



ORIGINAL RESEARCH PAPER

E-Waste Management

EXPLORATION OF MOBILE PHONE RECYCLING BEHAVIOR: A BIBLIOMETRIC PERSPECTIVE

KEY WORDS: Mobile Phone, Recycling Behavior, E-waste, Theory of Planned Behavior (TPB), Norm Activation Model (NAM)

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ABSTRACT

In the 21st century technology dominates ecosystems with electronics at the core of the revolution and thus exploring the literature on recycling and specifically behavior with mobile phones will contribute towards understanding the present situation and provide solutions for a sustainable future. This bibliometric analysis of the research on e-waste, mobile phone recycling and circular economy practices from 1975 to 2025 was retrieved from the Scopus database, where the analysis evaluates publication research trends, citation impacts, top influential journals, keyword co-occurrence networks using VOS viewer'. Since 2010 there is rising concern on global sustainability goals, environmental awareness, and regulatory EPR frameworks on e-waste management rules. Systematic mapping identifies "e-waste", "recycling" and "circular economy" as central research anchors with emerging interest in behavioral models, material recovery techniques, formal recycling job opportunities, device specific studies especially in mobile phones electronics. Despite the growth, gaps remain in integrating behavioral patterns, addressing informal recycling sectors and conducting device specific studies. The study further reveals that the lack of theoretical integrating frameworks needs to understand the consumer patterns especially in reasoning against criteria for all electrical and electronic equipment waste. The findings highlight that there is urgency with targeted policies, cross sector collaborations and innovative recycling solutions particularly in emerging economies countries like India where smart phone adoption rates are increasing exponentially.

INTRODUCTION

Over the last two decades, the world has been swept by unprecedented waves of innovative technologies (Abdul Waheed et al., 2023). Smartphones, once a luxury, are now integral to act as a third hand of humans from staying connected to managing finances, and monitoring health. This surge has suppressed a heightened focus on productivity and sustainability (Islam et al., 2025), yet it has also birthed a forbidden problem to society like e-waste or electronic waste. In 2023, globally 62 million metric tonnes of e-waste were produced and merely 22% of that was formally recycled (Balke, n.d.). Globally e-waste production averages 6.8kg per person each year and solid waste is projected to reach 3.88 billion tonnes by 2050, growing at 23.7% annual rate over the last decade (Garg et al., 2023; UNEP, 2007). India illustrates an urgency to handle informal recycling as they collect dangerous discarded electronics and often resort to hazardous practices such as open burning and acid leaching (Grant et al., 2013); (Chi et al., 2011) for disposing them. The challenge is not merely infrastructure or regulatory but its profound disposal practices of e-waste. How consumers decide to buy, use, store, dispose or recycle directly determines the effectiveness of recycling systems (Nadarajan et al., 2024). Many people hesitate to hand over their old mobile phones because of their privacy concerns, data security theft, emotional attachment values resulting in countless "hibernating" devices that accumulate in homes (Thukral et al., 2023). Published reports (EY- Parthenon (Building a Better New World), 2023) state mobile phones dominate in India both in terms of electronic device production and consequently streaming to as e-waste. Despite the growing body of research on green consumer behaviour most studies have applied theories such as Theory of planned behavior, Norm Activation Model to measure green consumerism and develop environmental actions (Ajzen, 2011; AJZEN, 1991; Schwartz, 1977). Few have focused on Behavioral Reasoning Theory and Innovation Resistance Theory (Ram & Sheth, 1989; Westaby, 2005) while integrating these theories will help to understand in-depth patterns of recycling sustainable behaviors. Few have zoomed in on the unique challenge of mobile phone recycling. This bibliometric study aims to bridge that gap by mapping and synthesizing the literature on mobile phone recycling behavior especially within emerging economies like India

where informal recycling practices differ geographically showing device specific and context dependent research voids. The goal is to provide a solid theoretical and policy foundation that can guide future empirical investigations and targeted interventions transforming how we handle one of the world's most pressing and urgent calls for research on e-waste recycling behavior.

LITERATURE REVIEW

Mobile phones contribution to e-waste is higher than from other electronic equipment (Afroz et al., 2020), that cannot be underscored within the fast-paced technology growth, shorter innovation cycles leading to ever increasing mobile upgrades by consumers, shorter product lifecycle and subsequently landing to e-waste. United Nations Environment Program report (UNEP, 2007), defines E-waste as being largely generated from discarded electrical and electronic gadgets which consists of recyclable components that are precious metals having economic value to toxic substances that are hazardous to the environment. Hence circular economy practices can mitigate e-waste disposal through reuse, recovery and recycling. A circular economy can ensure and retain prolonged value of resources and reduce waste at each life cycle stage (Chinchkhede, 2024a). It contains raw materials such as gold, copper, silver and other metals which will maximize the resources, and these recycling practices can dramatically reduce waste generation. Systematic reviews of the literature confirm that rapid technological progress has driven a surge in e-waste which in turn contributes to global warming (Islam et al., 2025); (Thukral et al., 2023). In many developing countries like India formal recycling programs are limited (Balke, n.d.). Instead, informal recycling often involves open burning and other hazardous techniques. This practice has been linked to a range of health problems, which includes respiratory illnesses and neurotoxicity (Abdul Waheed et al., 2023); (Grant et al., 2013); (Ylä-Mella et al., 2015). Earlier studies also found that there is health risks associated with informal recycling practices (Chi et al., 2011; Mohamad et al., 2022). While formal recycling facilities can recover valuable metals and secure data through advanced hydrometallurgical processes, consumer participation remains low due to privacy concerns (Ahanger et al., 2021).

RESEARCH OBJECTIVES (i) To conduct a bibliometric analysis of e-waste literature focusing specifically on mobile phone recycling from 1976 to 2025, (ii) To identify suitable research gaps for an empirical study designed to transform improper mobile phone disposal into a more sustainable behavior.

RESEARCH METHODOLOGY This paper adopts bibliometric analysis to conduct a systematic review of the academic research status around the topics of e-waste, mobile phone recycling behavioral patterns. The sources of data were obtained from the Scopus publishing platform as it covers a wide range of peer-reviewed studies and makes sure that they represent worldwide and regional research when selecting the research that would be covered for in depth analysis. The data was limited to articles, reviews, and conference papers published between 1976 to 2025 with language of articles being English as filtration criteria. The search strategy used Boolean operators like AND, OR, and NOT to make the data as relevant and comprehensive as possible. Other keywords that have been used to narrow down the search results are “e-waste”, “recycling”, “theories”, “mobile phone”, “sustainable behavior”, “Gen-Z” in different combinations were used to get the data. Overall, 866 studies were extracted from Scopus database. Data filters included areas limited to marketing perspectives, consumer behavior, management, business, green consumerism and exclusion criteria used filters like green technology, green engineering, solid waste management, green chemical studies. As in Figure 1 about 143 documents were considered for detailed study on the research topic selected. After complete data extraction, the records were cleaned to eliminate duplicates and irrelevant records. Visualization of co-authorship networks, co-occurrence patterns in keywords, density visualization and citation relationships was done with analytical tools like VOS viewer. This method offered a multidimensional perspective of the intellectual framework, patterns of the collaborations and even theme development in the field of research undertaken by the researchers.

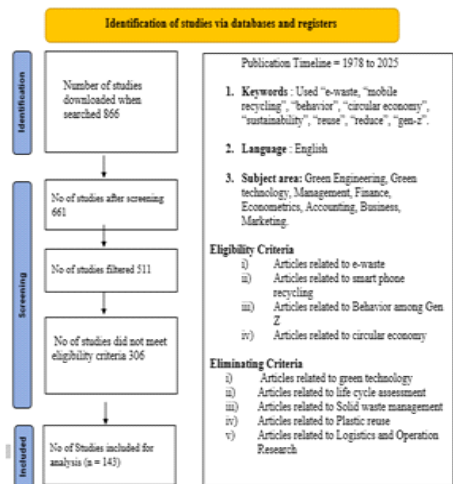


Figure 1: Structure of Bibliometric Study (Prisma Chart)

Source:Primary Data

DISCUSSION & ANALYSIS OF BIBLIOMETRIC STUDY
RESEARCH PUBLICATION TRENDS
 The visual mapping charts on analysis of the data collected from 1976-2025 papers for the bibliometric study are discussed as follows;
 Figure 2 shows that the number of publications was quite low until 2015, after which the number of publications has significantly grown, which is explained by increased global concern on e-waste and smartphones, and this postulates the need to look for sustainable circular economy practices. The seeming decrease in publications during 2021 to 2024 can be

explained by the incomplete Scopus indexation of publications in recent years and hence the decrease is not an indication of the slowdown in research activity. Hence the studies' relevance to policy directions cannot be overlooked.



Figure 2: Publication Trends

Source:Primary Data

ANNUAL TREND IN CITATION

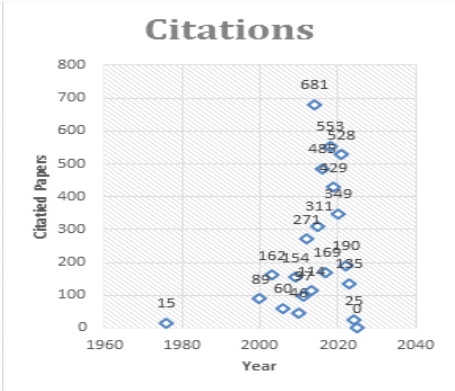


Figure 3 – Scatter Plot of Citations

Source:Primary Data

The scatter plot shown in Figure 3 presents an annual trend in cited papers related to e-waste keywords. There is an increase in citations moving into early 2000 reflecting incremental growth in scholarly attention as scientific awareness about electronic waste began to shape globally. After 2011, there was a significant surge in both publication frequency and citations in e-waste research. By 2015, the number of cited papers reached 271, peaking in 2014 with 681 cited papers, likely due to increasing global concerns about a significant surge in both publication frequency and citations in e-waste research. Studies in this direction can help to synthesize the fragmented theories in the field of recycling and come with workable strategies for habituating recycling.

SUM OF CITATIONS BY JOURNALS

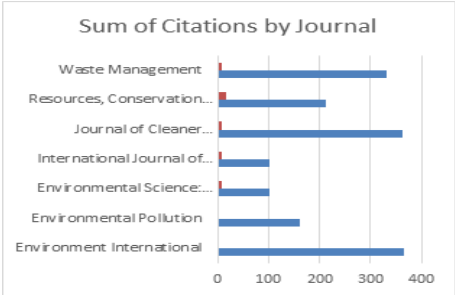


Figure 4- Sum of Citations by Journals

Source:Primary Data

Figure 4 shows the sum of citations by top journals and represents the distribution of total citations by major journals on e-waste, recycling and environmental sustainability. The distribution demonstrates that the scholarly discourse is

adds value to the research gap synthesized. It also indicates research with system model tools that enable real time monitoring of the Mobile Phone usage from production to end of use or life cycle stages to recovery of precious metal challenges. The Bibliometric paper thus demonstrates a moderate to good originality making way for a sound empirical data for more concerted policy implications.

LIMITATIONS OF THE STUDY

This study is limited to Scopus database only and hence calls for integrating bibliometric analysis with popular databases like Web of Science, Taylor and Francis or other repositories. Further limiting the study to English language resources, we may be overlooking research indexed in Asian, Latin American and other regional languages that are significant in value.

The study relies on the use of broad keyword strategy with Boolean operators and in connection with MPR and this contributes to the need for replicating the study with other databases of prominence and can lead to generalized or region-specific research objectives. This is specifically observed as European Union recycling behaviour is more pronounced with policy regulations than in other regions, moreover comparative and longitudinal research may also be necessary for sound implications, Circular economy concepts are mentioned but their application is yet to be measured. Scalable business models like refurbishment market, product as a service, supply chain management to incorporate sustainability into electronics recycling is also scarce (Alnajem et al., 2021).

CONCLUSION

The mapping of literature on e-waste, recycling behaviour and connection with mobile phones in specific has strongly pointed out that mobile phone recycling research is moving from generic waste discussions to behaviour-centric and technology-driven approaches. However, some policy-oriented conclusions, especially those related to implementation challenges and system process design, go beyond what bibliometric data alone can enlighten the researcher where empirical justifications can be of use. The relevance of the gaps identified in this paper is significant to reducing e-waste in general and growing mobile waste in specific to nurture sustainable behaviour. The urgency in recycling mobile phones becomes critical concern due to the special design of the device, short life span, customer disposal patterns and difficulties in material recovery. Overall, the study brings out the need to explore geographical understanding of recycling, cultural specific challenges, behavioral science factors behind disposal, and the development of targeted regional approaches to circular economy. Addressing the research practice gap will promote sustainable e-waste management and target a circular economy.

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