacturers can comply with the EPR rules through the lens of institutional theory and resource dependence theory. Institutional theory helps explore how regulatory mandates and industry norms shape company responses to EPR, while resource dependence theory analyses how interdependence between firms, their supply chain actors, and technology can influence outcomes.

A literature review of 749 papers on EPR over a ten year period from 2012 onwards, helped identify factors that could enable firms to comply with EPR regulations: (i) Policy and legislation, (ii) Supply chain drivers of product design, remanufacturing capability, and reverse flow process and partnerships, (iii) Use of digital technology and science, (iv) Consumer behaviour, and (v) Business operating models. The review also showed that plastics were a relatively under-researched commodity. Most of the plastic EPR rules are made for plastic packaging used by major companies, especially in the consumer-packaged goods (CPG) supply chains. Further, we found that optimisation and analytical modelling were more prevalent in research than actual on-ground empirical or qualitative studies. Hence, our research concentrates on how CPG firms respond to EPR mandates by focusing on compliance strategies, enablers and barriers, and the role of partnerships and collaborations in fulfilling these responsibilities, through qualitative general inquiry methods.

We first conduct a directed qualitative content analysis through document-based secondary research in our study. We analyse the sustainability reports of 16 CPG companies listed on the National Stock Exchange of India for two consecutive years (FY2022-23 and FY2023-24) to understand the applicability of the identified factors to plastic packaging waste. The findings indicate that policy and legislation, product design, science, reverse flow processes, and partnerships are the factors that influence EPR implementation in companies.

To further our understanding, we conduct a qualitative general inquiry next, through semi-structured interviews of industry practitioners in the CPG supply chain, followed by a thematic analysis. A purposive sample helps us select 25 managers, after which saturation is achieved. We identify nine distinct factors through thematic analysis (on Atlas.ti software) that may act as enablers and barriers for EPR implementation in such firms. We develop relevant propositions and propose a conceptual antecedents-decisions-outcomes (ADO) framework that can guide both academicians and managers in implementing EPR. We also recommend a mnemonic acronym – PROCTTERD – on the lines of DMAIC (of Six Sigma), which can act as a helpful guide to managers implementing steps towards EPR.

Finally, we understand the interactions between the supply chain actors and how coordination is achieved at an operational level through a four-entity game-theoretic model. We model the decision of incorporating recycled materials in packaging, based on the quality and availability of such material from a collector-recycler, and the ability of the supplier to meet the quality specifications laid down by the manufacturer, in the backdrop of governmental EPR norms. Two scenarios are identified, with the manufacturer-as-a-leader scenario

generating higher profits compared to the supplier-as-a-leader scenario. We examine various options and boundary conditions, when availability becomes a constraint and when quality acts as a limiting factor and draw conclusions for the manufacturer's decision to relax quality standards, reduce costs, manage the availability of recycled goods, and comply with governmental regulations. We also recommend suggestions on how governmental incentives can be studied to make collectors drive a higher quality of their produce.

In conclusion, this study bridges the gap in understanding EPR compliance by combining qualitative primary and secondary data, game-theoretic interactions, and provides actionable recommendations to lawmakers and practitioners alike.

Keywords: Extended producer responsibility (EPR), responsible production and consumption (SDG12), plastic packaging, packaging waste, circularity, sustainability

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सब धरती कागज करूँ, लेखनी सब बनराय।

सात समुद्र की मसि करूँ, गुरु गुण लिखा न जाय।

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List of Acronyms

Acronym	Extended form
3R	Reduce Reuse Recycle
ADO	Antecedents Decisions Outcomes
AI	Artificial Intelligence
BOPP	Biaxially Oriented Polypropylene
BRSR	Business Responsibility and Sustainability Report
CE	Circular Economy
CLSC	Closed-Loop Supply Chain
COGS	Cost of Goods Sold
COREQ	Consolidated Criteria for Reporting Qualitative Studies
CPCB	Central Pollution Control Board (of India)
CPG	Consumer Packaged Goods
DfE	Design for Environmentability
DfR	Design for Recycling
DMAIC	Define Measure Analyse Improve Control
EMT	Ecological Modernisation Theory
EOL	End of Life
EPR	Extended Producer Responsibility
ESG	Environmental, Social, and Governance
EU	European Union
E-waste	Electronic Waste
FMCG	Fast Moving Consumer Goods
FSSAI	Food Safety and Standards Authority of India
GSCs	Green Supply Chains

HARL	Home Appliances Recycling Law (of Japan)
HDPE	High-Density Polyethylene
ICR	Inter-Coder Reliability
ICT	Information and Communication Technologies
InT	Institutional Theory
IoT	Internet of Things
IT	Information Technology
LDPE	Low-Density Polyethylene
LLM	Large Language Model
LR	Literature Review
MLP	Multi-layered Plastic (a type of laminate)
MSME	Micro, Small, and Medium Enterprises
MSW	Municipal Solid Waste
NLP	Natural Language Processing
NVG	National Voluntary Guidelines
OECD	Organisation for Economic Co-operation and Development
OM	Operations Management
PCR	Post-Consumer Recyclate (Post-Consumer Recycled material)
PE	Polyethylene
PET	Polyethylene Terephthalate
PLI	Production-linked incentive
PP	Poly Propylene
PPW	Plastic Packaging Waste
PRO	Producer Responsibility Organisation
PVC	Poly Vinyl Chloride
PWP	Plastic Waste Processors
R&D	Research and Development

RDT	Resource Dependence Theory
RFID	Radio Frequency Identification
RL	Reverse Logistics
rPET	recycled Polyethylene Terephthalate
RQ	Research Question
SASB	Sustainability Accounting Standards Board
SDG	Sustainable Development Goal
SEBI	Securities and Exchange Board of India
SKU	Stock Keeping Unit
TCE	Transaction Cost Economics
TFCD	Task Force on Climate-Related Financial Disclosures
TSE	Theory-based Stakeholder Evaluation
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNGP	United Nations Guiding Principles
UNHRC	United Nations Human Rights Council
USA	United States of America
USLP	Unilever Sustainable Living Plan
WEEE	Waste Electrical and Electronic Equipment
WoS	Web of Science database

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