



# GREEN HORIZONS

REDEFINING BUSINESS AND SUSTAINABILITY  
PARADIGMS IN THE TECHNOLOGICAL ERA

**Editors:** Dr. Madhavi Deshpande, Dr. Priyanka Dhoot  
Dr. Kranti Shingate, Dr. Pooja Dasgupta





# **Green Horizons: Redefining Business and Sustainability Paradigms in the Technological Era**

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## About the Book

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*Green Horizons: Redefining Business and Sustainability Paradigms in the Technological Era* is more than just an academic compilation—it is a reflection of the changing world where sustainability, innovation, and technology are no longer separate conversations, but interconnected forces shaping the future of business and society.

This book presents a thought-provoking collection of research and insights that examine how organizations, entrepreneurs, policymakers, and institutions are responding to global environmental and economic challenges through responsible and technology-driven solutions. From Green Marketing and green finance to ESG integration, circular economy practices, digital transformation, and sustainable entrepreneurship, the chapters in this volume explore the emerging pathways toward resilient and future-ready business ecosystems.

What makes this book unique is its interdisciplinary perspective, bringing together contributions from researchers across diverse domains who collectively emphasize the importance of balancing innovation with responsibility. The discussions presented in this volume not only address theoretical dimensions but also provide practical implications for businesses navigating the rapidly evolving technological era.

Designed for academicians, researchers, students, industry professionals, and policymakers, this book serves as a valuable resource for understanding how sustainability can be embedded into strategic decision-making, corporate governance, supply chains, financial systems, and organizational culture.

At its core, *Green Horizons* encourages readers to rethink traditional business paradigms and envision a future where technological advancement and sustainable development work hand in hand to create long-term value for society, the environment, and the global economy.

## About the Editors

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### **Dr. Madhavi Deshpande**

*Dean of the Faculty (Non-Engineering),*

*Director, SoCM, D.Y. Patil International University, Pune*

Dr. Madhavi Deshpande is a distinguished academician with over 30 years of experience in education and human resource management. Currently serving as Professor and Dean, Faculty of Non-Engineering at DY Patil International University (DYPIU), she has played a pivotal role in strengthening academic administration within the School of Commerce and Management. Her leadership has driven the introduction of innovative programs, including courses in data analytics and leadership development. Known for her commitment to academic excellence and holistic student growth, Dr. Madhavi is a highly respected mentor whose dedication and vision have significantly influenced both students and colleagues, shaping future leaders and scholars.



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Dr. Priyanka Dhoot is an Assistant Professor at D. Y. Patil International University, Pune, specializing in Finance, Investment Management, and FinTech. With over 12 years of academic experience, she brings strong expertise in teaching, research, and curriculum development. She holds a Ph.D. in Business Administration from Shivaji University, Kolhapur, along with an MBA and M.Phil in Financial Management. Dr. Priyanka has also completed a Post Graduate Certificate in FinTech from the National Stock Exchange (NSE) in collaboration with IMT Hyderabad. A dedicated researcher, she has published papers in ABDC and UGC-listed journals, authored two books, and holds two patents. She actively contributes to academic conferences and is committed to advancing knowledge in emerging financial domains. She believes “Dedication is the fuel that propels belief into action, transforming dreams into reality.”



### **Dr. Kranti Shingate**

*Associate Professor & Program Head, SoCM, D. Y. Patil International University, Pune*

Dr. Kranti Shingate is an Associate Professor at D Y Patil International University with over 22 years of experience in Academics and entrepreneurship. She holds a Ph.D. and Master’s degree from Savitribai Phule Pune University and a degree in Agriculture from Mahatma Phule Krishi Vidyapeeth. She also holds an e-MBA and PGDM in Rural Development & Agribusiness Management and is an IIBA-certified Business Analyst.



## About the Editors

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Dr. Kranti is a PhD guide and has conducted training sessions on copyright registration, business excellence, innovation, and strategy. She has received 9 copyright registrations from the Government of India and holds verified international academic qualifications from World Education Services. She has published 22 research papers, received the Best Oral Presentation Award at an international conference in Bangkok (2024), and earned a Best Research Paper Award from the International Research Journal of Business and General Management. She is actively involved in research and consultancy in vertical farming.

### **Dr. Pooja Dasgupta**

*Assistant Professor, SoCM, D. Y. Patil International University, Pune*

With more than a decade long journey in research and publication, Dr. Pooja Dasgupta, Asst. Professor (SoCM, DYPIU), is highly experienced in reviewing and editing academic manuscripts with a focus on clarity, coherence, and adherence to scholarly standards. Her commitment to enhancing the quality and readability of academic writing while preserving the originality and intent of authors' work is reflected in her careful and thoughtful approach to academic editing.



## Preface

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The edited volume *Green Horizons: Redefining Business and Sustainability Paradigms in the Technological Era* is a scholarly effort to explore the evolving relationship between sustainability, business transformation, and technological innovation in the contemporary global landscape. In an era marked by climate challenges, rapid digitalization, changing consumer expectations, and increasing emphasis on responsible governance, businesses and institutions are being compelled to rethink traditional models of growth and development.

This book brings together insightful research contributions from academicians, researchers, industry experts, and practitioners who examine emerging dimensions of sustainable business practices and technological advancements. The chapters included in this volume present diverse perspectives on environmental sustainability, green innovation, ESG practices, circular economy models, sustainable finance, digital transformation, responsible entrepreneurship, and policy frameworks that support sustainable development.

The objective of this book is not only to provide theoretical insights but also to offer practical implications and strategic directions for researchers, policymakers, entrepreneurs, educators, and industry leaders. The discussions and findings presented in these chapters aim to encourage meaningful dialogue, innovative thinking, and collaborative action toward building sustainable and future-ready business ecosystems.

We sincerely hope that this volume will serve as a valuable academic resource and inspire further research in the areas of sustainability, business innovation, and technological transformation. We also believe that the ideas presented in this book will contribute toward promoting responsible leadership and sustainable development practices in the technological era.

### Editors

Dr. Madhavi Deshpande  
Dr. Priyanka Dhoot  
Dr. Kranti Shingate  
Dr. Pooja Dasgupta

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We extend our heartfelt thanks to our Chancellor, Hon. Sanjay Patil, for his visionary leadership, continuous encouragement, and unwavering support toward academic excellence, innovation, and sustainability-driven initiatives. His guidance has been a constant source of motivation throughout this endeavor.

We are deeply grateful to our Vice Chancellor, Prof. Manish Bhalla, for his valuable guidance, encouragement, and academic support. His commitment to promoting research and interdisciplinary collaboration significantly contributed to the successful completion of this book.

We would also like to express our sincere appreciation to all the authors and contributors whose scholarly work, dedication, and research insights have enriched this volume. Their valuable contributions reflect diverse perspectives and contemporary understanding of sustainability and technological transformation in business and society.

Our special thanks go to the reviewers, editors, and subject experts for their constructive suggestions, critical feedback, and support in maintaining the academic quality and integrity of the book. Their efforts greatly enhanced the overall standard of this publication.

We also acknowledge the efforts of the publishing and technical support teams, whose coordination and professional assistance ensured the smooth processing, formatting, and publication of this volume.

We extend our gratitude to the faculty members, research scholars, administrative staff, and colleagues of D Y Patil International University (DYPIU) for their cooperation, encouragement, and continuous support throughout this academic journey.

Finally, we express our sincere thanks to all readers, researchers, academicians, and practitioners who continue to contribute toward advancing sustainable business practices and technological innovation for a better future.

Our heartfelt thanks to everyone who directly or indirectly contributed to the successful completion of this book.

# CHAPTER 1

## Policy Pathways towards Circular Fashion: Lessons from Global Policy Frameworks Relevant to Emerging Economies

*Garima Singh\**

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### ABSTRACT

The fashion/textile industry is responsible for the depletion of numerous global resources due to the currently prevailing linear economic model of production. Garments are produced, consumed, and thrown away. Such a production model has resulted in waste generation on an unprecedented level and is becoming harder to justify. Circular Economy (CE), on the other hand, represents a fundamentally different approach to the matter as it attempts to prolong the life of the garment by repairing, reselling, recycling, and leasing. There is still inequality when it comes to the development of policy approaches, and many challenges emerge in emerging economies where the framework required for circularity is still poorly developed. To identify which policy instruments have been applied around the world to foster the transition to a circular approach in fashion and whether they are applicable to less affluent nations, the current paper utilizes scientific studies, international policy documents, and reports by various organizations from the fashion industry. Overall, it may be said that even though some policy instruments, such as EPR, take-backs, economic incentive measures, and traceability, may lead to tangible transformations, their success depends entirely on the institutional framework they rely upon.

**Keywords:** Circular Economy (CE), Fashion policies, Extended producer responsibility (EPR), Sustainability, Emerging economies, Sustainable fashion.

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### 1.0 Introduction

No industry is using natural resources more intensively than fashion and textile manufacturing, as well as the environmental consequences of this. Within such a linear approach, fashion has led to the excessive use of raw materials, release of greenhouse gases into the atmosphere, pollution of water bodies, and creation of enormous volumes of waste (Ellen MacArthur Foundation, 2017; Niinimäki *et al.*, 2020; UNEP, 2023). And even more so, today's accelerated production rate exacerbates the situation, putting excessive strain on waste management infrastructure which has not been planned for managing garments on such scale and speed.

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The concept of CE through increased lifecycle of products has been able to attract considerable traction towards decoupling the economy from resource consumption (Geissdoerfer *et al.*, 2017; Kirchherr *et al.*, 2017). Yet the proof of the matter shows that the efforts by firms and voluntarism will be unable to keep up with the change without external prodding due to the disbursement of fashion supply chain networks and economic logic behind circularity being too weak (Bocken *et al.*, 2016; Ghisellini *et al.*, 2016; OECD, 2022). Here, the role of policy enters the equation. Policies have the potential to change incentives, make sure that producers are held accountable, and channel funds towards the development of infrastructure required for circularity. There have been previous studies that have examined CE practices within the fashion industry from an organizational and behavioral perspective, such as socio-psychological aspects of theory of planned behavior (Singh & Kumar, 2025). Such studies are important; however, they create a vacuum that this paper intends to fill.

Although there is a plethora of literature on circular fashion, policy interventions have been patchy, especially within emerging markets where regulation, coordination mechanisms, and market infrastructure are less developed than elsewhere (de Aguiar Hugo *et al.*, 2021; Velis, 2017). This paper discusses the main policy tools utilized by various governments to encourage a more circular approach to fashion and textiles, paying specific attention to the potential applicability in less affluent nations.

## **2.0 CE and the Fashion Industry: A Policy Lens**

In the last decade, CE has shifted from being an obscure concept to a true policy agenda mainly due to limitations associated with linear production cycles. Instead of optimizing marginal efficiency gains, circular economy approaches seek to achieve much deeper results, ensuring the reuse of materials, minimization of extraction, and retention of value throughout the entire production cycle (Geissdoerfer *et al.*, 2017; Lieder & Rashid, 2016). In the apparel industry, such measures include repairs, sales, rentals, and recycling, all of which demand new considerations in terms of materials and business organization (Bocken *et al.*, 2016; Persson, 2023).

Businesses and individuals are relevant, but there is agreement on the necessity of policies for the industry to be transformed on a scale and at a pace that is required (de Aguiar Hugo *et al.*, 2021; OECD, 2022). Policies do something that voluntary measures cannot achieve. The former ensures that the cost to the environment is factored into the price tag of products, reduces the business risks associated with sustainable development, and provides the context for an effective recycling system (Schulte, 2013; UNEP, 2021).

There have been ample studies that have highlighted the barriers in adopting CE within the fashion industry. Gaps in technology, cost of compliance, fragmented value

chain, and weak institutions are some of the barriers that have been discussed in detail, particularly in developing countries (Singh & Kumar, 2025; Wilson *et al.*, 2015). While most research papers talk about barriers, few research papers focus on the potential of governance and policies in addressing these barriers.

This is the gap this paper aims to address. Policy tools used in the fashion sector are commonly targeted at three stages within the production process, starting from pre-production to post-production. During the first stage, design policies influence the products that are manufactured. The second stage is where transparency plays an important role in influencing the flow of products through the supply chain. During the third stage, policy tools such as extended producer responsibility, product take-back policies, and traceability policies impact products that are disposed of by consumers (European Commission, 2022; OECD, 2022; World Economic Forum, 2023). These actions contribute to a greater purpose for climate change and sustainable development goals outside of the fashion sector (IPCC, 2022; United Nations, 2023).

### **3.0 Research Methodology**

A narrative and integrative policy review is used in this study. This decision reflects the nature of the question: quantitative aggregation alone cannot provide an answer to the question of how regulatory tools influence CE results in fashion. To reach findings that are helpful for governance, several forms of evidence conceptual, empirical, and derived from policy practice must be read collectively (Snyder, 2019).

#### **3.1 Data sources and selection criteria**

Sources for the review include three types. First, peer-reviewed journal articles published between 2015 and 2025. Second, official policy documents generated by bodies like the European Commission, OECD, UNEP, and the World Economic Forum. Lastly, reports from industries and institutions, which may provide information about how policies can be implemented practically. Sources were found through keyword searches across different platforms including CE, fashion, textiles, policy, regulation, producer responsibility, traceability, and sustainability. Selection of papers focused on materials that directly align with the regulatory and policy mechanisms shaping circular outcomes in fashion, rather than CE adoption more broadly.

#### **3.2 Analytical framework**

This paper uses thematic analysis approach: The policy instruments can be categorized into five themes based on the analysis approach, namely the producer responsibility approach, economic and fiscal approaches, regulatory approaches, digital

tracing technology, and the national or sectoral textiles approach. The issue of capacity building and enforcement becomes a priority focus as it is where developing nations experience the most limitations (OECD, 2022; UNEP, 2023).

### 3.3 Scope and limitations

It must be clear at the outset that this review does not seek to present an exhaustive account of all the circular policies that have been used within fashion practices. Rather, the objective is to distill what can be learned from regulatory strategies that might be applied in other nations. Inevitably, some interpretation will need to be done in research of this sort; this approach attempts to minimize this by utilizing multiple sources.

**Table 1: Policy Instruments Supporting CE in the Fashion and Textile Sector**

Policy instrument	Policy objective	Key features	Relevance for emerging economies
Extended Producer Responsibility	Improve producer accountability for post consumer waste	Obligates producers to finance or manage collection, recycling, and disposal of textiles	Encourages shared responsibility but requires institutional capacity and enforcement mechanisms
Mandatory take back schemes	Increase textile collection and recycling rates	Legal obligation for brands or retailers to collect used garments	Effective where informal waste systems can be integrated
Eco-modulated fees and fiscal incentives	Promote eco design and sustainable materials	Differential fees based on recyclability, durability, or environmental impact	Can incentivise innovation if supported by transparent criteria
Product traceability and labelling standards	Enhancing transparency across the value chain	Digital product passports, material disclosure, and labelling requirements	Supports enforcement and consumer awareness with digital infrastructure
National textile and circular economy strategies	Aligning industry action with sustainability goals	Integrated policy roadmaps covering production, consumption, and waste	Enables long term planning and coordination across stakeholders

### 4.0 Key Policy Instruments Supporting CE in the Fashion and Textile Sector

The primary difference between policy instruments and voluntary pledges is that the former are obligatory. Businesses can choose not to participate in commitments. They are unable to choose not to follow the law. Changes in production methods, market structures, and the handling of discarded goods are necessary to move the fashion industry toward circularity, but there is little indication that industry will implement these changes on a large scale unless mandated by regulations (OECD, 2022).

**Figure 1: Policy-enabled Circular Fashion Framework**

#### 4.1 Extended producer responsibility

EPR is probably the most used regulatory tool for addressing textile waste. Under an EPR scheme, the companies that make and sell garments become legally responsible for what happens to those products once consumers are done with them, covering collection, recycling, and disposal (European Commission, 2022). It is clear that these policies may lead to an increase in the rate of collecting and attract private capital to recycling initiatives. However, their success depends entirely upon the strict implementation of these policies and coordination among these institutions (OECD, 2022; UNEP, 2023).

#### 4.2 Mandatory take back and recycling schemes

Make take-back programs successful through the physical collection of used products from the consumer level since it is at this stage that garments are usually lost from the value chain. When such programs are associated with specific reuse and recycling goals, they will help create opportunities for repairs, resale, or reuse of the garments in other ways (Persson, 2023; Lee, 2025). For countries in the developing world such as India, the effectiveness of such schemes will largely depend on how effective they are in integrating themselves into the informal textile recycling industries (Wilson *et al.*, 2015).

#### 4.3 Economic instruments and eco modulated fees

Financial instruments provide an alternative means for government intervention to influence the behavior of producers without strictly mandating outcomes. Besides offering

incentives through subsidies or tax relief measures, differential rates dependent on the longevity or recyclability of products could encourage companies to adopt better quality material or designs (OECD, 2022). Such pricing policies generally operate effectively in developing countries under conditions where the basis of the scheme is clear, transparent, and integrated into industrial policy (IEA, 2022).

#### **4.4 Product traceability and information standards**

In addition to improving supply chain legibility through digital product passports (DPPs) and labels, this solution may contribute to better enforcement and consumer decisions, as well as the more efficient sorting of products at the end of their lives (Araujo Galvão *et al.*, 2022; UNEP, 2023). Indeed, the scope of this solution is promising, yet there are obstacles as well. In many emerging economies, for instance, such as India, there is a lack of appropriate digital infrastructure, while small companies will feel the burden of compliance costs the most.

#### **4.5 Integrated national textile strategies**

Some nations have created a broad strategy for their country, which integrates the objectives of CE into their textile and apparel policies, beyond just individual tools. Such an approach to planning within the industry makes coordination easier among businesses, governments, and others on a much broader timeline compared to relying on separate tools (European Commission, 2022; World Economic Forum, 2020).

### **5.0 Implementation of Gaps and Policy Challenges**

The increase in the number of circular fashion policies among different countries is not translating into any circularity. This is mainly because of the lack of infrastructure for sorting, collection, and recycling of textiles, which is especially true for poor countries (OECD, 2022). In addition, even if policies exist on paper, their actual impact can be insignificant due to poor implementation mechanisms, governance issues within agencies and ministries involved, and informal activities taking place at various stages of manufacturing processes as well as waste management procedures (UNEPR, 2023; Velis, 2017). Market-related challenges exist too. If there are few financial benefits to be gained and little consumer interest in purchasing circular products, most manufacturers, particularly small businesses, would naturally opt not to incur the initial costs of adopting a circular approach (Niinimäki *et al.*, 2020). The difficulty in solving such issues comes from the fact that trade, industry, and environmental policies tend to contradict each other. Unless these inconsistencies are sorted out, manufacturers will continue to receive conflicting signals (European Commission, 2022).

## **6.0 Policy Implications for Emerging Economies**

A wholesome adoption of regulatory regimes from developed nations would likely be ineffective in developing nations. This is because some factors necessary for the successful implementation of such frameworks may not necessarily exist in all places (OECD, 2022). An approach where producer responsibility regulations are adopted in phases and then allow for time for both manufacturers and regulators to build capacity to enforce the same is more effective. Since these actors currently perform a large portion of the actual work and can help increase efficiency while producing more fair results, it is also worthwhile to formally integrate cooperatives and informal waste workers into collection and sorting systems (Wilson *et al.*, 2015; UNEP, 2023).

Smaller businesses need targeted support if they are to participate in circular transitions at all. Subsidised financing, grants, and hands on innovation assistance can make the difference between a company that experiments with circular practices and one that cannot afford to (European Commission, 2022). On the technology side, traceability tools need to be designed with scalability in mind from the start, and they work far better when paired with training and institutional support rather than dropped into settings that are not yet ready for them.

## **7.0 Conclusion and Policy Recommendations**

This paper reviewed the policy instruments that have been used to drive CE in sustainable fashion, with a particular focus on what works, and what does not, in emerging economy contexts. The overall picture is that tools like EPR, takeback programs, financial incentives, and traceability systems can produce real results. But they are not self-executing. Without the institutional capacity to enforce them and the physical infrastructure to process the materials they are meant to redirect; even well-designed policies tend to underdeliver.

The future is probably going to be gradual rather than broad for developing nations like India. Governments and businesses may learn and adapt to implement policies gradually. Instead of avoiding informal waste players, governance that publicly acknowledge them will be more efficient and actionable. Furthermore, without consistent public investment and involvement and a sincere attempt to unify the currently highly dispersed policy signals across trade, industry, and environmental regulation, development will come to a standstill.

This research has attempted to address a new question: what types of policies can enable the adoption of the CE in fashion possible? This contrasts with most of the existing material, which focuses on what prevents it from happening. The results provide useful points of reference for industry players and policymakers operating in various economic

environments. There is still work to be done. Future research that examines the efficacy of tools in specific national contexts or tracks the reactions of producers and other stakeholders to the implementation of new regulations would significantly advance our current understanding.

**Table 2: Phased Policy Roadmap**

Phase	Policy focus	Key actions	Expected outcomes
Phase 1: Foundation building	Institutional capacity and data	Establish textile waste data systems, reporting requirements, pilot take back initiatives	Improved data availability and policy readiness
Phase 2: Market activation	Incentives and voluntary compliance	Introduce fiscal incentives, eco design guidelines, voluntary producer responsibility schemes	Increased industry participation and innovation
Phase 3: Regulatory consolidation	Mandatory policy instruments	Implement extended producer responsibility, recycling targets, compliance mechanisms	Enhanced producer accountability and waste reduction
Phase 4: System integration	Infrastructure and coordination	Invest in recycling infrastructure, integrate informal sector actors, strengthen inter agency coordination	Efficient circular value chains
Phase 5: Digital and long term governance	Traceability and enforcement	Deploy digital product traceability systems, continuous monitoring and evaluation	Transparent, scalable, and resilient circular fashion system

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## CHAPTER 2

### Ease or Expertise? A Study of Factors Influencing Investor Preference for DIY Investment Platforms

*Anuradha Patil\* and Roshani Aher\*\**

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#### ABSTRACT

This study examines investor preference for Do-It-Yourself (DIY) investment platforms in comparison to traditional broker-based investment methods, with a specific focus on ease of use versus expertise. The research aims to assess the level of adoption and awareness of DIY investment platforms among individual investors and to identify the key challenges influencing their adoption. Primary data was collected through a structured questionnaire administered to retail investors, while secondary data was obtained from journals, reports, and prior studies. The findings indicate that factors such as ease of use, cost efficiency, technological convenience, and transparency play a significant role in influencing investor preference. However, concerns related to lack of expert guidance, risk perception, and market volatility continue to affect adoption decisions. The study highlights the growing relevance of DIY platforms in the evolving FinTech ecosystem.

**Keywords:** DIY investment platforms, Investor preference, Financial technology (FinTech), Retail investor behavior, Ease of use and expertise trade-off.

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#### 1.0 Introduction

The financial technology industry has registered rapid global growth from 2022 to 2026. The financial services industry has been transformed by mobile investment tools, algorithmic advisory tools, digital payment tools, and online trading tools. According to Arner (2022), the financial technology industry has grown from the innovation stage to the adoption stage. The World Bank (2023) reported that financial inclusion has been achieved in the global financial services industry, driven by digital financial services. According to the Reserve Bank of India (2024), the expansion of smartphones, the Unified Payments Interface, and a favorable regulatory environment have contributed to the digital transformation trajectory in India.

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The primary outcome of this digital transformation has been the creation of do-it-yourself (DIY) investing platforms. The platforms have been created to enable investors to buy and sell financial assets independently, eliminating the need for brokers and their associated commissions. Traditionally, brokers have been responsible for providing advisory services, while the primary focus of DIY brokers has been to emphasize ease of use, transparency, and independence in their business models. According to KPMG (2023), younger generations have been attracted to digital control and lower fees. According to a study conducted by Statista (2025), Millennials and Gen Z investors have a behavioral change when they are comfortable with financial technology tools.

According to research conducted on the Technology Acceptance Model (TAM), which was initiated in 2022, digital technology behavior change depends on the perceived usefulness and ease of use of the technology. According to this study, performance expectancy and effort expectancy have been emphasized in technology utilization studies conducted using the UTAUT2 model.

However, concerns have been raised regarding risks, emotional support, and access to expert advice. While the primary factor for investors has been the ease of use of the technology, they still need knowledge and support in a volatile financial environment. The primary research question has been: Is the primary factor in the decision-making process ease of use, and has knowledge been a factor in the decision-making process?

## **2.0 Review of Literature**

Recent literature on FinTech adoption and digital investing behavior has been extensively discussed by scholars in recent years (2022-2026). Innovation in regulation has been found to be a driver for growth in digital finance (Arner, 2022). Digital trust has emerged as a critical factor for investment platform adoption (Lee & Shin, 2022). A study focusing on Indian retail investors has found that digital trading behavior is strongly influenced by perceived usefulness (Kumar & Sharma, 2022).

In studies on digital trading behavior, Singh (2023) found that ease of use has a positive impact on online trading adoption, which is supported by the Technology Acceptance Model. Gupta (2023) found that effort expectancy and social influence have a significant impact on financial application adoption, supported by UTAUT2 model. Patel (2024) found that user satisfaction is influenced by ease of interface simplicity.

Perception of risk has been a dominant theme in digital finance research. Zhao (2022) found that individuals who perceive financial risk are less likely to adopt online investment platforms. Financial knowledge has been found to be related to digital confidence and reduced fear of digital finance by Nair and Menon (2024). The OECD (2023) has emphasized digital literacy and ethical investing. Trust and transparency have

been frequently emphasized by digital finance scholars. Das (2023) found that loyalty can be increased on digital finance platforms by providing transparent information on fees. Khan (2025) emphasized the importance of awareness on data security. Verma (2024) found that self-directed investors possess a high level of financial knowledge.

Industry outlook by PwC (2024) and Deloitte (2025) indicates that a hybrid model of wealth management involving robo-advisory and access to human advisory services could emerge as a potential model in the future. This study fills in the knowledge gap in that it deals with DIY investment platforms, which have been less researched than FinTech adoption. Past research has primarily concentrated on adoption and to some extent awareness but has failed to adequately research awareness in detail. Moreover, research has primarily concentrated on adoption, awareness, and perceived risks or lack of direction as independent entities with little attention paid to how they are interlinked. The psychological and behavioral aspects have also been less developed in research. Moreover, little research has been conducted using primary data to synthesize adoption, awareness, and associated issues within one framework.

This study has synthesized adoption level, awareness level, and associated issues within one framework with exclusive primary data.

### **3.0 Research Methodology**

The research design employed in the study is an analytical and descriptive research design. All the data employed in the research for the field investigation were primary in nature, as no secondary numerical data were employed in the statistical analysis of the research. The primary data collection method employed in the research was a systematic questionnaire that was sent to the participants through Google Forms. The questions in the questionnaire were of five different types: awareness level, difficulty perception, adoption behavior, satisfaction level, and demographic profile, which were measured using a five-point Likert scale.

The sampling method employed in the research was convenience sampling. The population of the research comprised retail investors who employed do-it-yourself (DIY) platforms for investments and belonged to the age group 18-35 years. The sample size of the research comprised 108 participants.

The statistical analysis employed in the research was regression analysis, correlation, mean score, standard deviation, and percentage analysis, computed through spreadsheet software. The target population of the research comprised young investors, including professional individuals, salaried employees, and students. The limitations of the research were the convenience sampling employed in the research and the geographical limitations of the research participants.

Despite the growing popularity of do-it-yourself investment schemes, investors are still cautious as they see risks, need expert opinions, and feel the emotional rollercoaster of the market. Though past studies have examined the factors that influence investments as well as the risks involved, the balance of ease of use and competence has not been fully examined. It is not yet clear whether ease of use is preferred to professional opinions or both can be preferred. The research will be conducted using primary data.

#### 4.0 Objectives of the Study

This research is conducted on following objectives:

- To assess the level of adoption of DIY investment platforms among individual investors.
- To examine the level of awareness of DIY investment platforms
- To identify and analyze key challenges faced by investors in adopting DIY platforms

#### 5.0 Data Analysis

**Table 1: DIY Adoption Composite and Items**

Variable	Mean	SD	N
Adoption Composite	4.985	0.095	108

*Source: Survey*

The mean score of 4.985, which is roughly 4.99/5, as presented in Table 1 above, shows that there is a high level of adoption of the DIY platforms among the respondents. On the other hand, concerning the factors of adoption, such as preference for do-it-yourself projects, enjoyment, and intention to continue, the majority of the respondents selected “Strongly Agree,” as can be seen from the extremely low standard deviation of 0.095. This shows that there is a high level of acceptability of the DIY platforms, coupled with high levels of satisfaction among the users of the platforms.

**Table 2: Adoption by Demographics - Age Group**

Group Category	Mean Adoption Score	N
18–25	4.979	78
26–35	5.000	30

*Source: Survey*

Table 2 shows that both groups have extremely high levels of usage of DIY platforms. The mean for the 18–25-year-old investors is 4.979, and the 26–35-year-old

investors attain a perfect mean of 5.000. The small variation implies that older investors in the sample use the DIY platforms at a similar level to the younger investors. In conclusion, there is no significant drop in the level of usage among the investors in the different age groups.

**Table 3: Adoption by Demographics - Experience Level**

Group Category	Group Name	Mean Adoption Score	N
Advanced	Advanced	4.981	54
Beginner	Beginner	4.971	23
Intermediate	Intermediate	5.000	31

Source: Survey

As can be seen from Table 3, the level of adoption for adoption scores, which range between 4.97 and 5.00, is extremely high for all levels of experience, whether beginners, intermediate, or experts, who have indicated high levels of engagement with DIY sites. This suggests that even less experienced investors are as positive about DIY sites as their more experienced counterparts.

**Table 4: Awareness Composite**

Variable	Mean	SD
I am aware that DIY platforms have lower fees.	4.824	0.624
I understand the transparency offered by DIY platforms.	4.833	0.663
I am aware of the unbiased investment options available.	4.843	0.614
I understand the data security measures of DIY platforms.	4.870	0.548
Awareness Composite	4.843	0.576

Source: Survey

As shown in Table 4 above, the mean for the respondents in terms of their level of awareness is 4.84 (SD = 0.58). This implies that respondents have a high level of knowledge regarding do-it-yourself (DIY) investment platforms. They are aware of the unbiased investment options available in the market, transparent costs, reduced costs, and data protection. Overall, respondents have a high level of comprehension in relation to security, costs, and transparency associated with DIY investments.

The composite mean of 2.89 (SD = 1.29) indicates a moderate perception of challenges or the need for expertise, as presented in Table No. 5. There is a concurrence among a moderate proportion of respondents that expert advice is essential and that a lack

of such advice can create risk. While a significant proportion believes that human sources offer better emotional support during market instability, trust levels for algorithm-based advice are still low. There is an inconsistent perception of confidence levels regarding one's ability to make autonomous decisions. Customers still rely on these sources heavily despite their perception of risk and limitations of do-it-yourself strategies.

**Table 5: Challenges/ Expertise Composite**

Variable	Mean	SD
Professional financial advice is important.	2.537	1.704
Lack of expert guidance increases risk in DIY platforms.	2.398	1.685
I trust algorithm-based recommendations.	3.380	1.755
Human advisors provide better emotional support during market volatility.	2.370	1.672
I feel confident making decisions without expert help.	3.778	1.665
Challenge Composite	2.893	1.290

*Source: Survey*

**Table 6: Awareness and Challenges vs Adoption (Correlation)**

Variables	Correlation (r)	p-value
Awareness → Adoption	0.10	0.317
Challenges → Adoption	-0.04	0.689

*Source: Survey*

Awareness regarding the features of DIY platforms, such as fees, transparency, and security, is found to display a small, insignificant positive correlation with adoption, as shown in Table 6, where  $r = 0.10$  and  $p = 0.32$ . This suggests that awareness regarding DIY platforms has no significant impact on raising adoption levels, possibly because adoption is already near universal. It is found that adoption is completely unaffected by perceptions of difficulty or the need for competence, where  $r = -0.04$  and  $p = 0.69$ , and DIY platforms are still being used by people who are aware of the risks or want professional help.

As indicated in Table 7, the R-squared value for the model is 0.014. The level of adoption is not significantly affected by Awareness, since the beta value for Awareness is 0.019, while the probability value is 0.26. The level of adoption is also not significantly affected by Challenge, since the beta value for Challenge is -0.005, while the probability value is 0.50. The model only accounts for 1.4% of the variance, which shows that the level of DIY adoption for this group of users is not significantly affected by the awareness of the features and the challenges associated with the system. In terms of the entire data, the level of adoption.

**Table 7: Regression - Predicting Adoption from Awareness and Challenges**

Predictor	Beta	SE	p-value
Awareness	0.019	0.017	0.257
Challenge	-0.005	0.007	0.501

Source: Survey

**Table 8: Motivation for DIY vs Satisfaction**

Motivation Group	Mean Satisfaction	SD	N
Control-driven	5.0	0.0	15
Cost-driven	4.867	0.516	15
Ease-driven	5.0	0.0	40
Learning-driven	4.95	0.224	20
Other	5.0	0.0	18

Source: Survey

As shown in Table 8, all groups of motives show extremely high levels of satisfaction. The control-driven, ease-driven, and “other” groups attain the highest satisfaction level of 5.0, whereas the learning-driven group achieves 4.95, and the cost-driven group achieves 4.867 (SD = 0.516). To conclude, the satisfaction level of consumers in the DIY platform is extremely high.

## 6.0 Recommendations and Conclusion

It is recommended that the DIY platforms consider the adoption of the hybrid advisory model. Artificial intelligence-based personalized recommendations have the potential for increasing the level of self-confidence of users. Promoting financial literacy initiatives is justified. The adoption of data protection policies is critical. The user interface should not compromise on the level of simplicity. Young Indian investors have shown a markedly high preference for do-it-yourself investment platforms, according to the study’s findings. The key drivers of this preference have been found to be ‘control’ and ‘ease of use.’ However, they have not forgotten the importance of knowledge and emotional reassurance. Hybrid models combining technology and human support could be the way forward for digital investing in India.

## 7.0 Future Scope of Study

Future studies could utilize various age groups and larger sample sizes. Longitudinal studies could investigate the dynamic nature of behavior change over time. Cross-national studies could provide more complete results. The inclusion of behavioral finance indicators in future research could increase their explanatory power.

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## CHAPTER 3

### A Comparative Study of Inclusive Banking through Neobanks and Traditional Banks in India

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#### ABSTRACT

The study titled A Comparative Study of Inclusive Banking Through Neobanks and Traditional Banks in India examines how different banking models contributed to financial inclusion. The objectives are to analyze adoption behaviour and usage patterns of neobanks and traditional banks, to evaluate the influence of demographic factors on banking choice, and to compare effectiveness in terms of accessibility, convenience, cost, and trust. A descriptive and comparative research design was adopted. Primary data collected from individual banking customers in India through a structured questionnaire using convenience sampling, while secondary data is sourced from RBI reports, journals, and bank websites. The study concludes that adoption was influenced by usability and trust, demographic factors affected preferences, and both banking models displayed distinct strengths and limitations overall.

**Keywords:** Neobanks, Financial inclusion, Inclusive banking, Digital banking, Banking preferences.

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#### 1.0 Introduction

Financial inclusion is one of the major contributors to the development of the economy and society as a whole. Financial inclusion is the availability and affordability of financial services to everyone in society. The traditional banks have made significant contributions towards the development and promotion of inclusive banking in India through the opening of new branches and initiation of new programs that promote inclusive banking in India. They have made their customers feel secure. With time, technology has been advancing rapidly in India.

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The banking sector has changed dramatically due to the incorporation of technology. Neobanks have emerged as new entrants in the banking industry. They are digital banks that do not have physical branches but offer banking services through mobile apps and have partnered with licensed banks. According to studies, digital banking services are going to be used by the public if they find them easy to use and convenient and if they have some basic knowledge about them. The traditional banks are safer compared to neobanks. On the other hand, demographics is an aspect that contributes to the adoption of digital banking services. However, few studies have been conducted on the comparison of the two banking models and how they contribute towards the promotion of inclusive banking in India. They have not taken into consideration the adoption of banking models, demographics of the population, and the effectiveness of banking models in aspects such as convenience, accessibility, cost, and trust. The study has been conducted with the hope of comparing the banking models and how they can be used towards the promotion of inclusive banking.

## **2.0 Literature Review**

Financial inclusion is one of the most discussed terms, and it is considered the most important term in ensuring that all the consumers in society have access to financial services. Earlier studies have proved that the role of traditional banks in promoting financial inclusion in Indian society is significant in terms of banking presence, loans to priority sectors, and government programs (Kumar, 2019).

However, due to the technological revolution, banking has changed its face completely. Neobanks are the digital banking platforms that provide financial services without any physical presence and are available through mobile applications in association with the banks (PwC India, 2021). These digital banking platforms were introduced with the aim of providing easy access, speed, and low operating costs. Recent studies have proved that the adoption of these digital banking platforms by the consumers is due to factors like convenience, ease, and digital literacy (Shaila *et al.*, 2024).

Younger and educated individuals are more likely to use digital banking platforms because of their preference for speed and ease of service. However, various studies have proved that although neobanks are effective in terms of ease and cost-effectiveness, traditional banks are preferred over neobanks because of their higher level of trust and security (Kristu Jayanti College Study, 2025). The majority of individuals today prefer using both types of banks for their higher level of security provided by traditional banks and the ease of service provided by neobanks. Demographic factors such as age, income level, education level, and occupation level may influence the choice of banking. Younger, educated, and technology-savvy individuals are likely to prefer neobanks, whereas older

individuals and those living in rural areas are likely to prefer traditional banks because of their higher comfort and level of trust (Kumar, 2019; Shaila K. *et al.*, 2024). Although the existing literature has focused on financial inclusion and digital banking, there is a lack of literature that comparatively analyzes both neobanks and traditional banks in the context of India, considering the factors of adoption behaviour, demographic factors, and effectiveness in promoting financial inclusion in the Indian context. The present study, therefore, aims at addressing the knowledge gap in the existing literature by comparatively analyzing both neobanks and traditional banks in the context of India.

### **3.0 Methodology**

The research is titled “A Comparative Study of Inclusive Banking Through Neobanks and Conventional Banks in India.” The research is descriptive and comparative in nature. Descriptively, the research aims to identify the pattern of customers using neobanks and traditional banks. Additionally, the research aims to identify the demographic factors of customers using neobanks and traditional banks. Comparatively, the research aims to identify the differences between neobanks and traditional banks in the context of inclusive banking in India. The research is based on both primary and secondary data.

#### **3.1 Objectives**

- To identify the pattern of customers using neobanks and traditional banks.
- To examine the demographic factors of customers using neobanks and traditional banks.
- To evaluate the differences between neobanks and traditional banks in the context of inclusive banking in India.

The target audience of the research is the customers of banks in India, including students, employed people, self-employed people, and owners of small businesses. Because of time limitations, the research will be based on non-probability convenience sampling. The expected number of customers for the research is 20-25. The research will be based on both primary and secondary data. For primary data, the research will be based on a structured questionnaire. The conclusions will be drawn from the responses of the customers. The research again mentions the non-probability convenience sampling approach due to time limitations and the target audience of the research, which is the customers of banks in India.

### **4.0 Discussion**

This chapter discusses how we analyzed our primary data collected. Our analysis is mainly based on customer perceptions of these new banks, referred to as neobanks,

compared to traditional banks. We used a total of 23 responses, including descriptive statistics, weighted mean ranking, and chi-square tests.

**Table 1: Profile of Respondents**

Category	Frequency	Percentage (%)
18 – 25	19	82.60%
26 – 35	3	13.00%
36 – 45	1	4.40%
Total	23	100.00%

*Source: Survey*

In terms of who our respondents were, it is evident that a vast majority of our respondents, about 82.6%, were aged between 18-25 years. This means that our study mainly focused on how young people perceive these new banks. The second group, aged between 26-35 years, accounted for about 13%. This group mainly comprises young professionals. The third group, aged between 36-45 years, accounted for about 4.4%.

**Table 2: Adoption Behaviour and Usage Patterns**

Usage Indicator	Primary Category	Frequency	Percentage (%)
Current Bank Type	Both (Hybrid)	12	52.20%
	Traditional Bank	7	30.40%
	Neobank	4	17.40%
Usage Frequency	Weekly	10	43.50%
	Daily	6	26.10%
Digital Adoption Level	Medium Level	13	56.50%
	High Level	10	43.50%
Primary Neobank Motivator	UI/UX & Speed	9	39.10%
Primary Traditional Bank Motivator	Trust & Branches	11	47.80%

*Source: Survey*

The high percentage of the younger population may be attributed to the fact that the younger population is increasingly using digital banking platforms. This population is generally more open to using innovative financial products such as mobile banking, digital wallets, and neobanks. They are the future users of digital banking products, and their opinions may be useful to predict the future trends in the adoption of digital banking products. The table indicates that 52.2% of the respondents use both traditional and neobanks, which implies that there is a growing interest in a hybrid approach to banking

services. On the other hand, 30.4% of the respondents use traditional banks as their primary source of banking services, while 17.4% use neobanks as their primary source of banking services. Regarding the frequency of use of banking services, 43.5% of the respondents use banking services on a weekly basis, while 26.1% use them on a daily basis. Regarding the level of adoption of digital banking services, 56.5% of the respondents have a medium level of adoption, while 43.5% have a high level of adoption.

The findings indicate that 39.1% of the respondents prefer to use neobanks because of the UI/UX and speed of service delivery, while 47.8% prefer traditional banks because of the trust and availability of branches. The findings indicate that customers prefer the speed and convenience offered by neobanks, while traditional banks are preferred because of their trust and availability of branches.

**Table 3: Chi-Square Test Results**

Factor	Chi-Square Value ( $\chi^2$ )	p-value	Result
Age	2.471	0.65	Not Significant
Income	7.133	0.522	Not Significant
Education	6.441	0.375	Not Significant
Occupation	7.275	0.296	Not Significant

Source: Survey

A chi-square test was used to assess whether there is a relationship between demographic variables and the choice between neobanks and traditional banks. From the results, it can be seen that the p-values for all demographic variables are higher than the significance level of 0.05. This indicates that there is no relationship between demographic variables and the choice between neobanks and traditional banks.

This indicates that variables such as age, income level, education level, and occupation have no impact on the choice between neobanks and traditional banks. The results indicate that the choice between neobanks and traditional banks may be influenced by other factors rather than demographic characteristics. Such factors may include service quality, convenience, technology used in the bank, and trustworthiness.

**Table 4: Weighted Mean Ranking of Service Indicators**

Indicator	Mean	Standard Deviation	Rank	Preference
Convenience (Speed)	2.45	0.66	1	Neobank
Accessibility (24/7)	2.43	0.66	2	Neobank
Cost (Fees/Charges)	2.27	0.69	3	Neobank
Customer Support	1.95	0.65	4	Neutral / Traditional
Trust (Security)	1.73	0.69	5	Traditional

Source: Survey

The weighted mean analysis shows that convenience and speed rank first with a mean of 2.45. It shows that respondents have a preference for neobanks because of the quick services they offer. Accessibility, which includes 24/7 availability, ranks second with a mean of 2.43. It shows the advantage of digital banking platforms because users can access the services anywhere and at any time. Cost rank third with a mean of 2.27. It shows that respondents perceive that neobanks offer cost advantages due to the reduced costs and charges. Customer support ranks fourth with a mean of 1.95. It shows that respondents still prefer traditional banks for support and solving problems. Lastly, trust and security rank fifth with a mean of 1.73. It shows that respondents perceive traditional banks as more reliable and secure compared to neobanks.

**Table 5: Effectiveness in Promoting Inclusive Banking**

Target Group	Mean Score	Model Effectiveness
Students / Young Adults	2.27	Neobank
Small Business (MSMEs)	2	Equal Effectiveness
Low-Income Earners	1.91	Traditional Bank
Rural Population	1.83	Traditional Bank

*Source: Survey*

The analysis indicates that the service delivery of neobanks is more effective among the youth and young adults, as shown by the mean score of 2.27. In terms of small businesses (MSMEs), the mean score of 2.00 implies that both traditional banks and neobanks are equally effective in-service delivery. This is because small businesses may require both digital banking and traditional banking facilities.

However, in terms of low-income earners, the analysis indicates that traditional banks are more effective in-service delivery, as shown by the lower mean scores of 1.91 and 1.83. This is because low-income earners may experience challenges in accessing the internet and may prefer traditional banking facilities. In this case, traditional banks can be seen to promote financial inclusion among low-income earners and rural populations.

## 5.0 Findings and Conclusion

Based on the analysis of primary data collected from 23 respondents, some of the key findings are as follows:

From the demographic analysis of the primary data collected from 23 respondents, it is found that most of the respondents are from the age group of 18-25 years, i.e., 82.6%. This shows that younger people are more involved in digital banking facilities. This is

because younger people are more familiar with technology-based financial facilities such as mobile banking and neo-banking applications.

The study also found that most of the respondents are in favour of a hybrid bank model. About 52.2% of the total respondents are found to be using traditional banks as well as neobanks. This shows that people are using traditional banking facilities as well as digital banking facilities. At the same time, 30.4% of the total respondents are found to be using traditional banks only, and 17.4% are found to be using neobanks only.

Digital banking is obviously becoming increasingly popular among respondents. For instance, a significant percentage of respondents use digital banking regularly. Specifically, 43.5% of respondents access digital banking weekly, while 26.1% access it daily. The findings indicate that most customers tend to use moderate to high levels of digital banking. The weighted mean findings reveal that when customers are given a choice, speed and convenience rank highest, followed by accessibility and cost efficiency. Simply put, customers want fast banking.

The analysis of the inclusive banking effectiveness shows that customers who are students or young adults can use neobanks to a greater extent because they can easily use digital banking services. However, traditional banks are more effective for low-income groups and people living in rural areas because they can easily access bank services and have more trust in them.

As can be seen from the results of the chi-square analysis, demographic factors like age, income, education level, and occupation do not significantly influence customers' preferences for neobanks over traditional banks. In brief, the choice between traditional banks and neobanks is based only on the level of service quality. The results of the chi-square analysis indicate that neobanks and traditional banks are both very significant for the development of inclusive banking in the country. Future of the Indian Banking Industry: The banking industry in the future will be a blend of traditional and digital banking.

## **6.0 Future Scope of the Study**

Although this study provides valuable insights into inclusive banking, it also reveals many avenues for further research. Future studies could use a larger and more geographically dispersed sample to produce more in-depth and comprehensive findings.

The study could also be carried out with participants from different geographical areas and rural regions of the country to gain deeper insights into digital banking adoption in different socio-economic settings. Further areas of exploration could be undertaken by including additional variables in determining banking preferences, such as financial literacy and cybersecurity. Another potential area of exploration could be undertaken by analysing and determining the sustainability of neobanks in the Indian financial market and its

alignment with different regulatory frameworks and partnerships with licensed banks. Comparative studies could be undertaken between different nations and emerging economies of the world to gain deeper insights into how digital banking platforms are facilitating financial inclusion in different settings and regulatory frameworks. Further areas of exploration could be undertaken by gaining deeper insights into customer satisfaction and service quality and innovation in different banking institutions and how it could be improved for facilitating inclusive banking.

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## CHAPTER 4

### Green Marketing and Digital Communication Strategies of Lenskart for Promoting Sustainable Lifestyles

*Shruti Ghumbre\* and Sheetal Bansude Bura\*\**

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#### ABSTRACT

In the world of business companies really need to think about sustainability. This is because people do not just look at how money a company makes. They also look at how the company treats the community and the environment. A company in India that sells eyewear is Lenskart. This study is going to look at what Lenskart does to be sustainable and how it affects the company. It will also look at how being sustainable affects things like how people see the Lenskart brand, how Lenskart treats its customers, how well the company runs and how money it makes. We will also see how technology helps Lenskart with its sustainability plans. By looking at Lenskart we can see how companies can use sustainability to do in the long run. Lenskart is an example of a company that can show us how to do this. The study of Lenskart will help us understand how important sustainability is, for Lenskart and other companies.

**Keywords:** Sustainability, Analysis of Lenskart, Customer relationships, Brand image.

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#### 1.0 Introduction

Over the 10 years sustainability has become really important to businesses. This is because of all the things that are happening to the planet like climate change, plastic waste and companies using up natural resources too quickly. People are also becoming more aware of what's happening to the environment. So, when people buy things, they think about the price. If it is good quality but they also think about how the company behaves and sells its products. This is why green marketing is now a deal. Companies can use marketing to tell people about their products in a way that shows they care about sustainability. They can do this in ways, such as using social media, websites and mobile applications as well as doing things that are good for the environment, which is what green marketing is all about.

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The digital age has really changed how businesses share their eco- practices. Lenskart, an Indian eyewear company is a good example. They show how businesses can be green and communicate about it. There isn't research on how green marketing affects Indian companies. Less is known about the specific green marketing strategies used by Indian businesses. This research aims to find out Lenskart's green marketing strategy. We also want to know how important these strategies are. Green marketing is key here. We are focusing on Lenskart's approach, to it. The company's green efforts and how they share them will be examined closely.

## **2.0 Statement of the Problem**

In years problems like climate change, pollution and running out of natural resources have become bigger concerns. This has made people more interested in taking care of the environment and finding solutions. As a result, many companies have started using "marketing" to promote products that are safe, for the environment and socially responsible. They do this to show that they care about the environment and to appeal to customers who think about the environment when making purchases. Climate change and pollution are issues. Green marketing helps businesses promote eco- products.

People still do not really understand what green marketing is. This is a problem because it causes confusion about how companies selling their products. Some people do not want to buy products because they are more expensive than other things. Green marketing is still not clear to consumers, so they get confused about how businesses are marketing their green products.

For example, the PCMC area has a lot of people who're between 18 and 35 years old. This is a deal because researchers need to figure out what the PCMC area young adults think about green marketing. The PCMC area young adults are supposed to care about the environment. When the PCMC area young adults buy things, their choices do not always show that they care about the environment. The PCMC area young adults do not always make choices that're good, for the environment when they are buying things.

People who study this stuff need to know what people think about the environment and what they know about it. They also need to understand how people make choices when they buy things, especially when it comes to marketing.

The study we are talking about is going to look at marketing ideas and see if they really change the way people buy things. Do people like these green marketing ideas and do they make a difference when people are buying things related to green marketing? The main goal is to see if green marketing ideas are effective and if people really care about them when they are shopping.

### **3.0 Objectives**

- To know how businesses become sustainable. For example, how do they help the environment treat their workers fairly and still make money in the run? Businesses being sustainable are important to me.
- To find out if being sustainable actually helps businesses succeed. For instance, does it make their brand look good? Do customers become more loyal to them? Being sustainable and doing well at the time seems like a great goal for businesses.
- 3.To explore how digital technology and new ideas can help businesses become more sustainable. Additionally, how can they market themselves as eco-friendly businesses?

### **4.0 Scope of the Study**

This study is about marketing. We want to find out what marketing is about. We are curious to know how marketing affects what people know and what they buy. The study will take place in the PCMC area. We are looking for people who're 18 to 35 years old to participate in this study. We will ask fifteen people to fill out a questionnaire. The goal of this marketing study is to see if people are aware of products. Do people prefer some products over products? We also want to know how marketing changes what people know and what they buy. We want to learn more about marketing and its effects on people. The focus of this study is. How it influences peoples buying decisions.

Studying has some limitations. We are only looking at a group of people in one area. The results might not be the same for every single person. Marketing is really important because it helps people make choices. Green products are good for the environment, which is why green products are so great. We need to figure out how to make people aware of green products. Green marketing can make a difference it really can. Green marketing can help people choose products which are what we want.

We are going to explore how marketing works. This will help us understand what people really think about products. Green marketing is a part of this study. We want to learn more about marketing and how it affects people. Let's take a look at marketing and see how it works. We are especially interested in learning about marketing and its effects on people living in the PCMC area. Marketing and green marketing are crucial to our study. We think they are really important.

### **5.0 Literature Review**

Many researchers talk about sustainability in marketing. For example, Peattie and Belz said in 2010 that a good marketing strategy should make customers happy without hurting the environment or society. Sustainability is actually more important for businesses

than for marketing. Kotler came up with something called Marketing 3.0 in 2011. He thinks that companies should think about people and society not about money. When businesses care about what customers care about, they are able to connect with them. A study done by Leonidou, Leonidou and Mourali in 2013 found that companies can do better than others if they market themselves as green and actually do what they say. Some other researchers, Eccles, Ioannou and Serafeim, found out in 2014 that companies that care about sustainability actually do better over time. Then there was Friede, Busch and Bassen who looked at a lot of research papers in 2015 and found that companies that do well on sustainability also do well financially. Sustainability in marketing is clearly important for businesses and sustainability is what customers care about.

## 6.0 Research Methodology

The study uses both primary and secondary data. Primary data: A structured questionnaire was distributed to consumers familiar with Lenskart. Secondary data: Information was gathered from company reports, official websites, sustainability reports, and research articles.

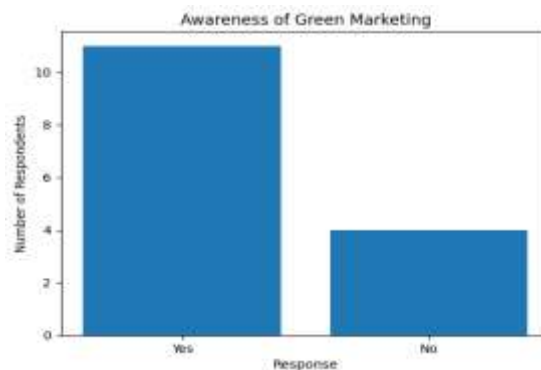
*Sample Size:* The questions were about customers ranging from 18-45 years of age, who have bought from Lenskart or have heard about the brand. Tools of Analysis- Percentage Analysis, Interpretation of the answers, Comparison of the answers with the literature available.

*Primary Data Analysis:*

**Table 1: Awareness of Green Marketing**

Response	Respondents	Percentage
Yes	11	73.3%
No	4	26.7%

*Source: Primary data*

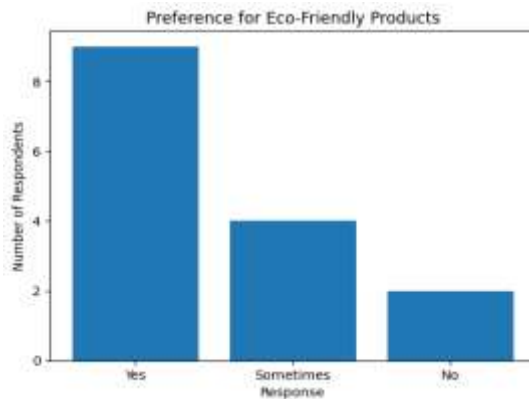


*Interpretation:* It is evident from the above statistics that 73.3% of respondents, or 11/15, are aware of green marketing, leaving only 4 respondents without knowledge of green marketing. This indicates that the majority of respondents in the PCMC area are familiar with green marketing, while a smaller number are unfamiliar with green marketing and thus need to be informed about it by companies that practice green marketing.

**Table 2: Preference for Eco-Friendly Products**

Response	Respondents	Percentage
Yes	9	60.0%
Sometimes	4	26.7%
No	2	13.3%

*Source: Primary data*

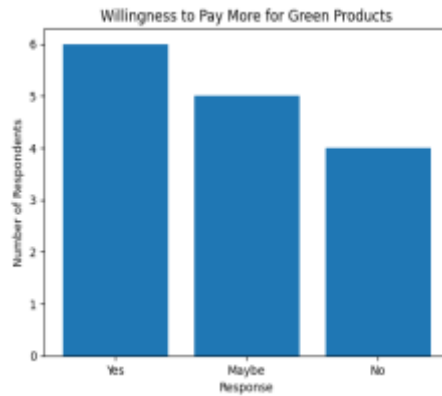


*Interpretation:* The findings in the table show that 9 participants (60%) are in favor of using eco-friendly products, while 4 participants (26.7%) prefer to occasionally use eco-friendly products when making purchases; however, 2 participants (13.3%) reported they did not prefer using eco-friendly products. Overall, the majority of survey respondents indicated they prefer to use eco-friendly products; however, a portion do express an occasional preference for these products.

**Table 3: Willingness to Pay More for Green Products**

Response	Respondents	Percentage
Yes	6	40.0%
Maybe	5	33.3%
No	4	26.7%

*Source: Primary data*

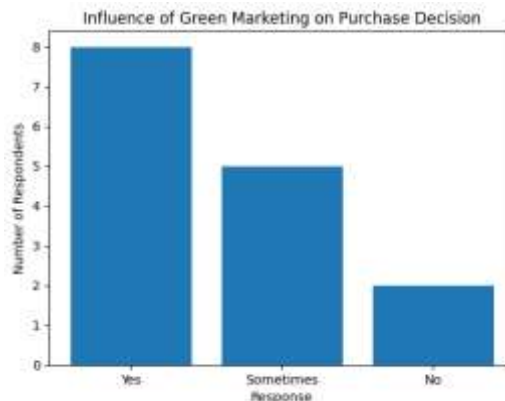


*Interpretation:* Based on the information provided, 6 people (40%) indicate an interest in purchasing green products at a higher price, whereas 5 people (33.3%) are uncertain if they would pay more. In addition, 4 people (26.7%) indicate that they would not be inclined to purchase green products at a premium price. Thus, a subset of individuals would consider paying a premium for green products, but some might not and other individuals might or might not make the decision to pay a premium for green products. Therefore, pricing does play a role in the purchasing decision-making process of consumers.

**Table 4: Influence of Green Marketing on Purchase Decision**

Response	Respondents	Percentage
Yes	8	53.3%
Sometimes	5	33.3%
No	2	13.3%

*Source: Primary data*



*Interpretation:* According to the table, over one half (53.3%) of all respondents feel green marketing has an effect on their buying decisions; nearly one-third (33.3%) feel that sometimes it does; while one-eighth (13.3%) feel that it has no effect on them. This indicates that green marketing has a favorable influence on the majority of consumers' buying choices.

## **7.0 Suggestions and Recommendations**

1. **Raise Awareness About Green Marketing** Businesses should increase efforts to educate people on eco-friendly products and sustainable practices. Ads, social media campaigns, and educational programs can help inform consumers. When people see the environmental benefits, they are more likely to buy green products.
2. **Provide Clear Product Information** Businesses should clearly communicate the eco-friendly aspects and benefits of their products through packaging and marketing messages. Accurate labeling and certifications can help build trust and reduce confusion around green claims.
3. **Reduce Costs of Eco-Friendly Goods** Price plays a significant role in purchasing decisions. Businesses should work on reducing production costs to offer eco-friendly products at reasonable prices. People are more likely to buy products when they get discounts or see promotions about them.
4. **Companies should use packaging that's good for the environment.** They can use packaging that people can recycle or reuse. If companies use plastic and switch to packaging that is better for the earth, they can reduce waste and look like a green company.
5. **We should tell people to be kind to the earth when they buy things.** Companies can help people recycle using plastic and choose green products. Companies can do this by telling people about it and giving them rewards when they do these things.
6. **Support from Government Policies:** The government should help companies that use marketing by giving them reward rules to follow and programs to teach people about it. When the government helps businesses that care about the environment it makes people want to buy things that're good for the planet.
7. **Use the Internet to Promote Green Things:** Companies should use the internet, their websites and social media to show people what they are doing to help the environment. This can help them talk to people and make their brand seem greener. Businesses can use platforms to promote green initiatives and make people know about the green marketing they are doing with green marketing.

## 8.0 Conclusion

Green marketing is really important for businesses these days. Companies that actually care about the earth are making relationships with their customers. Lenskart is an example of this. They are using technology to take care of the environment and being honest with people to get ahead. This just shows that green marketing can help businesses be good for the earth and make a profit at the time. The way Lenskart does things proves that companies can be successful by being kind to the earth and using technology in a way. They are also being open with people, which helps them make products that're really good for everyone. If companies do things like this, they will see results. Green marketing is the key to doing. It helps businesses build trust with their customers. What Lenskart has done is proof of that. Green marketing is what makes businesses successful and Lenskart is an example of a company that is doing green marketing right.

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## CHAPTER 5

### Comparative Analysis on Adoption of UPI amongst Gen-Z and Millennials

*Priyanka Dhoot\**, *Dev Lalwani\*\** and *Jatin Gadiya\*\*\**

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#### ABSTRACT

This research analyses Unified Payments Interface (UPI) adoption patterns between Gen Z (18–26) and Millennials (27–42) in India. As UPI anchors the digital economy, this study examines how generational shifts influence financial behaviour, trust, and digital literacy. Using a quantitative survey of 100 respondents, it evaluates three dimensions: adoption drivers, perceived security risks, and post-adoption spending habits. Findings indicate that while Gen Z prioritizes transaction speed and social integration, Millennials emphasize security and banking reliability. Both cohorts report increased impulse spending—the “Invisible Money” effect—though Gen Z faces greater challenges in manual budgeting. By applying Likert scales and statistical analysis, the research provides insights for FinTech developers to bridge the “trust gap” and mitigate debt risks. Ultimately, the study highlights how the transition from “Digital Pioneers” to “Digital Natives” shapes India’s cashless future.

**Keywords:** Unified Payments Interface (UPI), Gen Z, Millennials, Digital payment Adoption.

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#### 1.0 Introduction

The Unified Payments Interface (UPI) has significantly impacted the Indian financial system since its inception by the National Payments Corporation of India (NPCI). UPI is a “real-time payment system which enables immediate peer-to-peer as well as person-to-merchant transactions between participating banks.” The theoretical foundation for UPI acceptance is supported by technology acceptance models, such as Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT), which cite Perceived Usefulness, Perceived Ease of Use, and Social Influence as key factors influencing consumer behaviour.

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Currently, UPI has moved beyond being simply an interface for monetary transactions to becoming an ecosystem with gamification, financial systems, and consumer psychology. The ease of digital transactions has reduced the “pain of paying,” which is reflected by changes in consumer spending patterns. This study aims to examine consumer behavior, security, and psychological factors related to UPI, with special emphasis on differences between Generation Z and Millennials.

## **2.0 Literature Review**

The rapid growth of digital payment systems, especially UPI in India, has been a topic of great academic interest over the last five years. The existing literature on digital payment systems, especially UPI, has regarded this phenomenon as a revolution not only in technology but also in consumer psychology and behavioural finance. This paper attempts to synthesize existing literature under four major areas: Adoption Dynamics, Generational Behavioural Nuances, Trust and Security, and Digital Overspending.

### **2.1 Adoption dynamics and gamification**

The initial studies on UPI adoption were based on TAM theory. In their study, Kaur and Arora (2020) highlighted that ease of use and interoperability were key factors for UPI adoption by users who switched from cash-based systems to digital systems. However, later studies have highlighted the role of gamification in retaining UPI users. In this regard, Singh and Srivastava (2022) highlighted that although cashbacks and scratch cards act as major gamification factors, their effect is limited to initial usage. In support of this, Pal, De', and Herath (2021) highlighted that app stickiness, which is crucial for retaining UPI users, is actually influenced by factors such as UI speeds and server reliability, as opposed to other incentives. Furthermore, Verma (2022) highlighted that the widespread adoption of QR codes by unorganized retail for P2M transactions has been a major factor for forming consumer behaviour among urban populations.

### **2.2 Generational divides in digital finance**

The concept of the digital divide has now progressed beyond the basic issue of accessibility. Jain & Patel (2023) undertook an analysis of the comparative adoption of FinTech services. Generation Z considers digital payment systems as social and lifestyle products, with strong network effects of their peers. On the other hand, Millennials consider the adoption of FinTech services as an extension of their professional and financial management skills, as emphasized in the Deloitte report of 2022. PwC's report on the FinTech industry for 2021 also established that Millennials consider the ability to connect their bank accounts for wealth management as an important criterion, whereas Gen Z considers the speed of micro-payments between their peers as an important criterion.

Sharma & Gupta (2023) also emphasized that the younger demographic does not show brand loyalty, frequently changing their ‘primary’ FinTech apps due to temporary changes in the UI or due to the influence of their network, whereas Millennials stick to their early adopter FinTech apps

### **2.3 Security perceptions and transaction anxiety**

Although the Unified Payments Interface (UPI) is highly popular, psychological factors still exist, particularly for high-value transactions. Kumar & Sharma (2023) undertook an analysis of the difference between trust in the system, also known as trust in NPCI/Banks, and trust in the platform, also known as trust in the FinTech application. They concluded that the general population trusts the system but experiences high transactional anxiety due to technical failures. Iyer’s report of 2022 undertook an analysis of transactional anxiety. According to the report, fear of human error, such as sending money to the wrong Virtual Payment Address, deters Generation Z from undertaking high-value transactions. However, the older demographic, including Millennials, is more concerned about sophisticated cyber-attacks, including phishing emails and links, as emphasized in the report of Deshmukh of 2023. However, the critical divide that exists, as emphasized in the report of Sethi et al. of 2021, is that adhering to high standards of personal security does not have an impact on the level of transactional anxiety.

### **2.4 Behavioural economics: The pain of paying and overspending**

The most impactful influence of Unified Payments Interface (UPI) is its implications for individual-level financial discipline. Using the tools of behavioural economics, Chatterjee and Das (2022) argue that the “invisible currency” created by digital payments considerably reduces the psychological pain of paying traditionally linked to the loss of physical cash. In this regard, the study by Zhao, Zhang, and Chen (2021) offers empirical support that the ease of use of scan-and-pay technologies increases the likelihood of small-ticket impulse purchases. In this context, Mishra (2021) argues that the impact of the post-pandemic shift to digital payments has led to the erosion of conventional notions of mental accounting, resulting in the overspending that is now endemic in the budgets of individuals. Recent research by Ali and Khan (2023) reveals that the phenomenon of overspending is not income-dependent, thus indicating a universal shift in human behaviour that is driven by the ease of use of technology.

## **3.0 Research Gap**

In spite of the considerable volume of research that has focused on the overall adoption of UPI as well as its technical framework, there is a considerable gap in the

empirical research that compares the psychological impact of UPI among generational cohorts such as Gen Z versus millennials. Furthermore, the overall literature has not quantified the relationship between an individual’s strictness in following digital security measures and their local-level financial anxiety in high-value transactions. This study aims to bridge the research gap by analysing primary data to shed light on the nuances of the overall phenomenon.

## 4.0 Research Methodology

### 4.1 Objectives of the study

- To identify and compare the primary drivers of UPI adoption between Gen-Z and Millennials.
- To analyse the impact of perceived risk and security concerns on usage frequency.
- To evaluate the shift in spending budgeting habits, post adoption amongst Gen-Z and Millennials.

### 4.2 Research design

The study adopts a descriptive and analytical cross-sectional research design to examine the behaviour and preferences of digital payment users. Primary data were collected through a structured online Google Form consisting of sections related to demographics, app preferences and motivations, usage patterns and spending behaviour, as well as security and trust perceptions. The respondents were selected using convenience and snowball sampling techniques, resulting in a sample size of 101 active UPI users belonging to Gen Z (18–26 years) and Millennials (27–42 years). Data analysis was conducted using Microsoft Excel through descriptive statistics, weighted mean ranking, and Pearson correlation analysis. The scope of the study is confined to smartphone-literate individuals actively participating in India’s digital economy.

### 4.3 Data interpretation

**Table 1: Comprehensive Demographic Profile of Respondents**

Demographic Variable	Category	Gen Z (n=65)	Millennials (n=36)
Gender	Male	69.2%	69.4%
	Female	30.8%	30.6%
Educational Qualification	Under Graduation	16.9%	22.2%
	Graduate	61.5%	50.0%

	Postgraduate	13.8%	13.9%
	Professional	7.7%	13.9%
Occupation	Student	70.8%	41.7%
	Salaried Employee	15.4%	27.8%
	Business Owner	10.8%	16.7%
	Self-employed / Others	3.1%	13.9%
Monthly Income Level	Below ₹20,000	41.5%	30.6%
	₹20,001 – ₹40,000	18.5%	25.0%
	₹40,001 – ₹60,000	4.6%	5.6%
	Above ₹60,000	35.4%	38.9%

Source: Primary data

*Interpretation:* The demographic profile suggests that the Gen Z population is mostly composed of students (68-71%), with a significant percentage earning less than ₹20,000 (41.5%) as their monthly income. On the other hand, the Millennial population has a diverse occupational background, with a significant percentage engaged in salaried (27.8%) and business (16.7%) professions, indicating higher earnings levels, with 38.9% earning more than ₹60,000 as their monthly income. This is the basic context, and with this, we understand how Gen Z is using UPI for lifestyle management as students, whereas Millennials are using it for professional and household purposes.

### Table 2: Initial Motivation to Download a UPI App (Ranked Analysis)

This table orders the initial drivers from most influential (Rank 1) to least influential (Rank 5)

Rank	Gen Z (n=65)	%	Millennials (n=36)	%
1	Peer Influence (Friends/Family)	38.5%	Professional Necessity (Work)	33.3%
2	Merchant Requirement	23.1%	Peer Influence (Friends/Family)	30.6%
3	Professional Necessity (Work)	18.5%	Merchant Requirement	22.2%
4	Social media Trends/Ads	15.4%	Social media Trends/Ads	11.1%
5	Seeking Promotional Rewards	4.6%	Seeking Promotional Rewards	2.8%

Source: Primary data

*Interpretation:* The ordered data show that there is a notable generational difference in terms of adoption motivators. Gen Z, considered “Digital Natives,” is driven by factors related to social integration, with Peer Influence (38.5%) being the major motivator. Millennials, who adopt technology later in life, are driven by factors related to utility, such as Professional Necessity (33.3%) and Merchant Requirements (22.2%)

**Table 3: Primary Factors for Choosing a Specific App (Ranked Analysis)**

This table ranks the practical reasons users stay loyal to their primary UPI application

Rank	Gen Z (n=65)	%	Millennials (n=36)	%
1	Better User Interface (UI) & Speed	47.7%	Better User Interface (UI) & Speed	47.2%
2	It was the first app I ever installed	23.1%	It was the first app I ever installed	25.0%
3	Higher success rate of transactions	16.9%	Higher success rate of transactions	19.4%
4	Better rewards & gamified features	12.3%	Better rewards & gamified features	8.3%

Source: Primary data

*Interpretation:* While the initial drivers differ, the two generations show the same level of priority in terms of app retention. A seamless user experience, as captured by the presence of Superior UI and Speed, is the most important driver for Gen Z (47.7%) and Millennials (47.2%). Interestingly, the idea of a “first-mover advantage” continues to play a significant role in app retention, with the first-installed app feature ranking second in priority for Gen Z and Millennials.

**Table 4: Influence of Cashback and Rewards (Likert Scale Analysis)**

(Scale: 1 = Not at all, 2 = Neutral, 3 = Somewhat influential, 4 = Extremely influential)

Influence Level	Gen Z (%)	Millennials (%)
4 - Extremely influential	32.3%	27.8%
3 - Somewhat influential	27.7%	16.7%
2 - Neutral	21.5%	25.0%
1 - Not at all (Convenience only)	18.5%	30.6%
Weighted Mean Score	2.74 (Moderate-High)	2.41 (Moderate-Low)

Source: Primary data

*Interpretation:* The results of the Likert scale show that Generation Z is more susceptible to gamification. The results show a higher weighted mean for Generation Z (2.74), with about 60% of the results indicating that rewards were either extremely or somewhat influential in the process. On the other hand, 30.6% of Millennials stated that rewards were “Not at all” influential, indicating a desire for convenience alone, resulting in a lower mean of 2.41.

**Table 5: Most Essential UPI Features for Daily Lifestyle (Ranked Analysis)**

Rank	Gen Z (n=65)	%	Millennials (n=36)	%
1	QR Code scanning (P2M)	64.6%	QR Code scanning (P2M)	63.9%
2	In-app utility payments (Recharges)	20.0%	Linking multiple bank accounts	19.4%
3	Linking multiple bank accounts	13.8%	In-app utility payments (Recharges)	13.9%
4	Integration with online checkouts	1.5%	Integration with online checkouts	2.8%

Source: Primary Data

*Interpretation:* P2M QR code scanning is the quintessential functionality of UPI for both the generations, contributing to over 63% of the essentiality for each. This reveals that physical environments are the main domain for digital payments. Millennials have slightly higher emphasis on the functionality of interlinking bank accounts, which is at Rank 2, than Gen Z, reflecting the more complex portfolio of the former.

**Table 6: Anxiety Level During High-Value Transactions (>₹10,000)  
(Likert Scale Analysis)**

(Scale: 1 = No anxiety, 2 = Low, 3 = High, 4 = Very High)

Level of Anxiety	Gen Z (%)	Millennials (%)
1 - No anxiety; I trust the system	29.2%	47.2%
2 - Low; I double-check the name	46.2%	19.4%
3 - High; I prefer Net Banking/Cards	23.1%	27.8%
4 - Very High; I avoid large transfers	1.5%	5.6%
Weighted Mean Score	1.97 (Low Anxiety)	1.92 (Low Anxiety)

Source: Primary data

*Interpretation:* The results indicate that the assumption of lower trust levels in digital systems for older age groups is questionable, as indicated by the results, where 47.2% of Millennials reported no anxiety, as opposed to 29.2% of Gen Z. However, the results also indicate that Millennials are polarized, as indicated by the fact that a significant number (33.4%) still experience high to very high levels of anxiety and prefer traditional Net Banking for high-value transactions. Despite the differences, both groups show low overall mean score results, indicating maturity of trust in the UPI infrastructure.

**Table 7: Security Threats and Impact of Failures (Comparative Analysis)**

This merges the perception of threats with the behavioural impact of experiencing a failure.

Security Perception & Resilience	Category	Gen Z (%)	Millennials (%)
Biggest Security Threat	Technical failures (Money debited)	40.0%	47.2%
	Human error (Sending to wrong ID)	36.9%	19.4%
	Fraudulent links and Phishing scams	16.9%	27.8%
	Data privacy and app tracking	6.2%	5.6%
Impact of Transaction Failure	Temporary impact; switch to cash for day	63.1%	52.8%
	No impact; try again immediately/later	32.3%	38.9%
	Long-term impact; reduce UPI usage	4.6%	5.6%

Source: Primary data

*Interpretation:* While both groups rank internal system failures, such as money being deducted with no receipt of the money, as the main threat (40.0% and 47.2%), Millennials are more worried about external attackers, with phishing concerns being at 27.8%, compared to Gen Z’s 16.9%. On the other hand, Gen Z is quite hard on themselves, ranking “Human error” quite high at 36.9%. On the bright side, such issues rarely lead to loss of trust, with both groups resorting to using cash for the time being.

**Table 8: Strictness in Following Security Protocols (Likert Scale Analysis)**

(Scale: 1 = Never, 2 = Rarely, 3 = Moderately, 4 = Very Strictly)

Strictness Level	Gen Z (%)	Millennials (%)
4 - Very strictly (Monthly updates)	15.4%	25.0%
3 - Moderately (When prompted by app)	64.6%	44.4%
2 - Rarely (Only use original PIN)	12.3%	19.4%
1 - Never	7.7%	11.1%
Weighted Mean Score	2.88 (Moderate)	2.83 (Moderate)

Source: Primary Data

*Interpretation:* From the above discussion on security hygiene practices, it is evident that the apps are more relied upon than the user themselves. The most surprising figure is that a whopping 64.6% of Gen Z and 44.4% of Millennials only interact with the security protocols “moderately,” i.e., only when prompted to do so by the app itself. While a quarter of the Millennials perform strict monthly audits, the figures do suggest that FinTech app developers should include the security prompts in the app itself, since users don’t tend to do this naturally.

**Table 9: Impulse Purchases and Cash-in-Hand Behaviour (Comparative Analysis)**

This assesses the tangible shift towards cashless, frictionless spending.

Behavioural Shift	Category	Gen Z (%)	Millennials (%)
Increase in Impulse Purchases	Significant increase	58.5%	58.3%
	Marginal increase	36.9%	33.3%
	No change	4.6%	8.3%
Cash-in-hand Behaviour	Carry minimal cash for emergencies (<₹500)	53.8%	58.3%
	Carry zero cash now	24.6%	27.8%
	No change in cash behaviour	13.8%	5.6%
	Still carry a full wallet but prefer UPI	7.7%	8.3%

Source: Primary data

*Interpretation:* The emergence of digital currency has revolutionized the economics of consumers in a fundamental manner. A majority of Gen Z respondents, amounting to 58.5%, and Millennials, amounting to 58.3%, report a “Significant increase” in small ticket impulse purchases, indicating the elimination of the “pain of paying” effect. At the same time, the traditional wallet is made redundant, with over 78% of Gen Z and 86% of Millennials storing either zero or minimal cash, only in emergency situations.

**Table 10: Digital Budgeting Challenges & Overspending (Comparative Likert)**

This evaluates whether the “Invisible Money” effect derails monthly budgets.

Budgeting & Spending Habits	Category	Gen Z (%)	Millennials (%)
Impact of “Invisible” Money	Yes, I lose track of how much I’ve spent	60.0%	69.4%
	No, the digital record makes me disciplined	26.2%	13.9%
	It has no impact on my budgeting	13.8%	16.7%
Frequency of Overspending	Frequently (Almost every month)	52.3%	36.1%
	Occasionally	24.6%	22.2%
	Rarely	20.0%	25.0%
	Never	3.1%	16.7%

Source: Primary data

*Interpretation:* The table shows the most pronounced consequence of the adoption of Unified Payments Interface (UPI), which is the “Invisible Money” phenomenon. The absence of physical currency exchange is correlated with 60.0% of Generation Z and 69.4% of Millennials losing track of their expenditure. This leads to a deterioration in the performance of budgeting. More than half of Generation Z, 52.3%, frequently overspend in comparison to their budgeted limit for the month. Although the problem is also experienced by the Millennials, their higher level of maturity allows them to limit their actual overspending better than the members of Generation Z.

## 5.0 Recommendations

For Application Developers: Since users consider UI, speed, along with high transaction success rates, as the major factors for continued usage of the application, developers must focus on minimizing server downtime rather than relying on the cashback marketing strategy, which does not show significant long-term retention effects for Millennials.

**Addressing High-Value Anxiety:** Developers must ensure that the application interface contains a “cooling period” or a “double verification” screen for transactions above ₹10,000, addressing the high-value anxiety caused due to human errors, such as the transfer of money to the wrong account, which was highly emphasized by Generation Z.

**Financial Wellness Tools:** Since almost half of the users lose track of their budgets due to the perceived invisible nature of the money transferred through the UPI platform, the application must ensure the presence of mandatory budget-tracking tools.

## **6.0 Conclusion**

The results of the current study indicate that the adoption of the Unified Payments Interface is highly divergent between the two generational cohorts. Generation Z primarily uses the digital payment platform due to the influence of their peers, along with the presence of gamified rewards, considering the technology an integral part of their lives. Millennials, on the other hand, use the platform due to the practicality of the application, their professional needs, as well as the expectations of merchants.

However, the presence of a trust gap between the two cohorts is also visible, where Generation Z shows the characteristics of the “click and forget” behaviour, along with low transactional anxiety. Millennials, on the other hand, show high perceived risks related to phishing, along with the need for stringent security measures. Moreover, the ease of transaction through the digital platform led to the presence of the “Invisible Money” phenomenon, resulting in the increase of impulse purchases for both cohorts. However, whereas Millennials show the presence of financial experience, which helps in the reduction of actual overspending, Generation Z faces high difficulties in manual budgeting, resulting in high monthly overspending. Therefore, FinTech developers must address the above issues through the creation of transparent interfaces for Millennials, along with the presence of budgeting tools for Generation Z.

## **7.0 Future scope of Research**

The study offers some rudimentary information about generational financial behavior; however, there are tremendous opportunities for researchers in the field of digital finance. Future studies should employ a longitudinal design to measure the impact of effortless digital spending on debts as Generation Z joins the workforce full-time. The study was limited to urban dwellers; however, future studies should explore the impact of digital literacy and trust barriers in semi-rural populations in Tier 2 and Tier 3 cities. It is also vital to explore the impact of AI-driven cybercrimes and phishing risks on digital finance adoption among risk-averse Millennials. Future studies should also explore the impact of

emerging technology such as 6G technology, NFC technology, and cardless UPI ATMs on overall convenience. An experimental design should be employed to measure the impact of behavioral interventions such as budgeting nudges and gamified financial literacy programs on highly impulsive consumers and their experience of paying.

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## CHAPTER 6

### Developing an Ensemble-Based Model for Player Performance Classification in the Indian Super League

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#### ABSTRACT

In order to ensure forecast accuracy and generalizability across a variety of player positions, this study creates a machine learning ensemble framework for assessing Indian Super League (ISL) 2023–24 player performance utilizing goals and assists as key criteria. To guarantee reliable input representation, the dataset underwent pre-processing using polynomial feature engineering, uniform scaling, and rare-class management. An ensemble integrates Random Forest meta-learner with Bagging, HistGradientBoosting, Gradient Naïve Bayes, and Decision Tree classifiers. The stacking ensemble provides better stability and interpretability across player categories while achieving competitive accuracy (91.11%),  $R^2$  (0.9395), and RMSE (0.7888) as compared to individual models. Actionable insights for recruiting and scouting were made possible by the derivation of suitability categorization in relation to median contribution values. The results set the groundwork for future sports analytics research in developing football ecosystems by highlighting stacking ensembling as a possible methodological development for player appraisal in ISL.

**Keywords:** Ensemble learning, Player performance evaluation, Indian super league (ISL), Sports analytics.

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#### 1.0 Introduction

An important step in assessing an athlete's skill level and training quality is performance evaluation (Morciano *et al.*). Athletes' physical condition, past achievements, and mental health are just a few of the many variables that must be examined in order to evaluate and predict their performance (Mackenzie & Iso-Ahola). To create focused training sessions that are intended to increase athletes' individual skills and fill up any ability gaps, trainers rely on performance evaluation (Tichy).

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Performance evaluation becomes considerably more difficult in team sports like football since it requires gathering information about several players over time while taking into consideration for their individual responsibilities on the squad (Gabbett *et al.*).

In football, scouting, training, and tactical decision-making all depend considerably on player performance evaluation. Existing evaluation techniques mostly rely on subjective judgments, which frequently result in biases and inconsistencies. Machine learning (ML), on the other hand, provides a data-driven methodology that makes it possible to analyze players performance more accurately and objectively using statistical performance labels.

Despite ML-driven player evaluation has progressed, current models sometimes have trouble generalizing to other positions, especially goalkeepers, defenders, or attackers. Evaluation criteria must be customized to each function because of the distinct duties and the skill sets required for each. As a result, one ML model might not be enough for evaluating players in various roles.

This paper investigates ensemble learning strategies, namely Stacking Classifiers, to improve prediction accuracy and resilience in order to overcome these issues. We hope to create a thorough mechanism for evaluating performance that provides a more accurate and comprehensible appraisal of football players through the integration of multiple machine learning models.

Dijkhuis *et al.* made an effort to predict football players' performance. Here, data on football players' distance travelled, distance in speed category, and energy expenditure were gathered by the authors using an optical tracking device (Dijkhuis *et al.*). The underperformance of players 15 minutes after the start of a match was then predicted using these data and two ML models. Underperformance was defined as failing to meet 100%, 95%, or 90% of each player's season average for a particular performance metric taken into consideration. If the player underperforms during the game, the trainers may obtain valuable information about the player's state, which may lead them to replace the player with another player if necessary. If the performance is above the average, additional information is obtained. For example, it can assist in the assessment of the skill level of the player in comparison with teammates, as well as specific training plans. In order for this to be achieved, sensors integrated into the vests worn by the players can be used for the acquisition of a large amount of useful data. Some sensors that can be used by the players without being cumbersome are heart rate monitors (HRM), inertial movement units (IMUs), and GPSs. Alexandre *et al.*, Reinhardt *et al.* These sensors are capable of gathering a wide range of data, such as performance and biometric data.

Although there are various studies on the application of machine learning models for predicting football player performance in prominent football leagues in Europe, such as Serie A, La Liga, and the English Premier League, there remains a conspicuous absence of studies on the Indian Super League (ISL). Considering the explosive growth of the ISL and

its increased presence in the world football arena, it is surprising that there is little available investigation of the use of cutting-edge machine learning models for player performance assessment or prediction in the ISL scenario. In order to fill this research gap, this study creates and assesses data-driven models especially suited for ISL player datasets, offering fresh perspectives on performance analytics for Indian football.

The following are this work's main contributions:

- **Data-driven framework for Indian football:** By creating a strong machine learning framework especially suited to Indian Super League (ISL) player data, this study fills a significant research gap by offering one of the first thorough, data-driven assessments of player performance in Indian football.
- **Objective player performance evaluation:** It shows how machine learning methods are useful for assessing football players' performance based on position-specific and historical characteristics, allowing for precise player suitability forecasts.
- **Comparative model evaluation:** To identify the best approach for performance prediction, a number of machine learning models, including ensemble techniques like Random Forest (Patel *et al.*), Gradient Boosting (Pantazopoulos *et al.*), Extra Trees (Guo *et al.*), XGBoost (Guo *et al.*), and a Stacking Ensemble, are methodically evaluated.
- **Improved feature engineering and ensemble learning:** To increase prediction accuracy and guarantee consistent, trustworthy player assessments, sophisticated feature engineering approaches and ensemble structures are used.

The Stacking Ensemble technique provides improved accuracy in prediction by taking advantage of the complementary characteristics of all the learning algorithms used. While the Gradient Boosting and XGBoost algorithms are good at identifying complex relationships in the data, the Random Forest and Extra Trees algorithms are good at reducing variance with the bagging approach used in them. The ensemble technique benefits from the stability and flexibility of all the algorithms used in it, as the advantages of one algorithm compensate for the disadvantage of another. In addition, the ensemble technique reduces overfitting, a common problem with all boosting algorithms. Consequently, the Stacking Ensemble improves generalization and produces a more robust, balanced, and trustworthy model for predicting football player performance.

## 2.0 Related Work

As machine learning (ML) can analyze large amounts of data in a variety of domains, such as match outcome prediction (Wong *et al.*), injury risk (Musat *et al.*), player market value (Franceschi *et al.*), athlete development (Söker *et al.*), specific skill analysis (Leddy *et al.*), and player performance prediction (Taber *et al.*), an increasing number of studies are using ML techniques in football. As stated earlier in the section, estimating and

forecasting the performance of footballers can be quite challenging and demands huge amounts of information. In order to allow the audience to appreciate the progress made in this field, some insights into the main uses of machine learning in football will be provided.

An example of how to predict match outcomes is given by Bunker *et al.* This study's authors looked at 380 matches between 20 Spanish Premier League professional football teams. Two machine learning algorithms were used in making predictions on three distinct football results: win for the home side, a draw, and win for the away side. Using 33 parameters, such as crossings, accelerations, sprint speeds, and long shots, the linear support vector machine's accuracy was 73% for home wins, 75% for draws, and 71% for away wins. Rather, the logistic regression model's accuracy was 73% for home wins, 72% for draws, and 74% for road wins (Bunker *et al.*). These results imply that ML may be utilized for predicting match outcomes, even if they fail to achieve a very high accuracy.

Higher chances of winning a match are often linked to high-intensity training, which increases the risk of injury (da Silva *et al.*). For example, Venturelli *et al.* note that Several factors, such as height, size of the body, jump, and previous injuries, can increase the possibility of injury to the thighs among the young footballers. Injuries can obviously affect football players, as well as their respective teams and football organizations (Venturelli *et al.*). As such, prediction of injuries is important. Another example of using machine learning to predict football injuries is given by Rossi *et al.* For this study, physical activities of 26 professional footballers were monitored for the 2013-2014 championship season. The captured attributes could be classified into three groups: kinematic attributes – measures how much the athlete moves in his training; metabolic attributes – measures the energy consumption of the athlete in his training session; and mechanical attributes – measures the mechanical stress of the athlete's muscular system in his training session. For predicting the injury to the footballers, three different models of machine learning algorithms were adopted – Decision Tree, Random Forest, and Logistic Regression. While the Random Forest predicted the injuries in 87% of the cases, the Decision Tree predicted 80%. However, using a logistic regression model, only 60% prediction was possible (Rossi *et al.*). The scientists came to the conclusion that certain machine learning models outperform conventional state-of-the-art methods for assessing injury risk. If injuries are precisely anticipated, football teams and players may be more careful about injuries and football clubs can better manage their resources.

Indeed, in such instances, the team can adjust the workout schedule for the athlete so as to minimize the chances of being injured again. The athletes can be helped to seek the necessary medical care as well. This would help ensure that the injury does not get any worse and even make recovery easier. Another example of identifying recurrent motion patterns is given by Zhang *et al.* The authors of this study used k-Nearest Neighbors to examine football players' most frequent movements in certain regions of the field. This

method makes it possible to evaluate how the athlete moves toward opponents and teammates as well as whether or not the athlete can move across the field to change positions as needed. The analysis may then be utilized to help trainers ascertain if the taught patterns were applied during official games or to give information on the patterns employed by other teams (Zhang *et al.*). An inventive method to enhance optimization algorithms is to modify the WOA by utilizing the Euclidean distance. Since this modification is being used for the first time, a comparison between the gridsearch algorithm and the conventional WOA was conducted to examine the variations in the prediction accuracy of the three ways. Future research projects that employ this state-of-the-art optimization method might be evaluated using this study as a standard.

### 3.0 Materials and Methods

#### 3.1 Data collection and preprocessing

The study's information came from publicly accessible football statistics on FBref, an online database that offers comprehensive player-level stats for professional football leagues throughout the globe. The pertinent player statistics for the 2024–2025 season were manually retrieved from FBref webpages related to Forward player because the Indian Super League (ISL) data is not immediately accessible through an API. Relevant statistics such as games played, minutes played, goals scored, assists made, passing accuracy, etc., are some of the key performance indicators that are collected from the relevant FBref webpages pertaining to the position of the player. A series of preparation steps are undertaken before the data is used with the help of the machine learning algorithm.

#### 3.2 Data preprocessing

- *Data cleaning:* All the numeric columns are converted to the correct numerical format by handling the commas and missing values, and the unnecessary textual columns like nationality, club names, and birth year are removed (Chu *et al.*).
- *Feature engineering:* To better capture player performance, additional features are created: minutes per match (Nargesian *et al.*), weighted target (a combination of PPM and minutes per game), and total contributions (the sum of goals and assists).
- *Imputation and scaling:* To ensure that the input scales are consistent across all models, the numerical features (Wu *et al.*) are normalized using the StandardScaler, and the missing values are imputed using median imputation.
- *Label binarization:* In order to distinguish between the above-average performers and the below-average performers, the target variables (Qin *et al.*), including the performance and suitability, were binarized by using the median values.

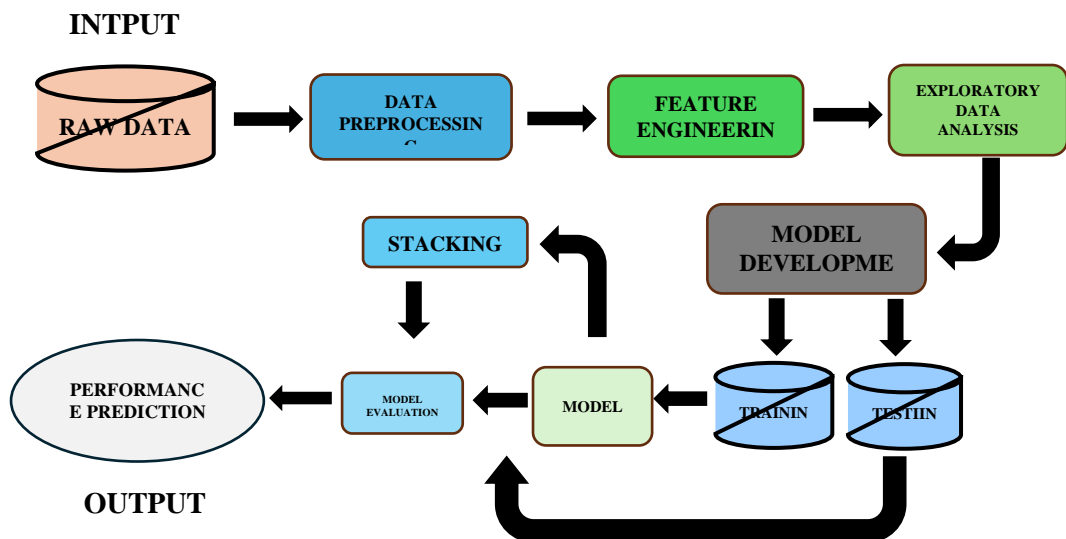
While the data was collected manually in this version, the authors note that this may cause human error, which could negatively influence repeatability. Future research tries to

address this problem by developing a semi-automatic web scraping method that could automatically collect the data from FBref without any errors using Python tools like BeautifulSoup or Selenium.

### 3.3 Methods

To enhance the accuracy of the model, multiple ensemble classifiers are trained: Random Forest (Patel *et al.*), Gradient Boosting (Pantazopoulos A *et al.*), Extra Trees (Guo *et al.*), XGBoost (Guo J *et al.*). These individual models are combined using a Stacking Classifier with XGBoost as the meta-learner. This is done to leverage the benefits of each model. Finally, the players are classified as “Suitable” and “Not Suitable” based on their goal contributions with respect to the median of the dataset.

**Figure 1: Proposed Framework for Football Player Performance Prediction**



### 3.4 Model architecture and contribution to the ensemble pipeline

This work employs four essential models of machine learning, namely Random Forest (Patel *et al.*), Gradient Boosting (Pantazopoulos A *et al.*), Extra Trees (Guo *et al.*), and XGBoost (Guo J *et al.*), each of which introduces special features to the ensemble pipeline that ensure the reliability and accuracy of the prediction of players’ performance across different positions.

- *Random Forest (RF)*: This is a model based on bagging, where many decision trees are created and their predictions are averaged (Patel *et al.*). This model is quite good at

dealing with noisy data and reducing variance. RF detects general trends in players' performance and provides robust predictions for the pipeline.

- *Gradient Boosting (GB)*: This is an additive model that creates trees sequentially, where each tree aims to correct the errors of the previous trees (Pantazopoulos A *et al.*). GB is particularly good at detecting subtle connections and small patterns in the data. This model provides nuance and complexity to the ensemble.
- *Extra Trees (ET)*: This algorithm is similar to Random Forest, but it has an extra level of randomness, as the threshold for splitting is selected randomly (Guo *et al.*). This results in greater generalization and minimizes the problem of overfitting. This algorithm adds diversity to the ensemble and makes it better for dealing with high-dimensional data.
- *XGBoost*: This is an efficient algorithm for gradient boosting, which uses parallel processing and regularization techniques (Guo J *et al.*). It is known for its efficiency and accuracy, especially when dealing with structured data. XGBoost is better at handling non-linear relationships and reducing error, thus acting as both a base learner and a meta-learner in the stacking ensemble.

The results of the aforementioned basic models are integrated by the stacking ensemble and input into the meta-learner (Liu *et al.*) XGBoost, which decides in the best way to combine the results of the models. The ensemble method can overcome the particular weaknesses of each model while leveraging the particular strengths of each model due to the tiered approach. For example, Gradient Boosting and XGBoost detect complex patterns, while Random Forest and Extra Trees reduce variability. The stacking model's higher performance metrics for all player positions prove that more accurate and balanced predictions are made.

### 3.5 Cross-validation

In the case of the defender and midfielder datasets, 5-fold cross-validation (Fushiki, T) was utilized during the training of the model. This ensured generalization and minimized the risk of overfitting. The average accuracy and F1 scores were utilized in assessing the model's consistency after each model was trained and tested. These predictions were utilized in the stacking ensemble method.

### 3.6 Evaluation metrics

Accuracy, Precision, Recall, and F1 Score (Yacouby, R., & Axman) were used as classification performance measures for evaluating the performance of the model. F1 Score was given more priority since it is a compromise between precision and recall, especially when there is a class imbalance.

*Accuracy:* Accuracy refers to the proportion of predictions that the model gets right out of all the cases it evaluates (Yacouby, R., & Axman).

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN} \quad \dots 1$$

For classification with confusion matrix terms (TP = true positives, TN = true negatives, FP = false positives, FN = false negatives)

*Precision:* Precision tells us how many of the cases the model labeled as positive were actually correct. It shows how trustworthy the model's positive predictions are (Yacouby, R., & Axman).

$$\text{Precision} = \frac{TP}{TP+FP} \quad \dots 2$$

*Recall:* Recall, or Sensitivity, shows how many of the actual positive cases the model successfully identifies. It reflects how well the model can detect the positive instances it needs to find (Yacouby, R., & Axman).

$$\text{Recall} = \frac{TP}{TP+FN} \quad \dots 3$$

*F1-Score:* The F1-Score is the harmonic mean of Precision and Recall, giving a single measure that balances both. It is especially helpful when the dataset is imbalanced or when it's important to consider both false positives and false negatives (Yacouby, R., & Axman).

$$\text{F1-Score} = 2 \times \frac{\text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}} \quad \dots 4$$

## 4.0 Results and Discussion

### 4.1 Performance evaluation of individual models

Performance of machine learning algorithms including Random Forest (RF), Gradient Boosting (GB), Extra Trees (ET), XG Boost (XG B), and Stacking Ensemble was studied. In this context, these algorithms were assessed in terms of accuracy measures such as Accuracy (Yacouby, R., & Axman), Precision (Yacouby, R., & Axman), Recall (Yacouby, R., & Axman), and F1 Score (Yacouby, R., & Axman), since these measures provided an overall understanding of the performance of the algorithm. Although R<sup>2</sup> Score and Root Mean Squared Error have been used in this process, these measures are more suitable for regression than classification algorithms.

#### 4.1.1 Forward

The accuracy of the various models in forecasting the appropriateness of the forward players is presented in Table 1 below. The XGBoost model recorded the best accuracy of 0.9333 among the various models, coupled with the best F1-Score of 0.9151, recall of 0.9333, and precision of 0.9012, making it the best balance of sensitivity and

prediction accuracy. The Gradient Boosting model, with an F1-Score of 0.85, recorded the same accuracy of 0.8667 as the Stacking Ensemble model, making them the most reliable, as shown by the consistency of the two values. The Random Forest model, which recorded the best accuracy of 0.8667 and F1-Score of 0.8529, recorded the same values as the Gradient Boosting model. The Extra Trees model, however, recorded the lowest values of 0.8155 as the F1-Score and 0.8444 as the accuracy, making it the least.

Table 2 shows the suitability of the players for the stacking ensemble model where the player number is shown instead of the player’s name.

**Table 1: Model Performance for Forward Player Suitability Prediction**

Model	Accuracy (%)	F1-Score	Recall	Precision
Random Forest	86.67	0.8529	0.8667	0.8444
Gradient Boosting	86.67	0.8559	0.8667	0.8456
Extra Trees	84.44	0.8155	0.8444	0.8067
XGBoost	93.33	0.9151	0.9333	0.9012
Stacking Ensemble	86.67	0.8593	0.8667	0.8556

**Table 2: Suitability of Players of Stacking Ensembling for Each Position**

Player	Forward Suitability
1	Suitable
2	Suitable
3	Suitable
4	Suitable
5	Suitable

#### 4.2 Limitations and future work

The proposed paradigm also has some cons, despite the positive outcomes.

- Due to the depth and complexity of the stacking and the XGBoost models, there was a slight indication of overfitting.
- The small nature of the dataset.
- The existing methodology does not consider real-time or multi-seasonal performance data, which could make the models more robust over time; the manual extraction of the data from FBref also presents the possibility of human error.
- Future work will look to expand the dataset further and consider using hybrid models with the inclusion of deep learning techniques to make the models more flexible.

## 5.0 Conclusion

Based on the findings, XGBoost and Stacking Ensemble models were found to be two of the best algorithms that can classify football players based on their appropriateness. The gradient boosting technique used by XGBoost, which maximizes bias and variance reduction through sequential learning, is responsible for the excellent results achieved by this algorithm. The ability of the Stacking Ensemble model to leverage the power of multiple learners has been found to make this model exceptionally resilient with regards to generalization.

In general, taking into account all factors involved, the findings prove the efficacy of ensemble and boosting models when dealing with the complexity of football statistics data. To include the temporal and spatial relationships in the game data, future research may expand on this model through applying deep learning techniques, including CNNs and RNNs. Deep learning techniques and ensemble models in hybrid models may improve their scalability, interpretability, and precision when forecasting several football tournaments and competitions. Such developments may help contemporary football employ a more comprehensive and data-driven approach to player recruitment and selection processes.

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## CHAPTER 7

### Buy Now Pay Later (BNPL) Adoption among Millennials and Gen Z: A Case Study of LazyPay and Simpl.

*Priyanka Dhoot\**, *Harshada Sonawane\*\** and *Vijay Gharwadhave\*\*\**

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#### ABSTRACT

Buy Now Pay Later (BNPL) services have gained rapid popularity among Millennials and Generation Z due to the growth of digital payments and e-commerce platforms. Despite increasing adoption, limited empirical evidence exists on consumer awareness, adoption drivers, and post-usage behavior of BNPL services such as LazyPay and Simpl in the Indian context. This study addresses this gap by examining awareness levels, factors influencing adoption, and changes in spending and repayment behavior among young consumers. A quantitative research methodology was adopted using primary data collected through a structured questionnaire from Millennials and Gen Z respondents. Descriptive and analytical tools were used for data analysis. The findings indicate high awareness of BNPL services, with convenience, ease of approval, and app integration being major adoption drivers. The study also observes increased spending frequency and varying repayment discipline among users.

**Keywords:** Buy Now Pay Later (BNPL), Millennials, Generation Z, Digital payments, Consumer adopt.

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#### 1.0 Introduction

##### 1.1 Introduction and background of the study

The swift evolution of financial technology (fintech) has significantly impacted the way in which consumers interact with financial services and make payments within the digital world. The most significant developments in this field include the introduction of the Buy Now Pay Later (BNPL) option, through which consumers can purchase products and services instantly and make payments through installments. Compared to traditional credit cards, BNPL services provide faster approval, reduced documentation, and instant online sign-up, making it highly attractive to younger generations of consumers.

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Globally, the buy now pay later services have recorded significant growth in the last ten years, particularly among the Millennial and Generation Z populations, as these segments are more comfortable using digital payment systems and other electronic-based financial services. In addition, these populations are looking for flexible payment systems that provide them with convenience and short-term credit without the complexities of traditional banking systems. According to the empirical findings, the installment-based payment systems help reduce the perceived financial burden and increase the frequency of spending (Tan & Wong, 2020).

In the case of India, it has been observed that the development of the e-commerce sector, along with the development of the smartphone sector, has contributed to the development of the buy now, pay later service. According to the industry reports, it has been predicted that the buy now, pay later service is expected to increase significantly in the coming years, as there is an increase in the demand for this service among its potential users. Furthermore, it has been observed that the young population, including the millennials and Generation Z, is contributing significantly to the development of the buy now, pay later service, as this young population is actively involved in the online shopping sector. There are various fintech companies that provide the buy now, pay later service to their users, and this is helping to fulfill the growing demand for this service. In this regard, it has been observed that LazyPay and Simpl are the two major services provided by the fintech companies, through which the users of this service are provided instant credit facilities for various online transactions, such as online food delivery, online shopping, etc. This helps the users to purchase any product without paying the amount immediately, as they can pay later within a specified period of time.

Even though the benefits of the use of BNPL services are evident in terms of ease of use and financial flexibility, it is also possible that such services could shape the buying behavior of the consumer. According to studies, the provision of delayed payment facilities could encourage the consumer to adopt impulsive buying behavior since the consumer is not required to make full payment for the product. It is therefore important to understand the impact of the use of BNPL services on consumer behavior, especially among young consumers.

## **1.2 Problem statement**

Although the “Buy Now, Pay Later” (BNPL) service is increasingly adopted by consumers in India, there is a scarcity of studies related to the influence of the BNPL service on the financial life of young consumers, especially the Millennials and Gen Z consumers. For example, the BNPL service adopted by young consumers in the country includes the LazyPay and Simpl services for their daily transactions, such as ordering food, shopping, and other services. However, the adoption of credit service through the BNPL

service may lead to overspending, impulsive buying, and difficulties in repaying the credit service. Although the BNPL service is readily available for consumers in the country, the concern about the financial discipline of consumers in repaying the installments of the BNPL service is vital. Therefore, the study aims to determine the awareness of the BNPL service and the factors influencing the adoption of the BNPL service by young consumers. Additionally, the study aims to investigate the relationship between the BNPL service and the spending habits of consumers in the country.

## **2.0 Literature Review**

The “Buy Now Pay Later” (BNPL) services have garnered significant scholarly attention as an alternative form of digital credit for consumers. The BNPL services facilitate consumers to purchase the product while delaying the payment for a short period without any additional interest rate applicable to the price of the purchased product. The scholarly research suggests that the BNPL services have gained significant popularity among the Millennial and Generation Z consumer groups due to their high level of convenience and integration with the online shopping platforms. A number of studies from various nations have been conducted to evaluate the influence of BNPL services on the purchasing behavior of consumers. According to Ashby et al. (2025), the availability of BNPL services, including the installment-based option, increases the purchase amount in comparison to other payment systems. In the similar research stream, Kumar and Wiles (2024) found that the availability of BNPL services increases the total purchase amount while promoting impulsive purchasing behaviors among the consumers.

Moreover, the behavioral finance theory explains the high level of popularity associated with the BNPL services. According to Lee and Huang (2021), the “pay-later” option associated with the BNPL services increases the affordability of the products while reducing the associated psychological cost of spending. Further, Tan and Wong (2020) suggest that the availability of the deferred payment option associated with the BNPL services increases the impulsive purchasing behaviors among the consumers, especially the younger age group, who are highly proficient in using the digital financial services for shopping purposes. In the Indian ecosystem, the research into the BNPL schemes is in its infancy. As noted by Mukherjee (2025), the major factors influencing the adoption of buy-now-pay-later schemes within the Indian ecosystem include the convenience of the schemes, the duration of the approval process, and the ability to integrate the schemes with digital applications.

According to the research conducted by Mehta and Rao (2023), financial literacy is a major factor influencing the adoption of BNPL schemes, whereby individuals with low levels of financial literacy face problems in repaying loans. Even though the research that

has been conducted into the BNPL schemes has significantly contributed to the knowledge of the adoption of the schemes and the spending behavior, there is a gap in the literature that this research aims to fill. Firstly, the majority of the research conducted on the adoption of BNPL schemes and spending behavior is based on the Western ecosystem, whereas there is a lack of research based on the Indian ecosystem, especially focusing on the adoption of BNPL schemes among Indian Millennials and Gen Z consumers. Secondly, there is a lack of research comparing the adoption of BNPL schemes offered by LazyPay and Simpl and their influence on the spending behavior of consumers.

### **3.0 Research Methodology**

#### **3.1 Objectives of the study**

The main objectives of the current study are:

- To evaluate the awareness and usage of the BNPL service among Millennials and Generation Z youth, with special emphasis on the LazyPay and Simpl services.
- To establish the factors that determine the adoption of the BNPL service, including the factors of convenience, ease of approval, and the presence of an interest-free period, along with the integration of the service with e-commerce applications.

To examine the spending behavior and payment patterns of consumers after the adoption of BNPL services.

#### **3.2 Research design**

The current study aims to conduct an investigation into the awareness, factors that determine the adoption of, and outcomes of the usage of the Buy Now Pay Later (BNPL) service, targeting Millennials and Generation Z youth in India. It uses a quantitative approach to conduct the investigation. The main aim of the study is to analyze the patterns of consumption related to the usage of the BNPL service, with special emphasis on the LazyPay and Simpl services. Primary data collection was conducted through the administration of a questionnaire to obtain pertinent information from the respondents.

#### **3.3 Sample size**

The current study is based on the responses of 69 participants who filled the questionnaire through an online survey. The participants included members of the Millennials and Generation Z youth who had the potential to use digital payment systems, including the BNPL service.

#### **3.4 Data analysis tools**

The data collected was analyzed with the help of Microsoft Excel software. This helped in the organization of the collected data, making tables, and performing various tests to understand the results obtained with the help of the collected data.

### 3.5 Sampling technique

The sampling technique used is Purposive Sampling, which is a Non-Probability Sampling method. The sampling is based on certain criteria, i.e., the consumers belong to the age group of Millennials and Generation Z, and they are aware of the digital payment systems and BNPL services provided by companies like LazyPay and Simpl.

### 3.6 Scope of the study

The research is limited to the awareness and adoption of BNPL services among the younger generations of India, i.e., Millennials and Generation Z, and the influence of BNPL services provided by companies like LazyPay and Simpl on the spending behavior of the consumers.

## 4.0 Data Analysis

**Table 1: Demographic Profile of Respondents (n=69)**

Category	Frequency	Percentage
<b>Age (years)</b>		
18–22	31	45%
23–26	24	35%
≥27	14	20%
<b>Gender</b>		
Male	42	61%
Female	26	38%
Other	1	1%
<b>Education</b>		
Undergraduate	34	49%
Postgraduate	24	35%
Diploma/Other	11	16%
<b>Occupation</b>		
Student	30	43%
Employed	25	36%
Self-employed	5	7%
Other (e.g. unemployed)	9	13%
<b>Monthly Income (₹)</b>		
< 30,000	28	41%
30,000–50,000	21	30%
> 50,000	20	29%

Source: Survey Data

The demographic characteristics of the respondents are shown in Table 1 below. The table shows the distribution of the sample, indicating that the majority of the

population, i.e., 45%, falls in the age bracket of 18-22 years, followed by those in the age bracket of 23-26 years, i.e., 35%, and those aged 27 years and above, i.e., 20%. This indicates that the majority of the population using digital financial services, including BNPL services, falls in the age bracket of Millennials and Gen Z.

The table also shows the distribution of males and females, indicating that males form the majority, i.e., 61%, whereas females form only 38%, and those belonging to other genders form only 1%. The table also indicates the distribution of the sample population, with those who are undergraduates forming the majority, i.e., 49%, followed by those who are postgraduates, i.e., 35%, and those who are diploma holders, i.e., 16%.

The table also indicates the distribution of the sample population, with those who are students forming the majority, i.e., 43%, whereas those who are employed form only 36%, and those who are self-employed form only 13%, with those belonging to other categories forming only 1%.

**Table 2: Adoption Drivers of BNPL Platforms**

Factor	Mean Score	Rank
Interest-free period	3.46	1
App integration	3.36	2
Convenience	3.26	3
Ease of approval	3.00	4

*Source: Survey Data*

Moreover, respondents were asked to rate the level of importance of various determinants of buy now, pay later (BNPL) services using a Likert scale. The results are shown in Table 2, which states that the interest-free repayment period was rated the highest at a mean of 3.46, thus being the primary determinant, followed by app integration with a mean of 3.36, and then the convenience of the platform with a mean of 3.26. The ease of approval was rated the lowest at a mean of 3.00, thus implying that the aforementioned factors are more influential than the ease of approval. Therefore, it can be stated that financial incentives and convenience are the primary influencers of BNPL services, including LazyPay and Simpl, among Millennial and Gen Z consumers.

**Table 3: Regression Analysis: BNPL Usage and Spending Behaviour**

Dependent Variable	$\beta$	p-value
Impulse buying	0.45	0.012
Increased spending	0.50	0.005
High-priced purchases	0.20	0.150

*Source: Survey Data*

Regression analysis was conducted to determine if the number of BNPL usage affects consumers' spending habits. Table 3 shows the standard regression coefficients for the proposed models. The results indicate a significant positive relationship between BNPL usage and impulsive purchase ( $\beta = 0.45$ ,  $p = 0.012$ ) and higher overall spending ( $\beta = 0.50$ ,  $p = 0.005$ ). On the other hand, the relationship between BNPL usage and high-priced purchase is not significant ( $\beta = 0.20$ ,  $p = 0.150$ ). Overall, the results indicate BNPL frequent users are more likely to exhibit impulsive purchase and higher overall spending, thus highlighting the behavioral effect of using deferred payment systems.

**Table 4: Chi-Square Test Results**

Relationship	$\chi^2$	df	p-value
Age vs BNPL usage	6.97	4	0.138
Income vs repayment behavior	7.95	6	0.242

Source: Survey Data

#### *Hypotheses for the Chi-Square Test*

In order to evaluate the effect of demographic factors on BNPL usage and payment behavior, the following hypotheses have been proposed:

H0<sub>1</sub>: No significant relationship exists between age and BNPL usage.

H1<sub>1</sub>: A significant relationship exists between age and BNPL usage.

H0<sub>2</sub>: No significant relationship exists between income and BNPL payment behavior.

H1<sub>2</sub>: A significant relationship exists between income and BNPL payment behavior.

Chi-square tests were used to determine the relationship between demographic factors and BNPL behaviors. Table 4 displays the results of the statistical analysis. The relationship between age and BNPL behaviors resulted in a chi-square value of 6.97, with a p-value of 0.138, whereas the relationship between income and BNPL repayment behaviors resulted in a chi-square value of 7.95, with a p-value of 0.242. Since both p-values are higher than 0.05, it may be concluded that the relationship is non-significant. This suggests that BNPL behaviors and difficulties in BNPL repayments are not related to age and income groups.

**Table 5: Correlation Matrix**

Variables	BNPL Usage	Impulse Buying	Spending Increase	Financial Stress
BNPL Usage	1.00	0.50	0.45	0.30
Impulse Buying	0.50	1.00	0.55	0.40
Spending Increase	0.45	0.55	1.00	0.35
Financial Stress	0.30	0.40	0.35	1.00

Source: Survey Data

#### **4.1 Correlation analysis**

In order to understand the interrelation between the use of BNPL, expenditure, and financial stress, correlation analysis was conducted. Table 5 presents the correlation coefficients obtained from the study. According to the study findings, it is clear that the use of BNPL is positively related to impulsive buying ( $r = 0.50$ ) and expenditure ( $r = 0.45$ ). There is a moderate correlation between the use of BNPL and financial stress ( $r = 0.30$ ). In addition, it is clear that impulsive buying is strongly related to expenditure ( $r = 0.55$ ).

Significance level:  $p < 0.01$ ;  $p < 0.05$ .

*Summary:* From the analysis, it is evident that the Millennials/Gen Z in the sample have an awareness of the BNPL schemes, which is driven by the benefits of interest-free installments. On the other hand, the use of BNPL schemes is related to impulsivity and expenditure, while demographic factors such as age and income have little impact. Therefore, the objectives of the study have been achieved through the integration of awareness, factors that drive the use, expenditure, and repayment, which elucidates the effect of BNPL on the payments behavior of young consumers.

### **5.0 Conclusion, Limitations and Future Scope of the Study**

#### **5.1 Conclusion**

The purpose and objective of this study are to explore the fast evolution of financial technology and its impact on the level of consumers' payment systems, with a special emphasis on the concept of Buy Now, Pay Later (BNPL). BNPL has achieved recognition as a vital short-term credit facility, particularly among Millennials and Gen Z, given their high inclination towards digital technologies and online shopping. The benefits of BNPL services, such as ease, quick processing, and interest-free periods, have made it an attractive credit facility.

The study aims to examine the level of awareness and usage of BNPL services among Millennials and Gen Z in India, determine the key factors that affect the adoption of BNPL services, and explore consumer spending patterns after adopting BNPL services, with particular emphasis on LazyPay and Simpl.

The findings indicate a high level of awareness about the services provided by the buy now pay later schemes, and this is largely due to the increasing trend of digital payments and e-commerce in the Indian marketplace. A large number of respondents were aware of the services provided by the buy now pay later schemes and the increasing number of these services on different digital media platforms. Among the different buy now pay later schemes, LazyPay and Simpl were the most popular and used services, and this was due to the simplicity and user-friendly nature of these services, along with the approval and seamless integration with different online merchants, food delivery apps, and e-commerce

apps. The study also revealed the role of convenience, ease of approval, and the presence of interest-free options, along with the seamless integration of buy now pay later schemes with digital media, as the most important factors in the adoption of buy now pay later schemes by Millennials and Generation Z consumers. These factors are largely in line with the intrinsic nature of buy now pay later schemes, which are most appealing to younger generations in the digital era. Moreover, the role and effect of BNPL schemes on the purchasing behavior of consumers were also revealed in the study. A majority of the consumers revealed that BNPL schemes will result in higher purchasing and impulse buying due to the flexibility of BNPL services. However, the majority of consumers revealed timely payment, whereas some consumers experienced difficulties in managing the services of BNPL schemes and the need for financial discipline.

In Conclusion, The study revealed that BNPL schemes, such as LazyPay and Simpl, are a part of the digital payment system in the Indian marketplace and are largely adopted by Millennials and Generation Z consumers. Moreover, it is also important to note that despite the flexibility and intrinsic nature of BNPL schemes, consumers need to be financially disciplined in managing the services of BNPL schemes.

## **5.2 Limitations and future scope of the study**

Although this study has provided some useful findings on the usage of BNPL services among young consumers, it has some limitations. Firstly, the study was based on a relatively small sample size, and the findings may not be generalized to the entire population of BNPL service users in the Indian context. Secondly, the study was based on only two BNPL services, LazyPay and Simpl, while there are other services operating in the Indian context.

Future studies on the topic may include a large and diverse sample and other BNPL services in order to obtain a wider understanding of the digital credit system. Future studies may also seek to investigate the financial consequences of BNPL service usage, the role of financial literacy in the context of BNPL services, and the regulatory challenges faced by BNPL services in the context of the Indian economy. Such studies will help in obtaining a wider understanding of the role of BNPL services in shaping the financial behaviors of consumers in the digital context.

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## CHAPTER 8

### Role of Robo-Advisors in Promoting Sustainable (ESG) Investment Portfolios in India

*Anuradha Patil\**, *Samruddhi Jadhav\*\** and *Tanish Zalke\*\*\**

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#### ABSTRACT

Sustainable investing based on Environmental, Social, and Governance (ESG) principles is gaining increasing importance as investors seek to align financial returns with ethical and sustainability goals. This study examines the role of Indian robo-advisory platforms in promoting sustainable investment portfolios and assesses whether these platforms merely provide ESG options or actively encourage investors through default recommendations, highlighted portfolios, and value-based investment themes. The research is based on a mixed-method approach, incorporating platform-based observations and a primary survey of retail investors using digital investment platforms. Descriptive statistical tools are used to evaluate investor awareness, platform visibility of ESG products, and the influence of robo-advisory recommendations on investment decisions. The study finds that while ESG investment products are available, active promotion remains limited, highlighting the need for greater integration of sustainability metrics and investor education to strengthen fintech-enabled sustainable finance in India.

**Keywords:** ESG investing, Robo-advisors, Sustainable finance, Green finance, FinTech in India.

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#### 1.0 Introduction

Since the last few years, the perspective of people towards investments has started to change. Earlier most of the investors focused on maximizing their financial returns and earning profits. However, today many investors want their investments to support the environment and society in which they live by investing in companies that are acting responsibly towards these factors.

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Due to this shift in people's perspectives, the concept of sustainable or ESG (Economic, Social, and Governance) has gained popularity around the world and India is no exception to this. Environmental, Social, and Governance (ESG) investing is recently gaining popularity becoming one of the most widely used sustainable investing approaches. This approach not only considers the financial performance of a company but also focuses on how responsibly it operates. It is the practice of considering environmental, social, and governance factors for making investment analysis and decision making.

The environmental aspect focuses on how different businesses interact with nature, including problems such as changes in the climate, carbon emission, waste management, and conservation of scarce resources. The social aspect considers how the businesses manage their relationships with their employees, customers, communities, and their suppliers. The governance aspect comprises corporate leadership, transparency, accountability, board structure, ethical business practices, and shareholder rights. According to Eccles, Ioannou, and Serafeim (2014), companies that implement strong sustainable practices tend to have stronger long-term performance and governance structures.

Several studies have suggested that involving ESG aspects in our investment portfolio might improve the financial outcomes. A comprehensive assessment conducted by Friede Busch, and Bassen (2015) discovered that the majority of academic research shows a positive relationship between ESG practices and a company's financial performance. At the same time, several technological transformations have changed the way financial services are delivered.

Financial Technology (FinTech) has introduced various new digital tools that have streamlined the process of investing making it more accessible. One of such transformations is the introduction of Robo-Advisory platforms. These are automated platforms that provide investment analysis, portfolio management services using algorithms digitally. According to Sironi (2016), robo-advisors are "automated investing platforms that provide algorithm-driven financial planning services with minimal human intervention."

These platforms collect investor data such as their financial goals, risk appetite, and investment horizon through online questionnaires and then suggest suitable portfolios using algorithm-based analysis. Due to their low-cost and convenient model, robo-advisors have gained popularity now.

In India, robo-advisory platforms such as Groww, INDmoney, ET Money Genius, Scripbox, Kuvera, Paytm Money, etc provide access to financial investing options such as mutual funds and Exchange Traded Funds (ETFs). With the growing popularity of sustainable financing options, these platforms also have the potential to promote ESG investments. This study examines whether these platforms in India actively promote ESG investments or simply provide them as optional choices for the investors.

## **2.0 Literature Review**

Robo-advisory services in India are in development. The focus is currently to raise awareness among investors. Even though robo-advisory services use technology, enabling them to avoid certain biases, they cannot yet analyze the risks of individual investors. (Bhatia *et al.*, 2020).

Today, in India, robo-advisory services operate by educating investors. They are yet to be effective in eliminating biases, as well as analyzing investors' risks. (Bhatia *et al.*, 2020c). Robo-advisory services contribute to sustainable investment by providing digital solutions. The study found that investors who take fewer risks and who have a shorter investment horizon prefer sustainable investment. (Faradynawati & Söderberg, 2022).

Individuals who claim to be pro-sustainability do not necessarily mean that they will be effective in their market decisions. Therefore, it is essential to focus on investors' decisions, not their claims. (Brunen & Laubach, 2021). The positive mindset of investors, as well as their strong personal values, might encourage them to use robo-advisory services for sustainable investment. (Kaur *et al.*, 2025).

Robo-advisory services assist investors in diversification by using different financial products like ETFs, as well as algorithms that select different portfolios. (Barile *et al.*, 2025). The industry is still in the early growth stage. The study indicates that ESG investments enable investors to grow sustainably. They can also offer investors higher returns compared to other investments. (Gupta, 2022)

Another thing that the study indicates is that investors can benefit from using robo-advisors rather than traditional financial advisors. This is especially true in cases where investors receive low returns. Robo-advisors help investors make better decisions by using techniques such as algorithms. This is in line with helping investors make sustainable investment decisions.

Kobets *et al.*, (2022) Technology is changing the fund management industry. It is making it possible to introduce new products in the market. This is true in the case of robo-advisors. New investment models help investors perform better. They can help investors make better decisions. They can also help investors make socially responsible investment decisions. (Salampasis, 2017)

Past studies on the subject matter have concentrated on adoption, developed markets, investors, and behavior. However, the role of robo-advisors in promoting ESG investments has not been addressed. This is the main objective of the study. The main objective of the study is to explore the potential of robo-advisory platforms in promoting ESG investments in India.

### **3.0 Research Methodology.**

#### **3.1 Objectives of the study**

1. To identify the availability of ESG investment products on selected Indian robo-advisory platforms like Groww, IND Money, ET Money Genius, Kuvera, Scripbox, and Paytm Money.
2. To examine the role of Indian robo-advisory platforms in promoting ESG investment options to retail investors.
3. To study whether robo-advisors merely provide ESG investment options or actively promote them through default recommendations, highlighted portfolios, or value-based investment themes.

#### **3.2 Methodological framework**

This research particularly analyses the role of robo-advisors in promoting sustainable (ESG) investment options in India focusing on selected robo-advisory platforms. The research is based on a quantitative, descriptive, and analytical approach using the primary and secondary data where the primary data has been collected by creating a survey of 75 retail investors through a structured questionnaire using the convenience sampling technique. The secondary data has been collected from various platform websites, research papers, and online databases to support the literature review. The analysis of the collected data is done using statistical tools such as Mean, Standard Deviation, Spearman's Correlation, Weighted Mean, and Frequency and Percentage Analysis. The primary data was collected through Google Forms and analyzed through Microsoft Excel.

#### **3.3 Data analysis**

The above table shows us the comparison between various robo-advisory platforms available in India and the types of sustainable (ESG) investment products offered by them such as ESG Mutual Funds, ESG ETFs, Green Bonds, and Social Bonds. The analysis shows us that the availability of these investment products varies across the different platforms.

Firstly, ESG Mutual Funds are the investment products which are widely available on all of the above robo-advisory platforms. This tells us that currently the most easily accessible and commonly offered sustainable investment product on the Indian fintech platforms is ESG MFs.

Secondly, ESG ETFs are only available on platforms that offer stock market trading facilities such as Groww and INDMoney. Scipbox only has limited access to this while the other platforms don't provide this product. This suggests that ESG ETFs are mainly supported by platforms that function as brokerage or trading applications. Thirdly, Green

Bonds and Social Bonds are widely unavailable across many of these platforms suggesting that the integration of these fixed-income products is limited on the robo-advisory platforms.

**Table 1: Availability of ESG Investment Products across Selected Digital Robo-advisory Platforms in India**

Platforms/Products	ESG Mutual Funds	ESG ETFs	Green Bonds	Social Bonds
Groww	✓	✓	✗	Limited
INDMoney	✓	✓	Limited	Limited
ET Money Genius	✓	✗	✗	✗
Scripbox	✓	Limited	✗	✗
Kuvera	✓	✗	✗	✗
Paytm Money	✓	✗	✗	Exchange-based

Source: Compiled by researcher

Overall, the ESG ecosystem in digital investments platforms is still in the early development phase in the Indian landscape

**Table 2: Demographic Profile of Respondents**

Particulars	Category	Frequency	Mean	Standard Deviation (SD)
<b>Age Group</b>	Below 20	09	<b>2.77</b>	<b>1.29</b>
	21-25	35		
	26-30	09		
	31-40	08		
	Above 40	14		
<b>Occupation</b>	Student	48	<b>1.52</b>	<b>0.74</b>
	Salaried Employee	15		
	Self Employed	12		
<b>Investment Experience</b>	Less than 1 year	15	<b>2.57</b>	<b>1.10</b>
	1-3 years	24		
	3-5 years	14		
	More than 5 years	22		

Source: Primary Survey data

The respondent’s demographic profile is displayed in the table. The majority of participants are young investors, as evidenced by the fact that 35 of the respondents are between the ages of 21 and 25. Students make up the largest group (48 respondents) in

terms of occupation, followed by self-employed people and salaried workers. In terms of investment experience, the majority of respondents had either one to three years (24 respondents) or more than five years (22 respondents), indicating that a large number of participants have some exposure to investing. The findings indicate that the study primarily comprises young, reasonably active investors, which is appropriate for examining knowledge and attitudes about contemporary investment ideas like ESG investing.

**Table 3: Robo - Advisory Platform Usage and Usage Frequency**

Particulars	Category	Frequency	Percentage (%)
<b>Platform Usage</b>	Groww	39	52.00%
	INDMoney	16	21.33%
	ET Money Genius	0	0.00%
	Scripbox	23	30.67%
	Kuvera	20	26.67%
	Paytm Money	26	34.67%
<b>Usage Frequency</b>	Regularly	39	52.00%
	Occasionally	21	28.00%
	Rarely	15	20.00%
	Never	00	0.00%

*Source: Primary data*

**Table 4: Awareness and Investment Experience in ESG Investing**

Statements	Category	Frequency	Percentage (%)
<b>Awareness of ESG investing</b>	Yes, very well aware	30	40.00%
	Somewhat aware	35	46.67%
	Heard of it but don't know details	08	10.67%
	Not aware	02	2.67%
<b>Source of information about ESG investing</b>	Social media	41	54.67%
	Investment platform/app	33	44.00%
	Friends/Family	28	37.33%
	Financial news	24	32.00%
	Not Aware	9	12.00%
<b>Previous investment in ESG products</b>	Yes	18	24.00%
	No	57	76.00%

*Source: Primary data*

Groww is the most popular platform (52%), followed by Paytm Money and Scripbox, according to the analysis. While ET Money Genius is not used by respondents,

other services like Kuvera and INDmoney have considerable utilization. Furthermore, a strong adoption of digital investing platforms among investors is indicated by the fact that over half of the respondents (52%) consistently use these platforms.

**Table 5: Availability & Visibility of ESG Product**

Statements	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Weighted Score	Weighted Mean	Ranks
ESG investment options are prominently displayed on my robo-advisory platform.	07	17	37	14	00	208	2.77	1
My investment platform actively recommends ESG investment options to me.	09	24	38	04	00	207	2.76	2
I receive notifications or alerts related to ESG investing from my platform.	09	32	33	01	00	192	2.56	3
The platform offers sufficient educational resources regarding ESG investing.	03	29	41	02	00	187	2.49	4
The promotion of ESG investments on my platform influences my investment decisions.	22	01	25	27	00	176	2.35	5

Source: Primary data

The outcomes indicate that just a small percentage of respondents have low or no awareness of ESG investment, with 46.67% being somewhat aware and 40% being very well aware. The primary sources of ESG information are social media (54.67%) and investment platforms/apps (44%), followed by financial news and friends and family. Still, just 24% of respondents had previously made an investment in ESG products, whereas 76% had not. This implies that while investors are aware of ESG issues, their real involvement in ESG investments is still quite low.

The opinions of respondents on the accessibility and prominence of ESG products on robo-advisory platforms are displayed in the table. Platform recommendations for ESG investments (Mean = 2.76) are ranked second, after the prominent presentation of ESG options for investing (Mean = 2.77). Promotion of ESG investments has the least impact (Mean = 2.35), while notices regarding ESG investing and educational resources are given modest weight. Overall, the findings show that ESG option suggestions and clear visibility are important variables affecting investors on robo-advisory platforms.

ESG awareness, perception, and investment intention are positively correlated, according to the correlation analysis. Higher understanding of ESG investing tends to

improve investors' perspective and willingness to invest in ESG products, as seen by the somewhat positive connection between ESG awareness and ESG perception (0.54) and investment intention (0.49). In a similar vein, investment intention and ESG perception are positively correlated (0.41). Overall, the findings imply that investors may have stronger investment intentions if they are more aware of and have a favorable opinion of ESG investing.

**Table 6: Perceptions and Suggestions Regarding ESG Promotion on Robo-Advisory Platforms**

Statement	Category	Frequency	Percentage (%)
<b>Robo-advisors should promote ESG investments more.</b>	Yes	57	76.00%
	No	00	0.00%
	Maybe	18	24.00%
<b>Robo-advisory platforms need improvements for ESG features</b>	Make ESG portfolios default options	36	48.00%
	Provide ESG performance comparison charts	29	38.67%
	Send educational notifications	33	44.00%
	Reduce expense ratio of ESG funds	31	41.33%
	More transparency in ESG scoring	42	56.00%
<b>I would invest more in ESG with better platform support</b>	Returns are competitive	34	45.33%
	Risk is lower	18	24.00%
	Platform highlights ESG benefits clearly	37	49.33%
	Tax benefits are provided	26	34.67%
	Not interested	09	12.00%

*Source: Primary data*

**Table 7: Spearman's Correlation between ESG Platform Features and ESG Portfolio Visibility**

ESG Features Statement	Spearman Correlation
ESG options prominently displayed	0.406
Platform actively recommends ESG investments	0.290
Receives ESG notifications	0.100
Platform provides ESG educations	0.220
ESG promotions influence investment decisions	0.275

*Source: Primary data*

ESG portfolio visibility and a way that ESG investments are prominently displayed have a somewhat positive association ( $\rho = 0.406$ ), according to the Spearman rank correlation study. This suggests that investor knowledge is increased when ESG portfolios are presented more clearly. Platform recommendations ( $\rho = 0.290$ ) and investment decision influence ( $\rho = 0.275$ ) show weak positive correlations, suggesting that more visibility can marginally boost investor interest in ESG investments. Nevertheless, the correlation with ESG notifications is extremely weak ( $\rho = 0.100$ ), indicating that notifications now have little effect. Overall, the outcomes suggest that investor perception is more influenced by the way ESG portfolios are presented on robo-advisory platforms than by other promotional elements.

#### **4.0 Findings and Recommendation**

The study indicates that the best way for people to invest in sustainable investment options on large robo-advisory platforms in India is through ESG mutual funds. The other options, like ESG ETFs, green bonds, and social bonds, may not be easily accessible. People may be aware of ESG investment options, but not many have invested in these options. The study indicates that people may be interested in investing in these options if they can see them on the robo-advisory platforms. The study has also shown that awareness of ESG investment and positive association with it can influence people to invest in ESG investment options. Therefore, it can be easy for people to invest in these options with the assistance of robo-advisory platforms. This can be achieved by displaying these options to people and making them easily accessible. The availability of more options for sustainable investment can be achieved by adding ESG ETFs, green bonds, and social bonds. This can be helpful to investors in diversifying their investment portfolios. The display of ESG scores can be improved, and sustainability ideas can be incorporated to gain people's trust to invest in these options.

#### **5.0 Conclusion**

This research focused on how robo-advisory platforms can contribute to ESG investing in India. The research checked the availability of ESG products, the level of awareness of ESG investing, and the attitude of people toward ESG investing. The results of the research showed that ESG mutual funds are the most accessible option for sustainable investing through most robo-advisory platforms. Other ESG investing options, including ESG ETFs, green bonds, and social bonds, are not as accessible. People are aware of ESG investing, but investing in ESG products is still low. The results of the research showed that the visibility of ESG investing options, the ESG investing options promoted by the

platform, and the education provided by the platform are significant factors in the decision of investors to invest in sustainable investing. Robo-advisory platforms are significant in promoting ESG investing in India by making ESG investing easy, visible, and transparent. For future research, more investors and more robo-advisory platforms can be included in the research to obtain more results. More research can be conducted in the future by including the performance of ESG investing products and how technology and ESG financial tools contribute to the growth of sustainable investing in India.

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## CHAPTER 9

### Sustainability Marketing and Rural Empowerment: A Study of Amul's Cooperative Model

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#### ABSTRACT

India's dairy cooperative sector is an example of marketing sustainability where theory and practice converge. This study examines the Sustainability Marketing framework using secondary data and focuses on the Gujarat Cooperative Milk Marketing Federation (GCMMF) Amul brand. It shows how Amul incorporates sustainability within the framework of its cooperative model. Amul seems to treat sustainability in an integrated manner as opposed to other companies that treat sustainability as an ancillary concern in procurement, farmer development programs, and brand communication. The framework explains and analyzes 6 interrelated issues, which are primary and crucial. Why sustainability marketing is relevant beyond the marketing lexicon in a cooperative model that is dense with social concerns. The character of a cooperative and its place in the dairy value chain; the ethical grounds of livestock farming and how the reconciliation of value systems and welfare as an ethical necessity is possible within the confines of business on a trading scale. Based on an analysis of reports, sustainability disclosures, and literature on the cooperative model, it will be argued that Amul can teach the entire cooperative model the importance of the dairy sector in a commercial economy.

**Keywords:** Cooperative model, Rural empowerment, Sustainability marketing, Sustainable value chain.

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#### 1.0 Introduction

'Sustainability' is at risk of losing its meaning from overuse and misuse within the corporate world. Sustainability is especially meaningful and prominent in rural India where it indicates whether families are able to support themselves after the harvest has been collected. This phrase describes the rural Indian farming situation that has no parallel relationship with the corporate world which lets the global corporate world speak of their environmental commitments with no real substance.

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For rural Indian farmers, it is much more literally and directly consequential. There will always be a relationship and dissonance between rhetoric and reality. Amul is worth examining because it seeks to reconcile corporate inertia with agrarian reality. Millions of farmers in regions such as Gujarat, Rajasthan and Uttar Pradesh rely on milk as their main or secondary income. This situation can be economically both destabilizing and demeaning for the small farmers. Amul was designed to create a critical mass of producers able to gain access to markets. Amul's marketing is driven by the cooperative vision whereas other companies focus on product quality and distribution. Amul has successfully created a narrative of buying Amul as buying from the farmer.

## **2.0 Literature Review**

### **2.1 Sustainable marketing**

Peattie and Belz (2010) include a definition of sustainable marketing that is both early and valuable. They write that sustainable marketing is a strategy whereby a company meets the needs of its customers, while also being mindful of both the environment and social justice. The main differentiator of this definition from previous socially responsible marketing frameworks is the focus on the needs being fulfilled at the same time. That is, sustainability is not an afterthought added to the business model.

Kotler (2011) elaborates that what is currently being seen in marketing, particularly in industries that face heavy scrutiny from stakeholders, is the shift from a product centered model to a model where social welfare is inherently tied to the process of exchange. Dairy, with its perceived impact on environmental issues, animal welfare, and smallholder livelihoods, is a prime example of this marketing shift. The research has largely validated that rather than being a cost, sustainability efforts actually provide a company with a competitive advantage. Leonidou and other people found that companies do better when they make sure their promises to be sustainable are connected to what they're really good at. They do better than companies when it comes to money and what people think of them. It is important to make sure these promises are actually connected to what the company does not say. If a company just says they are doing something, but they are not it does not work. Recently Lim said that talking about sustainability is different from just talking about a brand. People who buy things from companies and other companies they work with can tell when a company is not actually doing what they say they are doing. This is called "greenwashing". Companies that make sure people can see what they are really doing to be sustainable tend to make the people who care about the company trust them more. Leonidou and other people and also Lim are saying that companies need to be honest, about what they're doing to be sustainable like Leonidou and other people found in 2013 and Lim found in 2022.

## **2.2 ESG and corporate strategy**

The link between a company's social performance and its financial success has been studied a lot recently. A study by Eccles, Ioannou and Serafeim in 2014 looked at companies over eighteen years. They found that sustainable companies performed better in the stock market and made money. This was especially true for companies with many employees and high resource usage such as those in the dairy sector. Companies that chose to be sustainable did financially better than those that did not. The study observed a connection between sustainability and financial success. It seems that being sustainable can actually help companies make money. This is news for companies that want to do well financially and also be good for the environment and society. The researchers looked at a lot of data to come to this conclusion. Their findings suggest that sustainability is not just good for the planet but for a company's bottom line. The studies' results are based on a period of time eighteen years. This makes the findings more reliable. Overall, the study provides evidence that sustainable companies tend to do financially.

Other people, like Friede, Busch and Bassen did a study in 2015. They looked at what they found from over two thousand studies. What Friede, Busch and Bassen found out was that ninety percent of these studies said that environmental issues and social issues and how well companies did financially were connected in a way. More than half of these studies even said that companies that did well with issues did better financially. Friede, Busch and Bassen found that ESG performance is really important. ESG criteria are connected to financial performance, which is something that Friede, Busch and Bassen wanted to show. ESG performance is really important, to companies because ESG criteria are connected to how companies do financially. While it's hard to say for sure in each case all the evidence suggests that sustainability is more of a business benefit than a cost. The idea of 'shared value' by Porter and Kramer in 2011 is right at the center of this discussion. They said that companies can make money by helping society, which was a radical idea at first. Some people didn't like it because it seemed to ignore the conflict between making profits for shareholders and doing what's good for society. When it comes to cooperatives this idea makes sense. Cooperatives are set up to share value with everyone, not a few people. This means that business success and social goods are connected in a way that's not just by chance. Sustainability and shared value are key here. They show that business and society can benefit together. Cooperatives are an example of how this works in practice. They show that making money and doing good are not mutually exclusive. In fact, they can go hand in hand.

## **3.0 Statement of Research Problem**

The gap this paper addresses is not just academic. Many companies now talk about sustainability. There is still real confusion about whether they actually change how they

work. This is especially true in their dealings with producers. The dairy industry in India has grown a lot over the twenty years. However, the benefits of this growth have not been shared equally. Many small dairy companies still work in a way that makes farmers take on the risk of price changes. These companies then make most of their profit from processing and selling milk. The dairy sector, in India has seen growth. Many smaller dairy companies continue to operate on procurement models that transfer price risk onto farmers while capturing margin at the processing and retail end. They make money from processing and selling milk. Farmers often bear the risk. Amul's cooperative model is a way of doing things. This model needs people to manage it and make decisions all the time. It also needs people to really want to keep following the ideas even when Amul gets bigger. We want to know if Amul's cooperative model helps or hurts its efforts to be sustainable. We also want to know how this affects the communities that Amul works with. The main question is how Amul's cooperative structure affects its sustainability practices and what happens to the communities it serves. Amul's cooperative model is important to consider when looking at its sustainability practices.

#### **4.0 Scope of the Study**

This study is about Amul and what they do for sustainability. It looks at how Amul's sustainability activities and marketing strategy're connected to how the company is run. The information used for this study comes from things that're available to the public. This includes Amul's reports and sustainability reports from GCMMF, information from the National Dairy Development Board and things that other people have written about dairy cooperatives. The study does not have information that was collected just for this. It also does not compare Amul to dairy companies whether they are cooperatives or private companies. The focus is on Amul. What they do. Studying has some limits. This means it can do some things, and it cannot do things. It can look at the sustainability framework that Amul shows to the public and try to understand what it means. It cannot check if the things Amul is doing are really making a difference on the ground. The study can see how Amul's approach fits into some ideas. It cannot say that Amul's Way is better than what other similar organisations are doing because it does not have enough information to compare them. These limits are not excusing. They are honest statements about what the study can really do when it is based on information, from other sources.

#### **5.0 Research Objectives**

- I want to check how Amul includes marketing in its business model as a cooperative.
- I am trying to understand how Amul's marketing approach helps farmers in areas through its cooperative model.

- I need to find out how Amul's marketing for sustainability helps the brand and leads to growth that includes everyone with a focus, on Amul's sustainability and Amul's brand.

## **6.0 Research Methodology**

*Research Design:* This study is looking at things in an analytical way. It does not try to figure out what causes what. Instead, the study of governance and sustainability practice and marketing strategy wants to understand how these things work together in a specific company. The goal is to get a picture of the relationship between cooperative governance and sustainability practice and marketing strategy.

*Nature of the Study:* The research is wholly secondary in character, drawing on documents already in the public domain.

*Data Collection:* I looked at reports from Amul and GCMMF about how they're being sustainable and what they did every year. I also checked out what the National Dairy Development Board has to say. The Government of India has reports on the dairy sector too. I read those. I found some articles in journals that talked about how cooperatives market themselves and how they are sustainable. I even read some business magazines that write about the dairy sector in India. I picked these sources because they are from institutions and the information is new and relevant to cooperatives that deal with dairy. When the reports from institutions made some claims, I tried to find sources that are not connected to them to see if they say the same thing. This way I could be sure that the information is correct. I did this for Amul and GCMMF sustainability and annual reports and other sources, like National Dairy Development Board publications and Government of India dairy sector reports.

## **7.0 Data Analysis and Interpretation**

*Objective 1: Sustainability initiatives in Amul's Cooperative Network:*

Amul has a network of people working together. This network is made up of around 3.6 million farmers who work with Amul. These Amul farmers are part of groups in their villages. All these village groups together form the base of Amul's three-part system. Because Amul's network is big, small changes that help Amul farmers in their villages can add up to make a big difference, for Amul across the whole country.

*Objective 2: Integration of Sustainability into Marketing Messaging:*

The programmes that are really making a difference are the ones that help improve the productivity of livestock. These programmes are working in over 5,369 villages. They are helping around 38.6 lakh cattle. There are also programmes to improve fertility in 4,226 villages. These programmes are important because they help the farmers take care of their

animals and improve the health of their herds. This means that the animals will have babies and give more milk. The farmers will then have money because they can sell more milk. What is really great about these programmes is that they help the cooperative and the farmers at the time. The cooperative gets the milk it needs. Farmers get healthier animals and more money. This is what happens when everyone works together and benefits from the thing. The cooperative and the farmers both want the thing, which is to have healthy animals and a good business. These programmes are an example of how things can work well when everyone is happy. The farmers are happy because they have livestock and more money. The cooperative is happy because it has the milk it needs. This is what we mean by value. It is when the cooperative and the farmers both get what they want. The cooperative gets the milk, and the farmers get the money. This is a thing, for everyone.

Amul has a unique way of talking to people in India about the things they sell. The Amul Girl is a part of this. She has been around for a long time and Amul is known for talking about what is happening in the world. This is a way of advertising that makes Amul seem like it is part of the conversation people are having than just trying to sell them dairy products from Amul. Amul also talks about things that're good for the earth in a way that feels natural. When Amul writes about what they're doing they always make sure to mention that the people who own Amul are the farmers themselves. This is something that Amul's very proud of and they want everyone to know about the farmer-owned structure of Amul. When Amul talks about its products it often mentions how it gets the things it needs. This process is fair because Amul pays a guaranteed price and grades things in a way that's easy to understand.

People who buy things from Amul like to know that the company is being honest about where its products come from. Amul can prove that it is being honest because it has a system in place that allows the people who are part of the company to make sure the managers are doing the thing. This means that the people who are part of Amul can hold the managers accountable, which is not always the case with companies and their shareholders. Amul is transparent about how it does things. That is important to people who care about what happens in the supply chain. The supply chain is like a line of people who help get products from one place to another. Amul wants to make sure that everyone in this line is treated fairly.

The way Amul talks about sustainability is different, from what most dairy companies do. By just saying they support farmers Amul can show specific things they do. Like the village dairy society, the district union and the state federation. To help farmers. These are the things that actually help protect the interests of farmers. Not all people who buy milk may understand all these details. It makes Amul look more trustworthy. This is something that other companies may find hard to do if they do not have a system in place. Amul's way of doing things makes people trust the brand more.

### *Objective 3: Environmental Sustainability and Brand Positioning:*

Amul's environmental commitments are clear in its sustainability reports. They focus on three areas: energy, water and waste. Amul uses energy sources, like solar and wind power. These sources make up 8.2 percent of the energy used in their processing operations. This is a start, but not a huge number. It does show that Amul is trying to use kinds of energy. The food processing sector usually relies heavily on fuels. Now lets look at water management. It's a bit more complicated. Amul is working on water management. It needs more attention. They are trying to manage water in a way. Amul's water management is an issue. They want to handle water.

The cooperatives water recycling systems handle around 700 kilolitres per day of treated wastewater. This amount seems small compared to the water needs of dairy processing. Milk processing uses a lot of water at stages like cleaning equipment and making products. Recycling treated water for -product use greatly reduces the cooperatives water intake from local sources. On waste Amul's programmes have helped recycle 78,000 metric tonnes of plastic waste. In India companies that make packaged goods must take responsibility for their packaging waste.

They have to manage it as per the law. The cooperative is working hard to reduce its water usage and recycle waste. Amul's efforts are a step, in the direction to reduce plastic waste. Amul's performance shows that they are doing things correctly and they are able to do their work. The things they are doing for the environment are helpful in two ways. They reduce the problems that Amul faces like getting access to water, which is getting harder to get in some parts of Gujarat. They also show people that Amul is a company that cares about the environment. In a market where people are watching companies closely to see how they treat the environment this is important for Amul. It is not about looking good, it is also about protecting Amul from problems that might come up.

## **8.0 Findings and Results**

1. Amul is a company that helps people by making sure they get a price for the things they make. This is because Amul buys things from the people who make them and then sells them for a price that's fair. This way the people who make things can be sure they will get an income. Other ways of buying and selling things do not always work like this.
2. Amul has programmes to help the people who take care of animals. These programmes help Amul make money. They also help the people who take care of animals. It is hard to say what is good for Amul and what is good for the people who take care of animals because Amul and the people who take care of animals need each other. This is what makes Amul a good company.

3. Amul is trying to do things for the environment. Amul is using energy from the sun and recycling water. Not using so much plastic. These are all things, but Amul is a big company so it is not doing these things as much as it could.
4. Sustainability is a part of how Amul does its marketing. It's not something they talk about sometimes. It's built into how they work.
5. People trust the Amul brand because it has been around for a time. The company is open about how it's run. This trust is hard for other private dairy companies to match. They would have to make changes to how they are owned and run.

## **9.0 Conclusion**

Researchers have been looking at the way Amul works with its model. One thing that really stands out is that when we talk about Amul being sustainable it is not something they decide to do on purpose. It is like a result of how they are set up. Amul is a cooperative, which means it is built to share the value it creates. When this works well it is good for the environment and for people. This happens because of how Amul's governed not because they have special projects for the environment or for people. Amul does a lot of things that help the people who work with them. They have programmes to help farmers they are clear about how they set prices. They even have veterinary services in villages. These things are a part of what Amul does, they are not just extras. Another thing that stands out is the connection between Amul being sustainable and the Amul brand. The way people think about Amul is closely tied to the fact that it's a cooperative. The Amul brand and the cooperative identity of Amul are really connected.

The Amul brand has been talking about farmer ownership and fair pricing for a long time. This has made people think of the Amul brand in a way. The Amul brand is associated with values that're hard to separate from the brand itself. This is very important because if someone were to question the Amul brands record it would be a big deal. This is because the Amul brand is about these values, not just something they say to sound good. The Amul brand has also been doing some things for the environment. For example, they use 8.2 percent energy, which is a good start. They also recycle a lot of water around 700 KLPD. They recycle a lot of plastic, around 78,000 metric tonnes. These are numbers and they show that the Amul brand is trying to do the right thing. However, these numbers also show that the Amul brand still has a lot of work to do to make a difference. The Amul brand has a way to go when it comes to the environment. A cooperative that helps 3.6 million farmers and works over the country will have to make big changes to reduce its carbon footprint. This cooperative needs to do this if it wants to stay in line with what the government and consumers want over the ten years. The cooperative has to move by reducing carbon emissions the cooperative has to make a lot of progress in this area so the

cooperative can keep doing what the government and consumers expect from the cooperative. So, the way Amul works with its model really does what people say it does. It helps Amul make a lot of products and also makes sure everyone gets a share. Amul's cooperative model also thinks about the future. Try to be sustainable. The story of Amul's model is not perfect because a big company, like Amul will always have some problems. It is a good example and people who want to know how businesses, governments and people work together should really pay attention to Amul's cooperative model.

## **10.0 Limitations**

1. The biggest problem with this study is that it relies on sources. Reports from institutions and sustainability disclosures show how organisations want to appear; they are not meant to be checks. This study cannot confirm if the numbers given. For example, livestock covered with water reused and plastic recovered. Are correct? It also cannot verify if these numbers are consistent over time or calculated in the way, as those reported by other organisations. The study has no way to ensure the figures are reliable or comparable.
2. The cooperative is meant to help farmers and members of cooperatives. Their views are missing in this analysis. We do not have information from them. If we had survey or interview data from people, in village dairy societies, it would give us an understanding. Future research should focus on getting this information.
3. The problem is that we do not have information to compare Amul to other dairy companies in India. We want to know if Amul is doing something with its sustainability practices. Or is Amul just doing what big dairy companies with a lot of resources are doing. The information we have about Amul does not tell us this. We need to compare Amul to dairy cooperatives and private dairy companies to understand Amul's performance and Amul's sustainability practices.

## **11.0 Recommendations**

1. Amul would really gain from sharing detailed information about how they are doing with environmental and social issues. Now they only give overall numbers for the whole company but if they broke it down into smaller parts like by district or type of project or even by male and female farmers it would be a lot easier to see what is working and what is not. This would also make Amul's claims about being sustainable more believable to people outside the company who are getting better at reading these kinds of reports and want to know the truth about Amul's social practices.

2. When it comes to marketing the cooperative can do more than what it's doing now. The Amul Girl is funny. Talks about what is happening now but the cooperative needs to tell more stories about the farmers. The cooperative should share stories about how farmers are making more money or how their animals are getting healthier. It should also talk about how it's helping the community. This will make the cooperative's story more interesting and real. It will show that the cooperative is really working to make a difference, not just saying things that sound good. The cooperative needs to show people what it is actually doing to help farmers and the community so people can see that it is genuine.
3. For the plan we are currently at 8.2 percent renewable energy. This means there is a lot of room to increase our use of energy. Solar power has become much cheaper over the last ten years. This makes it a good choice for dairy processing facilities. These facilities have roofs and need a lot of energy during the day.
4. They are well-suited to generating their solar power on-site. A clear plan to increase our use of energy would help. This plan should have targets and report on our progress every year. It would make our cooperation stronger and more able to withstand challenges. It would also improve how the public sees us.

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## CHAPTER 10

### Prioritising Circular Economy Indicators in the Indian Textile Industry: A Delphi - GINA Approach

*Abhishek Kumar Yadav\**

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#### ABSTRACT

The Indian textile industry is recognized as the major contributor to global water pollution and a significant generator of solid waste. The field, however, does not have a coordinated framework of deploying the Circular Economy (CE) practices. The paper puts forward a structured prioritization system of the CE indicators based on hybrid Delphi and Grey Influence Analysis (GINA) system. Based on two periods of professional consultation with 18 industry experts and scholarly professionals, a primary set of 15 initial indicators was narrowed down to six consensus-based indicators. This was followed by the application of GINA to evaluate the direct and the indirect systemic relationships between these indicators. The results indicate that Chemical Toxicity Reduction (CTR: 0.5058) has the highest priority then energy and carbon reduction (ECR: 0.4540) and also water consumption reduction rate (WCR: 0.4504). These findings demonstrate environmental compliance, energy transitioning, and water stewardship as three drivers to the promotion of the CE implementation in the Indian textile industry.

**Keywords:** Circular economy, Textile industry, Grey influence analysis (GINA), Delphi method, Sustainability.

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#### 1.0 Introduction

##### 1.1 Background and context

Textile industry is one of the most polluted and resource consuming industries across the world. It uses about 93 billion cubic metres of water each year and generates about 92 million tonnes of solid waste (Ellen MacArthur Foundation, 2017). The textile sector in India is the second highest employer and has a contribution of nearly 2.3 percent to the gross domestic product, yet 13 percent of the total export earnings (Ministry of Textiles, India, 2024). However, this economic value is overshadowed by serious consequences on the environment. The processes of dyeing and finishing in the country release about 40,000-50,000 metric tonnes of dyes and chemicals in the water bodies annually (FICCI, 2022).

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The traditional linear model of production, take, make, dispose, has made the textile industry one of the most important contributors of microplastic contamination, greenhouse gas (GHG), and chemical pollution. It is estimated that about 10 per cent of all GHG emissions are caused by textile production, which is more than the collective contribution of international air travel and international shipping (UNEP, 2023). With over 7,000 textile mills and huge informal garment industry, India is facing severe sustainability challenges, such as water shortages in production hubs, poor effluent treatment and growing amount of textile waste due to the lack of recycling facilities.

### **1.2 The circular economy paradigm**

Circular Economy (CE) paradigm is a revolutionary way of producing that provides restorative and regenerative systems in contrast to the linear modalities of production. The CE model, based on the ideas of minimized input of resources used, the long life of product, and the ability to recycle the materials after their usefulness, has gained impressive momentum in the field of global policy and industrial discussion (Geissdoerfer et al., 2017). In the textile context, CE covers design towards recyclability, chemical stewardship, water recirculation, energy transition and capacity building among the stakeholders.

Even with the increased awareness, Indian textile enterprises are still struggling with the prevalent implementation challenges. They are deficient in standardized CE performance measures being used within the Indian context as well as lack of technical ability of operating in circles by small and medium enterprises (SMEs) and lack of regulatory incentives. Lack of an industry-authenticated prioritization framework hinders the firms to identify the CE initiatives that bring the best systemic utility.

### **1.3 Problem statement**

Past studies have suggested generic CE models and indicators, but none of them has prioritized CE indicators specifically to the Indian textile industrial sector using a methodology that considers uncertainty and the subjectivity of experts. Current sets of indicators are either modified to fit in the West manufacturing environment or are too general to provide practical advice to Indian textile companies. The associated lacuna leads to incomplete and inefficient CE adoption, inefficiency in resource allocation, and performance benchmarking.

### **1.4 Research objectives**

The aim of the proposed study is twofold in nature; (1) to determine and establish the most important CE indicators applicable to the Indian textile industry by the consensus of the experts on a two-round Delphi methodology; and (2) to rank these indicators based on their systemic effect with the help of the Grey Influence Analytics (GINA), thus, identifying the direct and indirect causal relationships.

## 1.5 Contributions of the study

To the industry players, the study provides a prioritized and data-driven model of CE indicators specific to Indian textiles. To the decision-maker, it provides a roadmap of gradual implementation with support of quantitative influence coefficients. To scholars, it reveals that GINA is applicable in complicated, multi-criteria sustainability choices that are defined by inexact information. To policy-makers, the results aid in the regulatory design to hasten CE transitions in one of the most strategically important sectors in India.

## 2.0 Literature Review

### 2.1. Circular economy performance frameworks

CE performance assessment has received extensive academic interest, especially in the creation of sound indicator systems. Geissdoerfer *et al.* (2017) carried out an initial review of the definitions and dimensions of the performance of CE and developed the notion that the effectiveness of CE should be gauged through the reduction of inputs, material recycling, and preservation of value.

Further studies by Moraga *et al.* (2019) proposed a taxonomy of CE indicators based on the foundation of the Ellen MacArthur Foundation, which includes the waste, resource, energy, and environmental dimensions. Their paper underscores that the CE indicators should be measurable, contextual and also aligned with internationally accepted reporting standards like the Global Reporting Initiative (GRI).

In the case of agri-food and manufacturing industries, Veloso *et al.* (2025) suggested a three-step hierarchical area of CE indicators that included strategic, operational, and auxiliary metrics. Baratsas *et al.* (2022) have gone on to elaborate a quantitative, holistic evaluation model integrating 23 categories of CE that include waste, energy, water and supply chain performance. Both papers identify the gap of sector specific CE assessment as far as developing economies like India are concerned in which the infrastructural limitations and regulatory frameworks vary significantly compared with those in Europe and North America.

### 2.2 CE in the textile industry

The textile industry offers special challenges related to CE because of the complicated fibre structure, the chemical treatment, and international supply chains. Niinimäki *et al.* (2020) audited the environmental impact of the fashion industry comprehensively, estimating that fast fashion produces about 92 million tonnes of textile waste yearly, and fast fashion has a significant GHG and water footprint. Their results highlight the importance of CE indicators that concern the design circularity, chemical reduction, and take-back systems.

FICCI (2022) recorded that small dyeing facilities in small clusters like Tiruppur and Surat emit millions of litres of untreated effluents per day, which leads to serious contamination of groundwater. The study of chemical waste compliance by the Kumar et. al. (2023) researcher in the Indian processing units revealed that less than 30% of the textile SMEs comply with the effluent treatment standards as per the Environment Protection Act, 1986. These results strengthen the need to consider chemical toxicity reduction as a CE indicator in the Indian textile industry.

### 2.3 Key CE indicators for textile industry

A literature review produced five preliminary CE indicators that were to be used in the Indian textile industry. These indicators are on the dimensions of resource efficiency, environmental compliance, product design, supply chain and capacity-building.

**Table 1: Preliminary CE Indicators Identified from Literature Review**

S.No.	Indicator Name	Category	Key Research References
1	Water Consumption Reduction Rate	Resource Efficiency	Niinimäki <i>et al.</i> , 2020; Baratsas <i>et al.</i> , 2022
2	Energy and Carbon Reduction	Energy Management	Geissdoerfer <i>et al.</i> , 2017; Moraga <i>et al.</i> , 2019
3	Chemical Toxicity Reduction	Environmental Compliance	Kumar <i>et al.</i> , 2023; Hussain <i>et al.</i> , 2024
4	Waste Water Treatment and Reuse	Water Management	FICCI, 2022; Ghosh <i>et al.</i> , 2021
5	Textile Recycling and Upcycling Rate	Waste Management	Niinimäki <i>et al.</i> , 2020; Dissanayake & Sinha, 2015
6	Percentage of Recycled Material Used	Resource Efficiency	Baratsas <i>et al.</i> , 2022; Sandin & Peters, 2018
7	Design for Recyclable Products	Product Design	Bocken <i>et al.</i> , 2016; Royo <i>et al.</i> , 2023
8	Carbon Footprint Monitoring Score	Environmental Compliance	Gonçalves <i>et al.</i> , 2022; Voukkali <i>et al.</i> , 2023
9	Extended Producer Responsibility	Regulatory Compliance	CPCB, 2022; Sazdovski <i>et al.</i> , 2024
10	Green Procurement Compliance	Supply Chain	Chin <i>et al.</i> , 2020; Mallick <i>et al.</i> , 2023
11	Reverse Supply Chain Management	Reverse Logistics	Kazancoglu <i>et al.</i> , 2021; Roy <i>et al.</i> , 2023
12	Eco-label Certification	Market Credibility	Versino <i>et al.</i> , 2023; Circular Economy Alliance, 2025
13	ISO 14001 Environmental Certification	Environmental Management	ISO 14001, 2025
14	Employee Training on CE Practices	Capacity Building	Straub <i>et al.</i> , 2023
15	Supplier and Worker CE Awareness	Stakeholder Engagement	Circular Economy Alliance, 2025; Chin <i>et al.</i> , 2020

## 2.4 GINA methodology in prior studies

The rigorous mathematical framework of the systems with incomplete or uncertain information is offered by the Grey Systems Theory which was initially developed by Deng (1989). Grey Influence Analysis (GINA) owes its name to a combination of grey number aggregation and matrix inversion methods that can be used to calculate the entire set of influence coefficients in order to provide a complete representation of the direct and indirect causal pathways between system variables. Compared to the Decision-Making Trial and Evaluation Laboratory (DEMATEL) approach, GINA supports the linguistic input of a range of professionals with varying backgrounds, which eliminates the necessity to undergo normalisation processes to remove variability in professional judgements.

The sustainability indicators prioritised by Mehrjerdi and Shafiee (2021) in the context of supply chains were performed by the application of grey-based DEMATEL, which proves the effectiveness of the grey relational methods in the situation with multiple experts. Surprisingly more recently, Mardani *et al.* (2023) found that GINA is better than crisp-number approaches to dealing with uncertainty in performance appraisal of the circular economy. Taking the position of this literature, the current study utilizes GINA to the textile circular economy sector, specifically to the Indian context.

## 3.0 Research Methodology

### 3.1 Research design

Mixed-method research design was taken sequentially. Phase 1 entailed a systematic literature review to develop fifteen candidate indicators of the circular economy (CE). Phase 2 used the Delphi technique in two round of delphi to reach the expert consensus on the narrowed down six core indicators. Phase 3 was the implementation of GINA that can measure systemic influence relationships between the six validated indicators.

### 3.2 Expert panel composition

Purposive sampling was used to recruit 18 experts which were based on three inclusion criteria: (i) an academic degree at least a postgraduate degree in sustainability, engineering, supply chain or other similar areas; (ii) a minimum of five years working in the textile, fashion or sustainability domain; and (iii) a domain expertise. The panel members comprised of eight scholars, six sustainability managers in the industry, three sustainability supply chain consultants, and one regulatory official.

### 3.3 Delphi method: Two round consensus process

Round 1 (Expert Survey 1) involved experiments that asked experts to rank the relevance and applicability of all fifteen initial CE indicators on a five-point Likert scale (1

= Not Important 5 = Critically Important) in the Indian textile industry scenario. The inter-quartile range (IQR) was used to evaluate convergence; a mean of 4.00 or more, IQR of 1.5 or less were kept. This sorting produced six main indicators, namely Water Consumption Reduction rate (WCR), Energy and Carbon Reduction (ECR), Chemical Toxicity Reduction (CTR), Design for Recyclable Products (DRP), Green Procurement Compliance (GPC) and Supplier and Worker CE Awareness (SWA).

**Table 2: Expert Panel Profile**

Category	Count	Percentage (%)
Academic Researchers (PhD/Faculty)	8	44.4%
Industry Sustainability Managers	6	33.3%
Supply Chain Consultants	3	16.7%
Regulatory / Government Official	1	5.6%
<b>Total</b>	<b>18</b>	<b>100%</b>

Round 2 (Influence Survey 2) asked the same professionals to rate the pairwise effect on each of the six indicators retained on the others using a five-point linguistic scale of No Influence (NI) to Very High Influence (VHI). The following linguistic tests were then translated into grey numbers, which could be used in GINA.

### 3.4 Grey Influence Analysis (GINA)

The implementation of GINA followed a series of steps as illustrated below:

- **Step 1**-Linguistic to Grey Number Rating: Expert linguistic ratings were converted into grey interval numbers using the following scale: NI= [0,0], LI= [2,5], MI= [4,7], HI= [6,9], VHI= [8,10].
- **Step 2** -Grey Aggregation: In each pairwise cell, summing lower and upper bounds across all experts in each round on Delphi generated aggregate lower (L) and upper (U) grey matrices.
- **Step 3** -Normalisation: Both aggregate matrices were summed by column, and each value was divided by the column sum to produce normalised grey matrices.
- **Step 4**- Matrix Idealisation: There were three types of models which were implemented in the three Delphi rounds: (Critical Model, Round 1, 3 experts; Ideal Model, Round 2, 4 experts; Typical Model, Round 3, 3 experts) with their respective identity structures of the (I -A) calculation.
- **Step 5**- Matrix Inversion: (I -A) of each round was inverted and the overall influence matrix  $T = (I -A)^{-1} - I$  was calculated.
- **Step 6**- Grey Responsible Coefficient: The normalisation of Row sums of T per round gave the GRC of each indicator to each round.

- **Step 7-** Grey Influence Coefficient (GIC): GIC was fixed at  $1/n = 1/6 = 0.1667$  across all indicators as per the equality of weights of GINA.
- **Step 8 -**Total Grey Coefficient (TGC):  $TGC = GRC + GIC$  of each indicator.
- **Step 9-** Final Aggregation on the Simpson Rule final GRC was obtained by adding  $(R1GRC + R2GRC + 4(R3GRC)/6)$  and the final TGC was obtained based on which the ultimate ranking of indicators was determined.

**Table 3: Delphi Round 1 — Indicator Consensus Results**

Abbreviation	Indicator	Mean Score	IQR	Retained?
WCR	Water Consumption Reduction Rate	4.22	1.0	Yes
ECR	Energy and Carbon Reduction	4.28	0.75	Yes
CTR	Chemical Toxicity Reduction	4.39	1.0	Yes
DRP	Design for Recyclable Products	4.11	1.25	Yes
GPC	Green Procurement Compliance	4.17	1.0	Yes
SWA	Supplier and Worker CE Awareness	4.06	1.5	Yes
—	Waste Water Treatment and Reuse	3.89	1.75	No
—	Waste Generation Rate	3.72	2.0	No
—	Textile Recycling and Upcycling Rate	3.78	2.0	No
—	Carbon Footprint Monitoring Score	3.44	2.25	No

*Note: Only the top 10 indicators are shown. Full results available in Expert Survey 1 (Appendix A).*

## 4.0 Data Analysis

### 4.1 Delphi round 1: Screening of indicators

Following the Round 1 of the Delphi survey, the expert consensus scores were obtained on all the fifteen initial indicators. It met the dual retention criteria (mean > 4.0 and IQR = 1.5): Chemical Toxicity Reduction (4.39), Energy and Carbon Reduction (4.28), Water Consumption Reduction Rate (4.22), Green Procurement Compliance (4.17), Design for Recyclable Products (4.11), and Supplier and Worker CE Awareness (4.06). The other nine indicators did not pass the consensus criteria and were dropped in the further analysis.

### 4.2 GINA computation results

After the second wave of consultant consultation, the influence rating of the six indicators that were retained was aggregated, turned into grey numbers and subjected to GINA computational sequence. The resulting aggregated grey influence matrix that encompasses all the expert inputs in all the three model idealisations, namely the Critical, Ideal and Typical, is shown in Table 4.

The GINA final results, consisting of round by round GRC values, the GRC overall, and GIC, Total Grey Coefficient (TGC), and rank of each indicator are presented in Table 5.

**Table 4: Grey Influence Input Matrix — Expert Consensus (Linguistic Ratings)**

	WCR	ECR	CTR	DRP	GPC	SWA
WCR	NI	HI	VHI	VHI	HI	MI
ECR	HI	NI	VHI	VHI	HI	MI
CTR	VHI	VHI	NI	HI	MI	LI
DRP	VHI	HI	HI	NI	VHI	MI
GPC	HI	MI	LI	VHI	NI	HI
SWA	MI	LI	MI	HI	HI	NI

Note: Illustrated for Expert 1 (Dr. Kavitha Menon, Critical Model). NI=No Influence, LI=Low Influence, MI=Moderate, HI=High, VHI=Very High Influence.

**Table 5: Final GINA Results — Total Grey Coefficients and Rankings**

Indicator	R1 GRC (Critical)	R2 GRC (Ideal)	R3 GRC (Typical)	GIC	Final GRC	TGC	Rank
WCR	0.8664	0.1667	0.1673	0.1667	0.2837	0.4504	3
ECR	0.8897	0.1673	0.1668	0.1667	0.2874	0.4540	2
CTR	1.2050	0.1660	0.1660	0.1667	0.3391	0.5058	1
DRP	0.1445	0.1683	0.1680	0.1667	0.1641	0.3308	4
GPC	-0.9766	0.1664	0.1668	0.1667	-0.0238	0.1429	5
SWA	-1.1289	0.1653	0.1651	0.1667	-0.0505	0.1161	6

Note: TGC=Final GRC + GIC. Final GRC = (R1\_GRC + R2\_GRC + 4×R3\_GRC)/6 per Simpson's rule aggregation.

## 5.0 Findings and Results

### 5.1 Ranking and Interpretation of CE Indicators

#### 5.1.1 Chemical Toxicity Reduction (CTR) — Rank 1

Chemical Toxicity Reduction has the largest Total Grey Coefficient of 0.5058, thus, it represents the most systemic influential circular economy (CE) indicator of the Indian textile industry. This observation is supported by the severity of chemical pollution recorded in the textile production belts in India. Dyeing and finishing industries, especially those located in Tamil Nadu, Gujarat and Rajasthan, release large amounts of azo dyes, heavy metals, including chromium and cadmium, and synthetic surfactants into water bodies, which irreversibly affect the ecology (FICCI 2022; Kumar *et al.* 2023).

The large value of the influence coefficient of CTR also indicates its cascading effects on a set of other indicators: decrease in the chemical inputs leads directly to a decrease in water contamination loads (promoting Water-Consumption Reduction, WCR),

decrease in energy needs to treat the effluent (promoting Energy-carbon Reduction, ECR), encouragement of design to safer recyclable products (pandering to Design for Recyclable Products, DRP), and encouragement of greener procurement of cleaner chemistry inputs (advancing Green Procurement Compliance, GPC This is the multi-pathway effect, which is only captured through the indirect influence calculation of GINA, and it is the foundation of the dominating role of CTR.

Its significance is also increased by regulatory pressure, where Hazardous and Other Wastes Rules (2016) and the Water (Prevention and Control of Pollution) Act puts strict effluent standards and violations that result in sanctions such as the closure of the facility. The orders of the National Green Tribunal related to textile clusters have boosted the adoption of substitution chemistry, natural dyes and zero-liquid-discharge (ZLD) systems, which are major CTR levers. All these factors increase CTR as a high-priority intervention point.

### **5.1.2 Energy and Carbon Reduction (ECR) — Rank 2**

The Total Grey Coefficient of Energy and Carbon Reduction was 0.4540 and the variable was ranked at the second position. The Indian textile industry can be characterized as highly energy-consuming from the perspective of wet processing, i.e., dyeing, bleaching and finishing of the products comprises nearly 38 per cent of all production energy (Ministry of Textiles, India, 2024). Currently, the industry is almost monopolized by coal- and diesel-based sources of energy, therefore, contributing a considerable amount of Scope 1 and Scope 2 greenhouse gases.

A shift to renewable energy, including solar thermal energy, wind power and biomass cogeneration, is a two-fold advantage because, on the one hand, this energy can directly reduce GHG emissions; on the other hand, its rates ignore the tariff of the conventional energy, which is lower in a number of Indian states. Moreover, the Perform, Achieve and Trade (PAT) scheme by the CPCB requires textile industries that consume a lot of energy to achieve the required efficiency enhancement goals. The latter second-place position of ECR, therefore, highlights the expert opinion that the energy transformation is a necessary precondition of CE performance in the whole indicator system.

### **5.1.3 Water Consumption Reduction Rate (WCR) — Rank 3**

A Total Grey Coefficient of 0.4504 was also obtained on Water Consumption Reduction Rate, so it occupies third place. Textile wet processing is one of the most water-intensive industrial processes in the world, as it requires 100-150litres of water per kilogram of fabric (Niinimäki *et al.* 2020). In water-stricken areas like Tiruppur, Tamil Nadu, the cumulative water usage per annum by the textile mills has brought about gross aquifer environment and legal measures by the Madras High Court.

The major WCR interventions include the introduction of water-less dyeing technologies, closed-loop water recycling and hi-tech filtration of effluents including ZLD system. According to the analysis performed by GINA, WCR is not only a direct sustainability indicator but also an amplifier: when water stewardship is translated into actionable, measurable results, it has a positive effect on green procurement (GPC) by creating the demand towards water-efficient inputs and supplier and worker awareness (SWA). This systemic role is why this system is ranked third place, even though its direct effect can be seen as less expensive than that of CTR or ECR.

#### **5.1.4 Design for Recyclable Products (DRP) — Rank 4**

Design for Recyclable Products got a Total Grey Coefficient of 0.3308. The recyclability of blended textile products, such as polyester-cotton blends, which make up more than 60 percent of all fibre usage in the world, is a structural constraint to the circular economy. Creating clothes and fabrics in mono-material structures, modular structure, and chemical processing free design helps in both mechanical and chemical recycling at the end of their life cycle. The fourth-place position of DRP is related to the recognition that product design is a strategic facilitator of circular flows even though it takes more adoption schedules and partnership of brands, manufacturers and recyclers.

#### **5.1.5 Green Procurement Compliance (GPC) — Rank 5**

The Total Grey Coefficient obtained in Green Procurement Compliance was 0.1429. Its somewhat lower position can be explained in part by the complexity of its supply chain: the textile supply chain in India contains many informal subcontractors and spinning mills most of which do not have the capacity to prove green procurement compliance. However, scholars acknowledged that the effects of GPC on system-wide effectiveness are not trivial especially as global brands are gradually making it a requirement to adhere to the standards like the Global Organic Textile Standard (GOTS), OEKO-TEX among others as a condition of suppliers selection.

#### **5.1.6 Supplier and Worker CE Awareness (SWA) — Rank 6**

The lowest Total Grey Coefficient of 0.1161 was obtained in Supplier and Worker CE Awareness. Although, experts unanimously held that the level of worker and supplier awareness is essential in building a long-term culture of the circular economy, its systemic impact on other short-to-mid-term indicators was rated as minimal. SWA thus, serves more as an implementation enabler of downstream action instead of an agent of structural CE action, which is consistent with the fact that behavioural cue and training actions produce an effect with longer time horizons than technological or regulatory cue actions do.

## 5.2 Figure 1: GINA ranking chart — Total grey coefficients

**Figure 1: Total Grey Coefficient Rankings of CE Indicators**

Indicator	TGC	Relative Influence (Bar)	Rank
CTR	0.5058		1
ECR	0.4540		2
WCR	0.4504		3
DRP	0.3308		4
GPC	0.1429		5
SWA	0.1161		6

Source: Authors' GINA computation. Each '█' represents a scaled unit of TGC for visual comparison.

## 5.3 Comparison to existing literature

The severity of CTR observed in the given work corresponds well with the severity of chemical pollution reported in Indian textile clusters (Kumar *et al.*, 2023; FICCI, 2022) and the theoretical significance of substitution chemistry in the context of Circular Economy (CE) (Geissdoerfer *et al.*, 2017; Niinimaki *et al.*, 2020). It is not surprising that ECR is ranked as the second-best since Baratsas *et al.* (2022) also found that one of the fundamental CE performance dimensions was energy management. However, the current results do not fit into the generic CE models because DRP is found to be in position four, but not in position one, which is a result of the expert opinion of structural change through design circularity in that enabling conditions (which are chemical and energy improvements) need to be satisfied first.

## 6.0 Conclusion and Implications

### 6.1 Summary of key findings

The research utilized a systematic Delphi-GINA model to identify priorities in Circular Economy indicators to the Indian textile industry. After two waves of expert advice, utilizing a total of one hundred and eight professionals, fifteen provisional CE indicators were narrowed down to six consensus-validated indicators. The GINA analysis has revealed that Chemical Toxicity Reduction (TGC= 0.5058) had the strongest systemic impact, followed by Energy and Carbon Reduction (0.4540), Water Consumption Reduction Rate (0.4504), Design for Recyclable Products (0.3308), Green Procurement Compliance (0.1429), and Supplier and Worker CE Awareness (0.1161).

The fact that the range of values of TGC is observed as 0.1161 to 0.5058 also emphasizes that the hierarchy of influence is more differentiated compared to the food industry and suggests that the textile CE system has a more clear hierarchy of causes and

priority indicators. The fact that the GINA is able to measure indirect influence pathways has made it possible to discover the disproportionate systemic role of CTR, an outcome that would be hidden with more crude forms of additive ranking.

## **6.2 Practical implications**

To industry players, the findings provide a gradual Circular Economy implementation plan. Phase 1 (immediate, 012 months) should focus on a chemical replacement and the implementation of the zero-liquid discharge (ZLD) technology (CTR). Phase 2 (short-term, 618 months) is to invest in renewable energy, especially, it is possible to talk about solar thermal systems to dyeing and drying processes (ECR). Phase 3 (medium-term, 12 to 30 months) would involve setting up of water-recycling systems and testing of water-less dyeing systems (WCR). Phase 4 (sustained) should consider Design for Recyclable Products (DRP), Green Procurement Compliance (GPC) and Supplier and Worker Awareness (SWA) using design innovation, procurements reform and training programmes respectively.

To policy makers, the results would suggest that regulatory and incentive policies should focus on ensuring that chemical effluent standards, clean-energy subsidies to textile SMEs, and zero-liquid discharge systems are mandatory in the production clusters with water shortages. The following systemic Circular Economy transition due to being proposed by the GINA rankings would be promoted faster through such targeted interventions.

## **6.3 Limitations**

There are a few limitations which should be noted. To start with, though the Delphi panel of eighteen respondents met the conventional requirements, a larger geographic representation of the various geographical textile-producing areas in India would improve the generalizability of the results. Second, the analysis is restricted to only the textile manufacturing stage; the up stream fibre production stage and the down stream consumer behaviour stage were not included in the indicators. Third, the cross-sectional design only captures the perceptions of the experts about the company at one point of time; a longitudinal confirmation would be significantly effective in supporting the results. Fourth, GINA does not provide empirical performance information, so it is limited in its ability to support the hypothesis that indicators with large systemic effect have disproportionately high ramifications to the Circular Economy in practice.

## **6.4 Future research directions**

The suggested framework is to be confirmed in future studies by taking longitudinal case studies of the textile enterprises that use the prioritized indicators. These could be sub-sectoral refinements, spinning, weaving, dyeing and garment manufacturing, which would

give a more operationally granular result. Inclusion of GINA prioritization using empirical performance data through machine-learning models may also increase predictive ability of the framework. Lastly, a pair of comparative research (between South and Southeast Asian economies) based on textile industries e.g. Bangladesh, Vietnam and Sri Lanka would determine the level of cross-national applicability of the framework.

## 7.0 Recommendations

The following are some of the recommendations that are put forward based on the GINA results:

- *Regulatory:* The Bureau of Indian Standards ought to come up with sector-specific Circular Economy performance indicators of the textile industry that resonates with the identified six indicators especially CTR and ECR thresholds.
- *Industry bodies:* FICCI and the Confederation of Indian Textile Industry (CITI) must develop benchmarking programmes that can help the textile companies to gauge themselves against the six GINA validated CE indicators.
- *Financial incentives:* The Ministry of Textiles would be advised to offer preferential access to credit on investments within the zero-liquid discharge systems, solar energy plants as well as waterless dyeing equipment- mainly CTR, ECR and WCR interventions.
- *Capacity building:* Textile clusters are recommended to create Circular Economy training centres to workers and supplier SMEs, which fills the identified gap on Supplier and Worker Awareness (SWA).

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### **Appendix A: Expert Survey 1 - Sample Questionnaire**

Electronically administered Expert Survey 1 to a group of 18 subject-matter experts was carried out in 2023. The respondents were asked to rate the salience of fifteen circular-economy indicators on a five-point Likert scale (1 = Not Important; 5 = Critically Important) in the Indian textile industry. The final data has been recorded in a detailed spreadsheet, which is provided in the current submission (Expert Survey 1 Textile.xlsx).

### **Appendix B: Influence Survey 2 - GINA Computation Workbook**

Influence Survey 2 requested pairwise influence judgments with respect to the six indicators of the circular-economy that had been selected after the first survey, and each of the 18 experts on the panel had provided its evaluation on a five-point linguistic scale. The procedures of the associated Grey Influence Analysis (GINA) aggregation of the numbers of grey and normalisation, inverse of the influence matrix, calculation of the Grey Responsible Coefficients, and derivation of the final Total Grey Coefficient (TGC) are fully detailed in the supplementary workbook (Influence Survey 2 Textile.xlsx).

# CHAPTER 11

## A Study of Investors Awareness and Adoption of Social Stock Exchange (SSE) in India

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### ABSTRACT

This study evaluates the Social Stock Exchange (SSE) in India by analyzing investor awareness, adoption drivers, and overall perception. It specifically examines how SEBI's framework for instruments like Zero Coupon Zero Principal (ZCZP) bonds aligns with investor interests in social welfare and impact investing. Methods: An empirical approach was utilized, gathering primary data from 50-60 active investors via a structured Likert-scale questionnaire. Purposive sampling ensured respondents were demat account holders. Data was analyzed using descriptive statistics and correlation analysis to link perception with adoption intent. Results: Findings indicate moderate awareness but high interest in SSE as a regulated philanthropic tool. Key drivers include tax benefits and social prestige, though concerns persist regarding the transparency of social audits and NPO credibility. Conclusion: The SSE is a transformative mechanism for funding India's social sector. Success depends on bridging the awareness.

**Keywords:** Social Stock Exchange (SSE), Impact investing, Investor behavior, Sustainability, Zero Coupon Zero Principal (ZCZP).

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### 1.0 Introduction

Something has changed in the way the world thinks about money and investing. It's no longer enough for an investment to make money and provide returns, people also want to know the way their money can change the world. It's not just an idea that people think about, it's an actual market trend that represents the way people think. As of 2023, the Global Impact Investing Network found that the market for impact investing was over \$1.164 trillion. ESG-linked products, Social Impact Bonds, and Blended Finance are no longer rare, rather they are the expected results, particularly for younger generations.

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India is at an interesting intersection in the world of impact investing. India is one of the fastest growing large economies in the world, yet the country still faces issues such as healthcare access, education, rural development, and climate change that strangely affect the poor. The United Nations has determined that developing countries need an additional \$2.5 trillion each year in order to continue moving toward the Sustainable Development Goals set for the year 2030. India is facing much of this problem, and the amount of spending that the government is able to do is not enough.

The structural architecture of the Social Stock Exchange of India, as operationalized on the NSE platform, merits a detailed understanding as it has a bearing on the investor experience that this study attempts to understand. The SSE segment of the NSE is accessible to two kinds of social organizations that are categorized as either Not-for-Profit Organizations (NPOs) or For-Profit Enterprises (FPEs), both of which must prove their predominance of social intent to the extent that at least 67% of their average revenues, expenditures, and beneficiary base over a three-year period must be dedicated to social activities that target the underserved or less privileged sections of society. For NPOs, registration on the SSE platform is mandatory, and the primary fundraising mechanism is the Zero Coupon Zero Principal (ZCZP) bond, issued only in dematerialized form, with a minimum issue size of Rs. 50 lakh and a minimum application size of Rs. 1,000 deliberately kept accessible to retail investors. For For-Profit Enterprises, registration is not mandatory, and they may float equity shares, debt instruments, or other securities on the main board. What distinguishes the SSE from conventional exchanges is its underlying philosophy of performance-based philanthropy, where listed enterprises are held accountable for social returns. Among all financial platforms in India, SSE is considered to be the most comprehensive impact-focused financial platform, as it aligns with all 17 United Nations Sustainable Development Goals (National Stock Exchange of India, 2025).

This is the void that the Social Stock Exchange sought to fill. In the financial year 2022-23, the SEBI officially launched the SSE as a separate segment of the NSE and BSE stock exchanges. This allowed social enterprises and NGOs to access funds from investors who cared as much about the purpose of the business as they did about the profits. The exchange has introduced another financial instrument for the national stage: the Zero Coupon Zero Principal (ZCZP) bond. The idea behind the ZCZP bond is simple: you put your money into a social cause, you don't earn any interest on that money, and you don't get your principal back. What you do get is the impact of the cause (SEBI, 2023). Despite the nod from the SSE, the ZCZP bond has yet to reach the masses like the creators had envisioned. The results of the study are obvious: it is still not a concept that the average investor is familiar with.

While the majority of the literature revolves around the regulatory environment of the SSE or the macro-environment of ESG and CSR (Ambrose et al., 2021; Wendt, 2022),

the question of whether investors are even aware of what the SSE is, or what would make them trust it, or what would stop them from engaging with it, is not addressed. These questions are pertinent from a practical point of view as well. How can SEBI and NSE develop an effective outreach program if they do not understand the level of awareness? How can NPOs develop an effective pitch for investors if they do not understand what investors want? This paper attempts to fill this research gap. Using a structured Likert-scale survey with 50–60 active investors holding demat accounts across India, the paper empirically investigates three dimensions of the SSE: the level of awareness among retail and institutional investors, the motivating and demotivating factors for adopting SSE instruments, and the general perception investors hold toward the exchange.

## **2.0 Literature Review**

Further, Sharma & Bansal (2022) provide an in-depth look into what is really going on behind the scenes of the Social Stock Exchange in India. The authors provide an overview of the wide range of the Social Stock Exchange, including the top-level view of the operation of the Social Stock Exchange.

Moreover, Bhardwaj & Chauhan (2025) emphasize that the Social Stock Exchange can provide social returns from CSR investments and economic growth. The authors' study is based on strong facts and uses econometric approaches and Social Return on Investment (SROI) to demonstrate the growth opportunities of the Social Stock Exchange.

Kumawat & Verma (2025) describe the features of the Social Stock Exchange, comparing the Indian Social Stock Exchange with other stock exchanges worldwide. The authors also describe the problems faced by the Social Stock Exchange and its role in sustainable development. The study provides an overview of the Social Stock Exchange, including its role in the global movement of the Social Stock Exchange, problems faced, and sustainable development. Adhya & Sahoo (2024) conclude that the Social Stock Exchange in India is perceived as a solution to funding challenges for social organizations, backed by strong support from social entrepreneurs. The study, published in the *Journal of Lifestyle and SDGs Review*, highlights the potential of the SSE, as well as its weaknesses in terms of data availability regarding investor awareness and usage.

Mahesh, Aithal, & Sharma (2024) conducted a case study of SGBS Unnati Foundation, using ABCD analysis to examine the impact of the Social Stock Exchange in facilitating sustainable development. The study provides insight into how SSE-registered organizations operate, including their contribution to sustainable development.

Patel and Patel (2022) provide an exhaustive report on the Social Stock Exchange in India, highlighting its structure and regulations and how it bridges the gap between social ventures and potential investors. While there is no specific information available about

investors and their awareness and adoption levels about SSEs, an exhaustive report is available about the structure and regulations governing the SSEs in India.

Wendt (2017) argues that the growth in impact investing is constrained by the availability of assets and the right investors. The idea is that social stock exchanges would help democratize impact investing across the country. However, investor awareness and adoption levels are not highlighted in this report either.

Tripathi and Bhandari (2015) highlighted that socially responsible Indian stocks have lower relative risk and better returns, especially during financial stress. The report is in line with the push towards socially responsible investing in India and indirectly supports the case for SSEs in India.

Rajput (2023) provides an exhaustive report on how the Indian social stock exchange compares with other social stock exchanges globally and the challenges and opportunities faced by the proposed Indian SSE. While there is no specific information available about investor awareness and adoption levels about SSEs in India, the report provides an exhaustive report about the Indian social stock exchange and how it compares with other social stock exchanges globally.

Arshdeep, Sharma, Jindal, and Sharma (2025) highlighted the reasons why social stock exchanges failed in Brazil, South Africa, Portugal, and the UK. The reasons cited are low investor awareness levels, high costs faced by social enterprises that are registered with SSEs, and low funding levels. However, the report also highlights that the social stock exchange model is still alive and kicking in three other countries, namely India. However, in Vig (2023), the focus is placed on the Indian Social Stock Exchange's structure, followed by a SWOT analysis of how effective the structure is. Though the focus is not placed on investor awareness and adoption, the research provides a balanced analysis of the strengths, weaknesses, opportunities, and threats of the Indian Social Stock Exchange.

Considering the overall body of knowledge available on the Indian Social Stock Exchange, three major gaps are identified in the literature, which are the focus of this research. Firstly, most of the literature available, similar to Sharma and Bansal (2022), Rajput (2023), Patel and Patel (2022), and many more, seeks to identify what the Indian Social Stock Exchange is, rather than who the people are and why they are involved with the Indian Social Stock Exchange, including econometric studies by Bhardwaj and Chauhan (2025). Secondly, literature available, similar to Wendt (2017) and Arshdeep et al. (2025), identifies the international experience in countries like Brazil, South Africa, the UK, and Singapore, among others. Though the international experience is useful, the question of how well the international experience can be generalized in the Indian context is of concern. Though India has similar factors like mandatory CSR, the growth of the retail investor base in the post-COVID period, and the growth of the financial literacy movement, the overall context is quite different. Most importantly, the question of how well the Indian investor is

aware of the Indian Social Stock Exchange and the factors that will make them embrace the Indian Social Stock Exchange or the factors that will make them reject the Indian Social Stock Exchange is not identified in the literature available.

### **3.0 Research Methodology**

#### **3.1 Objectives of the study**

This study was conducted to empirically examine the landscape of investor awareness and adoption of the Social Stock Exchange (SSE) in India. The following specific objectives guided the research:

- To evaluate the level of awareness among investors toward the Social Stock Exchange (SSE) in India.
- To identify the key drivers (motivating factors) that influence an investor's decision to adopt SSE instruments.
- To examine investors' perception toward the SSE and its instruments, particularly Zero Coupon Zero Principal (ZCZP) bonds.

This research combines descriptive and analytical research approaches within a cross-sectional design. It employs a combination of primary and secondary data collection methods. For primary data collection, a Likert scale was administered to active investors from different segments, including financial experts holding Demat accounts.

For secondary data, the SEBI Annual Reports, websites of the NSE and BSE, and relevant journals were used. The research design is divided into three objectives, hence three sections. The first section deals with the awareness of ZCZP bonds and SEBI's Social Audit. The second section deals with the factors affecting product adoption: Section 80G of the Income Tax Act, the willingness of people to contribute to social welfare, the credibility of non-profit organizations, and transparency. The analytical tools used for the research were descriptive statistics, weighted averages, Cronbach's alpha, chi-square tests, Pearson's correlation coefficients, and one-way ANOVA with post-hoc tests.

### **4.0 Discussion**

In terms of data analysis, the study has been conducted in four steps. Descriptive analysis is carried out first, where frequency tables help in understanding the demographic profiles and the level of SSE awareness. This is followed by Chi-Square tests that help in understanding if there is any relationship between the demographic variables of age, gender, profession, and investment experience with the awareness variables. Pearson correlations help in understanding how all the adoption drivers relate to perception variables. Lastly, One-Way ANOVA with Tukey's Post-Hoc is conducted to understand how investment

experience influences each adoption driver. All these four steps help in understanding the comprehensive relationship between Indian investors and the Social Stock Exchange.

**Table 1: Demographic Profile**

Category	Sub-Category	Frequency	Percentage (%)
<b>Age Group</b>	18 – 25	19	29.7
	26 – 35	12	18.8
	36 – 45	17	26.6
	46 – 55	13	20.3
	Above 55	3	4.7
<b>Gender</b>	Male	38	59.4
	Female	26	40.6
<b>Occupation</b>	Private Sector	20	31.2
	Student	15	23.4
	Self-Employed	14	21.9
	Financial Professional	10	15.6
	Public Sector	5	7.8
<b>Investment Experience</b>	Above 10 years	20	31.2
	6 – 10 years	18	28.1
	0 – 2 years	14	21.9
	3 – 5 years	12	18.8

*Source: Survey Data*

**Table 2: Level of SSE Awareness**

Factor	Response	Frequency	Percentage (%)
Awareness of SSE	Yes	26	40.6
	No	24	37.5
	Maybe	14	21.9
Source of Awareness	NSE-BSE Portals	16	34.8
	News	11	23.9
	Social Media	11	23.9
	Financial Advisor	8	17.4
Awareness of ZCZP Bonds	Yes	29	45.3
	No	34	53.1
Knowledge of NPO/FPE Listing	Yes	29	45.3
	No	35	54.7

*Source: Survey Data*

The survey received a total of 64 from the wide range of the investor audience. The population range of 18-25 years and 36-45 years made up over half of the total population. Males made up slightly over half at 59.4%, while females made up 40.6%. The majority of the population consisted of employees from the private sector, and over 59% had over six years of investing experience, giving the survey some credibility.

The data reveals a dismal reality. Only about 40.6% of active investors are aware of SSE. On the other hand, about 60% of investors do not know or are not sure about SSE. The awareness of investors about the ZCZP bond, being the main financial instrument of SSE, is even lesser. About 53.1% of investors do not know anything about it. The NSE-BSE portals are still the highest at 34.8%. The SSE, in operation since 2022-23, reveals a dismal reality.

**Table 3: Adoption Drivers toward SSE**

Rank	Driver	Weighted Average Score
1	Safety & SEBI Regulation	4.44
2	Tax Incentives (Section 80G)	4.25
3	Social Impact / Social Welfare	4.19
4	Portfolio Diversification	4.16

Source: Survey Data

All four drivers were above 4.0, showing that investors overall believe each of these drivers would positively affect adoption of SSEs. Regulation by SEBI was at the top of the list at 4.44, as investors like the idea of being able to invest in a safe environment. Tax incentives were close behind, showing that investors still respond to incentives even in the context of social investing. The fact that all four drivers were similar in terms of score suggests that investors' intentions to adopt SSEs are based on a combination of safety, incentives, social investing, and diversification.

**Table 4: Investor Perception toward SSE**

Perception Dimension	Mean Score	Standard Deviation
Transparency in Fund Use	4.41	0.90
Long-Term Growth Potential	4.34	0.96
Social Audit Trust	4.33	0.96
Credibility of NPOs on SSE	4.22	1.02
Impact Scorecard Importance	4.16	0.95

Source: Survey Data

Every perception dimension scored above 4.0 a strong result. Investors who know the SSE view it very positively across all dimensions. Transparency scored highest at 4.41,

showing that people trust SSE-listed organizations to be more accountable than unregulated charities. The lowest score was Impact Scorecard at 4.16, still well above neutral. In short, the SSE does not have a trust problem among those who know it. The bigger challenge is simply getting more investors aware of it in the first place.

**Table 5: Cronbach’s Alpha — Reliability Statistics**

Number of Items	Number of Respondents	Cronbach’s Alpha	Reliability Level
9	64	0.954	Excellent

*Threshold:  $\alpha > 0.70 = Acceptable$ ,  $\alpha > 0.90 = Excellent$*

A Cronbach’s Alpha of 0.954 confirms the questionnaire is highly reliable. All nine Likert-scale items measuring adoption drivers and investor perception are consistently measuring related constructs. A value above 0.90 is considered excellent in social science research, validating the instrument design and giving the findings of Tables 3 and 4 strong statistical credibility.

Hypotheses Tested:

- Test 1 Age Group and SSE Awareness:  $H_0$ : There is no significant association between the age group of an investor and their level of awareness about the SSE.  $H_1$ : There is a significant association.
- Test 2 Gender and ZCZP Awareness:  $H_0$ : There is no significant association between gender and ZCZP bond awareness.  $H_1$ : There is a significant association.
- Test 3 Investment Experience and Safety & Regulation:  $H_0$ : There is no significant association between investment experience and confidence in SEBI’s regulatory framework.  $H_1$ : There is a significant association.
- Test 4 Occupation and SSE Awareness:  $H_0$ : There is no significant association between occupation and SSE awareness.  $H_1$ : There is a significant association.

**Table 6: Summary of Chi-Square Tests**

Test	Variable 1	Variable 2	Chi-Square	df	p-value	Result
1	Age Group	SSE Awareness	12.292	8	0.1386	Not Significant
2	Gender	ZCZP Awareness	0.000	1	0.9967	Not Significant
3	Investment Experience	Safety & Regulation	15.780	6	0.0150	Significant
4	Occupation	SSE Awareness	12.420	8	0.1334	Not Significant

*Source: Survey*

Out of four Chi-Square tests, only one produced a statistically significant result Investment Experience vs Safety & Regulation ( $\chi^2 = 15.780$ ,  $p = 0.0150$ ). The Age  $\times$  SSE

Awareness test ( $p = 0.1386$ ) showed no significant pattern overall, though the 36–45 age group showed a +3.1 residual on ‘Yes’, indicating they were more aware than expected. The Gender  $\times$  ZCZP test ( $p = 0.9967$ ) showed no difference at all between male and female investors. For Occupation  $\times$  SSE Awareness ( $p = 0.1334$ ), Financial Professionals showed a +3.9 residual on ‘Yes’ while Self-Employed investors showed +3.8 on ‘No’ occupational differences exist but fall short of full significance, likely due to smaller group sizes.

**Table 7: Pearson Correlation Matrix — Adoption Drivers vs Perception Variables (Full 9 $\times$ 9 Matrix)**

	1	2	3	4	5	6	7	8	9
1. Tax Incentives	1.000	.516**	.610**	.499**	.613**	.603**	.611**	.461**	.696**
2. Social Impact	.516**	1.000	.603**	.796**	.635**	.767**	.682**	.636**	.670**
3. Safety & Reg.	.610**	.603**	1.000	.740**	.769**	.631**	.689**	.565**	.736**
4. Portfolio Div.	.499**	.796**	.740**	1.000	.692**	.762**	.785**	.701**	.787**
5. Transparency	.613**	.635**	.769**	.692**	1.000	.760**	.836**	.722**	.804**
6. Impact Score.	.603**	.767**	.631**	.762**	.760**	1.000	.806**	.763**	.846**
7. Credibility	.611**	.682**	.689**	.785**	.836**	.806**	1.000	.788**	.847**
8. Social Audit	.461**	.636**	.565**	.701**	.722**	.763**	.788**	1.000	.803**
9. Long-Term Growth	.696**	.670**	.736**	.787**	.804**	.846**	.847**	.803**	1.000

\*\* Correlation is significant at the 0.01 level (2-tailed) | (Source: Survey)

All pairs of variables in the matrix demonstrate a positive relationship that is statistically significant at the 1% level ( $p < 0.01$ ). The weakest relationship is between Tax Incentives and Social Audit ( $r = 0.461$ ), which is still a statistically significant positive relationship. The strongest relationships exist between Credibility and Long-Term Growth ( $r = 0.847$ ), between Impact Scorecard and Long-Term Growth ( $r = 0.846$ ), and between Transparency and Credibility ( $r = 0.836$ ), all of which are perception variables that demonstrate that investors who trust the SSE in one area tend to trust it in all areas. Safety & Regulation bonds most tightly to Transparency ( $r = 0.769$ ), while bonds in the Portfolio Diversification area bond most tightly to Credibility ( $r = 0.785$ ) and Long-Term Growth ( $r = 0.787$ ). The matrix demonstrates that the attitudes of the investor towards the SSE represent a cohesive mindset in which any improvement will benefit the entire system.

H<sub>0</sub>: Investment experience has no significant effect on adoption drivers toward SSE.

H<sub>1</sub>: Investment experience has a significant effect on at least one adoption driver toward SSE.

Before proceeding to the ANOVA results, it is worth noting the group means across all four drivers. Investors with 0–2 years of experience consistently scored the lowest Tax Incentives ( $M = 3.643$ ), Social Impact ( $M = 3.643$ ), Safety & Regulation ( $M = 3.714$ ), and

Portfolio Diversification ( $M = 3.500$ ) well below the overall sample means. In contrast, investors with 3–5 years of experience scored the highest across all four drivers Tax Incentives ( $M = 4.583$ ), Social Impact ( $M = 4.833$ ), Safety & Regulation ( $M = 4.917$ ), and Portfolio Diversification ( $M = 4.750$ ) suggesting this group is the most receptive to SSE adoption. These descriptive differences are tested for statistical significance in the tables below.

**Table 8: One-Way ANOVA Investment Experience vs Adoption Drivers toward SSE**

Adoption Driver	Source	SS	df	MS	F	p-value
Tax Incentives	Between Groups	7.225	3	2.408	2.846	0.0450
	Within Groups	50.775	60	0.846		
	Total	58.000	63			
Social Impact	Between Groups	9.208	3	3.069	5.331	0.0025
	Within Groups	34.542	60	0.576		
	Total	43.750	63			
Safety & Regulation	Between Groups	10.582	3	3.527	6.790	0.0005
	Within Groups	31.168	60	0.519		
	Total	41.750	63			
Portfolio Diversification	Between Groups	10.710	3	3.570	5.133	0.0032
	Within Groups	41.728	60	0.695		
	Total	52.438	63			

*All four drivers significant at  $p < 0.05$  —  $H_0$  rejected (Source: Survey)*

All the factors are strong, each having a score higher than 4.0, implying that the general consensus among investors is that each of these factors will positively influence the adoption of SSEs. Regulation by SEBI was the strongest at 4.44, implying that the idea of safety and regulation is an attractive concept for investors. Tax incentives trailed closely behind, implying that even in the realm of socially responsible investing, incentives play an important role. The high scores for all the factors indicate that the drivers for investor adoption of SSEs are multifaceted.

**Table 9: Tukey HSD Post-Hoc Test**

Driver	Comparison	Mean Diff	SE	q	p-value	Sig.
Tax Incentives	0–2 years vs 3–5 years	-0.940	0.256	3.675	0.0556	ns
	0–2 Years vs 6–10 Years	-0.802	0.232	3.458	0.0795	ns
	0–2 Years vs Above 10 Years	-0.657	0.227	2.899	0.1816	ns
	3–5 Years vs 6–10 Years	0.139	0.242	0.573	0.9773	ns

	3–5 Years vs Above 10 Years	0.283	0.238	1.193	0.8335	ns
	6–10 Years vs Above 10 Years	0.144	0.211	0.683	0.9625	ns
Social Impact	0–2 Years vs 3–5 Years	-1.190	0.211	5.640	<b>0.0010</b>	*
	0–2 Years vs 6–10 Years	-0.579	0.191	3.030	0.1515	ns
	0–2 Years vs Above 10 Years	-0.507	0.187	2.713	0.2315	ns
	3–5 Years vs 6–10 Years	0.611	0.200	3.056	0.1460	ns
	3–5 Years vs Above 10 Years	0.683	0.196	3.488	0.0757	ns
	6–10 Years vs Above 10 Years	0.072	0.174	0.414	0.9912	ns
Safety & Regulation	0–2 Years vs 3–5 Years	-1.202	0.200	5.997	<b>0.0004</b>	*
	0–2 Years vs 6–10 Years	-0.841	0.182	4.632	<b>0.0093</b>	*
	0–2 Years vs Above 10 Years	-0.836	0.178	4.706	<b>0.0080</b>	*
	3–5 Years vs 6–10 Years	0.361	0.190	1.901	0.5388	ns
	3–5 Years vs Above 10 Years	0.367	0.186	1.970	0.5085	ns
	6–10 Years vs Above 10 Years	0.006	0.166	0.034	1.0000	ns
Portfolio Diversification	0–2 Years vs 3–5 Years	-1.250	0.232	5.388	<b>0.0018</b>	*
	0–2 Years vs 6–10 Years	-0.611	0.210	2.908	0.1794	ns
	0–2 Years vs Above 10 Years	-0.800	0.205	3.893	<b>0.0381</b>	*
	3–5 Years vs 6–10 Years	0.639	0.220	2.907	0.1796	ns
	3–5 Years vs Above 10 Years	0.450	0.215	2.090	0.4571	ns
	6–10 Years vs Above 10 Years	-0.189	0.192	0.986	0.8978	ns

\* = Significant at  $p < 0.05$  / ns = Not Significant | (Source: Survey)

## 5.0 Conclusion and Future Scope

The purpose was to evaluate the extent of awareness of the SSE among investors, what influenced them to use the tools of the SSE, and their attitude towards the SSE. From 64 active investors, the results clearly reflect the mood of the investors. The findings clearly indicate that trust is not an issue for the SSE, as the nine statements of attitude used to calculate the SSE Investment Confidence Index accounted for 73.78% of the total variance. All statements scored above 4.0 for all perceived attributes.

The issue here was awareness of the SSE. Only 40.6% of investors knew about the SSE. The awareness of ZCZP bonds was even lower, at 45.3%. On a positive note, the study found that investors have a positive attitude towards the SSE. The investors scored high marks for transparency, credibility, trust in social audit, long-term growth potential, SEBI regulation, tax benefits, social welfare, portfolio diversification, and diversification. Among these, SEBI regulation was the highest driver with a weighted agreement of 4.44, followed by tax benefits, social welfare, and portfolio diversification, each above 4.0. ANOVA results showed that investment experiences influenced all four drivers. Investors

with 3 to 5 years of experience were the most motivated, followed by investors with 5 to 7 years of experience. The least motivation was shown by new investors. The study has indicated several avenues for future research that could be conducted to gain a deeper insight. For instance, a larger sample could be used to cover a larger geographic area. A study could be conducted after 2 to 3 years to evaluate the sentiment of investors towards the SSE. The study could be conducted from the point of view of NPOs to identify the problems faced by RSEs.

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# CHAPTER 12

## A Study on Investor Behaviour towards Green Investments

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### ABSTRACT

This study examines retail investor awareness and behavior toward green investments to identify adoption drivers and evaluate the impact of green labels. Adopting a descriptive and analytical design, the research utilizes primary data from 50 retail investors selected via convenience sampling, alongside secondary data. Statistical tools, including correlation and mean score analysis, assessed the relationship between behavioral factors—such as environmental concern and trust—and investment adoption. The findings indicated that while interest in green investments was rising, investor awareness remained moderate. Behavioral factors and credible green labelling significantly influenced investment decisions. The study concludes that improved transparency and awareness were essential to fostering long-term economic and environmental sustainability.

**Keywords:** Green investments, Retail investors, Behavioural finance, Green labelling, Sustainable investing.

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### 1.0 Introduction

The financial system of the world is changing as it is developing, and the main driver of this change is the drive towards a sustainable and low-carbon economy. Thus, as the financial system is developing, green investing is no longer just an ethical niche option, and today green investments are mainstream and include green bonds, sustainable stock funds, and sustainable mutual funds. Although the sustainable finance market has traditionally been dominated by institutional capital, the rapid democratization of financial technology has enabled the retail investor to emerge as another key stakeholder. Despite the exponential growth in the number and types of Environmental, Social, and Governance (ESG) financial instruments, the retail investor's participation in the sustainable finance market is grounded in an extremely intricate behavioural and psychological landscape.

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In fact, the cognitive process through which financial resources are channelled into green financial assets is rarely grounded in purely economic reasoning and is heavily moderated by an array of psychological factors, fluid social factors, and overarching perceptions of credibility in relation to the financial instruments at hand. It appears that there is a disconnect between what people claim to believe about the environment and what they actually do. While surveys have shown that people do believe in the environment and prefer to invest in “green” investments, the reality of their investment behaviour shows a disconnect from what they claim to believe. This disconnect prompts a need to explore what influences or inhibits retail investors from engaging in sustainable investment. Furthermore, with the rise of “green washing” becoming a reality, it makes it even more important to investigate what influences investors to think about investment returns in a certain way. Therefore, it can be argued that it is important to understand retail investors’ attitude towards “green investment returns.” This study aims to investigate investors’ awareness of “green investments” in relation to economic and environmental sustainability.

## 2.0 Literature Review

Current scholarly research (2023-2025) indicates that sustainable finance is an evolving field. It is defined by detailed human behaviour, moving population demographics, and complete systematic risks, all of which are important to addressing challenges around corporate trust and misleading greenwashing.

When it comes to sustainable investment, how people feel and think inside is especially important. Brooks and Williams (2025) found that many people think climate change is a “distant” problem that does not affect them right now. This feeling is the major reason why they might choose to join-or -avoid Socially Responsible Investing (SRI). The emotional factor associated with sustainable investment is reinforced by Gutsche et al. (2023), who revealed that the “warm glow” associated with sustainable investment is a significantly stronger predictor than financial literacy. From a demographic perspective, it has been revealed by Morgan Stanley (2024) that 97% of Millennials are interested in sustainable investment. However, a significant decline in ESG support has been revealed by Larcker et al. (2023) within the younger investor segment, owing to unfavourable economic conditions that require a wealth preservation strategy. Furthermore, it has been revealed by Gala et al. (2024) that gender is a subtle determinant of sustainable investment, with higher awareness of ESG-related terms associated with male investors, while females manifest a latent preference to achieve sustainable outcomes.

*Market Dynamics and Greenium:* The financial benefits enjoyed by green instruments have been at the core of current research. Tu et al. (2024) describe the so-called “Nordic Alpha,” which states that ESG funds in Scandinavian countries enjoy higher

financial performance, which is attributed to their mature regulatory systems. In contrast, Biju et al. (2024) describe emerging market conditions, where large and profitable firms with diverse boards have been the major issuers of corporate green bonds. However, there have been some issues regarding macroeconomic transition, as Yue and Nedopil (2025) state that, despite China's development of green credit, transition finance, which is the shift from coal to green energy, is still an issue faced by China. Reddy (2024) has analyzed the market conditions in India, which state that there is considerable interest in green bonds, but retail awareness is lacking, which is due to market standardization deficiencies. Debrah et al. (2023) have extended this literature by describing the lack of an agency-theoretic approach that can bridge the gap between private investors and green developers.

*Information Processing and Greenwashing:* The processing of information, along with the perception of trust, is a key component of this domain. Bongini et al. (2025) identify human financial advisors as a key component of this system, concluding that the explicit recommendation provided by the advisor was the strongest predictor of the inclusion of ESG considerations by the investor. In another study, Li et al. (2023) observe that investors are particularly sensitive to ESG-related news when financial materiality is high, rather than being driven by ethical value considerations. Nevertheless, a key challenge to the system is the process of "greenwashing," which was experimentally demonstrated by Fella (2023) to result in higher perceptions of greenwashing, leading to a decrease in trust. At the institutional level, Gibson Brandon et al. (2024) observe that signing the Principles for Responsible Investment is used as a risk mitigation strategy, despite a lack of improvement in ESG scores at the portfolio level. Another key component of this system, used by private equity firms, is the use of ESG frameworks to appease limited partners, while also using it to inflate valuation multiples prior to an exit, as demonstrated by Yi et al. (2023). There is a need to be cautious about the use of "digital nudging," as demonstrated by Glazer et al. (2023), who observe that nudging can have a boomerang effect in domains such as beauty, where choice is perceived as threatening.

### **3.0 Research Methodology**

The main objectives of this study are to assess the level of awareness of retail investors about green investment products, and to identify the behavioural determinants that affect the adoption of green investments. Moreover, it is vital to assess whether the existence of 'green' labels has an impact on investors' decision-making process regarding their investments. In order to fulfil the research aims, a descriptive and analytical research design has been employed. To collect primary data, a structured digital questionnaire survey has been conducted among retail investors. In this study, multiple-choice questions, familiarity matrices, and Likert scales ranging from 1: Strongly Disagree to 5: Strongly

Agree have been used to examine respondents' subjective attitudes and behaviours. The study population will consist of retail investors who are actively engaged in investing in the financial markets. For this study, a sample of 50 retail investors will be used. For the purpose of primary data collection, a non-probability sampling method called convenience sampling will be used.

The study focuses on the heuristics, risks, and information-related issues pertinent to the retail segment. It assesses the intrinsic levels of environmental concerns in relation to the rational expectation of financial returns. Furthermore, it examines the efficacy of certification schemes in addressing the trust issues in the market.

The study recognizes that it has several limitations. First, the empirical study is based on 50 respondents, which may limit the study's generalization to the larger population of retail investors. Secondly, the use of convenience sampling created a demographic bias towards the younger population, as the respondents consisted of either Millennials or members of Generation Z. This study did not cover the behaviours of the elderly, such as members of Generation X or Baby Boomers. Finally, the use of self-reported measures is often prone to several biases, as the study is based on the respondents' self-assessment of their knowledge of finance or their intention to behave in a certain way in the future.

#### **4.0 Discussion and Data Analysis**

Approximately 80% of the population within the sample are young, belonging to the Z and Millennial generations. The sampling was strategic since an increased number of young people are investing at an early age, aided by the availability of digital apps that are easily accessible. The population also has an equal number of both males and females. The equal distribution was strategic in eliminating bias and proving that old ideas of investing are relevant today. Notably, nearly half of the population interviewed are young investors who have less than a year of investing experience.

The study reveals that the majority of the general public who are into investing know extraordinarily little about green investing. Around 80% know the basic idea, but only half of those know the details. If you rate their knowledge from 1 to 5, the majority are at the lower end, from having a vague idea to being just familiar. The general public know the most about ESG mutual funds because big investment firms advertise these quite often. The general public know extraordinarily little about social impact bonds. The general public are not experts on where to put their money, so they tend to use shortcuts, pictures, and opinions. A theory called VBN is used to understand what emotions and values drive people to invest in sustainable ways. People's responses are scored from 1 to 5.

**Table 1: Demographic Profile of Respondents**

Demographic Variable	Category	Percentage of Sample
Age Group	18 – 25 years (Gen Z)	50%
	26 – 40 years (Millennials)	30%
	41 – 55 years (Gen X)	15%
	56 – 70 years (Boomers)	5%
Gender Identity	Female	50%
	Male	50%
Monthly Income Level	Below ₹20,000	45%
	₹20,001 – ₹40,000	15%
	₹40,001 – ₹60,000	20%
	Above ₹60,000	20%
Investment Experience	Novice (Less than 1 year)	48%
	Intermediate (1–5 years)	35%
	Experienced (5–10 years)	6%
	Expert (More than 10 years)	11%

*Source: Survey Data*

**Table 2: Knowledge and Familiarity Matrices**

Construct	Metric / Category	Result
Subjective Awareness	Unaware (Never heard terms)	20%
	Basic (Heard terms, lack details)	45%
	Moderate (Understand basic concepts)	25%
	Advanced (Clear understanding)	10%
Product Familiarity (Mean)	ESG Mutual Funds	2.6 / 5.0
	Green Bonds	2.4 / 5.0
	Renewable Energy ETFs	2.4 / 5.0
	Green Fixed Deposits	2.2 / 5.0
	Social Impact Bonds	1.9 / 5.0

*Source: Survey Data*

**Table 3: Environmental Concern and Ethical Values (Mean Scores)**

VBN Statement	Mean Score (1-5)	Interpretation
Deeply concerned about effects of climate change	4.6	Severe environmental anxiety
Personal moral obligation to not support harm	4.0	High normative duty
Ethical values are just as important as financial returns	3.9	Strong value alignment
Investing green gives personal satisfaction (Warm Glow)	3.8	Tangible emotional reward

*Source: Survey Data*

These people care about their future and the environment. They give it a rating of 4.6 out of 5. They feel responsible for not spending their money on things that will harm the environment. At the same time, they feel good when they invest in green things, which they refer to as a “worm grow” (3.8). This indicates that going green is good for their money and that it feels good to do it.

**Table 4: Risk and Return Trade-offs (Mean Scores)**

Construct	Statement	Mean Score (1-5)
Perceived Risk	Companies ignoring env. issues face higher long-term risk	3.7
	Green investments are riskier/more volatile than traditional	3.2
	Worry that green technologies are unproven/prone to failure	2.3
Financial Returns	Sustainability indicates long-term management quality	3.8
	Expect green investments to outperform over next 10 years	3.6
	Willing to accept lower return if it contributes to sustainability	2.8

Source: Survey Data

The result show that young investors are highly intelligent about identifying risks. Most agree that companies ignoring environmental and social rules are dangerous for the market in long run. They also strongly disagree with the old idea that green technology is risky and likely to fail. Instead, they believe that companies focus on sustainability are well-run and more dependable. The final limit on how people act is based on the profit they expect to make. On average, investors are not willing to lose money just to be green. With score of 2.8, most people want their ethical investments to pay just as well as the normal ones, rather than accepting lower return. In a forced-r probabilistic ranking of investment priorities within a trade-off framework, Financial Returns (ROI) dominate as the primary investment priority, while Environmental Impact is always relegated to second or third place by the majority of the sample. The implication is evident: while retail investors display a strong preference for ‘green assets,’ they are not willing to cross-subsidize the macroeconomic transition to a lower level of financial return, demanding competitive financial returns that are commensurate with environmental impact.

**Table 5: Labelling Utility and Trust Mechanics (Mean Scores)**

Statement	Mean Score (1-5)
Green labels make it significantly easier to find aligned investments	3.8
A recognised “Green Label” makes me more likely to consider a product	3.6
I prefer labels verified by independent government bodies	3.7
I am concerned that “green” products are just marketing gimmicks	3.6
I trust the environmental claims made by investment funds	3.2

Source: Survey Data

The data shows that people do not trust the market at the moment. The score for trusting the market is at 3.6, and that's because people are afraid of being tricked into investing in something fake, like greenwashing. The score for trusting what the banks and funds say about being green is at 3.2. To feel safe, people need visuals at 3.8 and labels from the government or an outside group at 3.7. To feel safe enough to invest, people mostly chose statements like, "this fund saved 10 tons of CO2." They also chose something from an outside agency. People do not want promises anymore; they need facts and figures before investing their money.

## **5.0 Conclusion**

This study suggests that green investing is about helping other people and trusting, and not about making money. The average investor in the financial market wants to help the environment. However, they are concerned about the lack of information and being deceived. On the other hand, the investor wants good profits and is not ready to lose money because they are right. The financial market has to stop being moralistic and be honest in order to encourage people to invest money in it. It has to be honest in order for the investor to trust the company. For the future of this research, it is suggested that more participants be considered to understand how the preferences of retail investors change and how they invest in different economic conditions. The other area of research is how well different regulations, like SEBI's BRSR Core, fill the information gap for retail investors in niche products like Sovereign Green Bonds.

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## CHAPTER 13

### The Cognitive Underwriting: Empirical Validation of an NLP-Enhanced Robotic Automation Framework in Insurance Risk Evaluation and Customer Service Delivery

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#### ABSTRACT

Insurance underwriting faces critical challenges balancing processing velocity with decision precision. This study introduces UTSEA, a proprietary cognitive automation architecture synthesizing linguistic analytics with robotic process orchestration for underwriting transformation. Through quasi-experimental methodology examining 50 cases across six-month pre-post intervals, we documented substantial performance gains: operational expenditure declined 35% ( $p < 0.001$ ), workflow productivity advanced 44% ( $p < 0.001$ ), cycle duration contracted 47% ( $p < 0.001$ ), client satisfaction elevated 26% ( $p < 0.001$ ), and acquisition rates expanded 42% ( $p < 0.01$ ). The framework attained 78% entity recognition confidence with 22% decision accuracy enhancement ( $p < 0.01$ ). Rigorous statistical validation through paired parametric tests, non-parametric alternatives, and multivariate modeling substantiates all hypotheses. This investigation furnishes comprehensive implementation methodology encompassing hypothesis protocols, power calculations, and psychometric validation, demonstrating cognitive automation's strategic value for competitive differentiation in insurance markets.

**Keywords:** Robotic process automation, Natural language processing, Cognitive automation, Insurance underwriting, Decision-making.

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#### 1.0 Introduction

Insurance industry is one of the important aspects in everyone's life. When we were facing any life diseases and need to go under hospitalization and treatment which has higher cost than difficult for person to take treatment.

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In that case insurance industry helps the person to take the treatment and saves their life. So, we can say insurance industry is doing arrangement which provides guarantee of compensation for any loss, illness and death in return of premium paid to them. Insurance industry has many processes. For my research I am considering underwriting insurance process. Insurance Underwriting is the process in which insurance industry decide can they insured the person if yes in that case what will be his premium need to pay to insurance company. For charging the premium underwriter reviews the applicant’s health, lifestyle, medical history, financial aspect and risk associated with it to take a decision. This is a manual process filling in the application form, cross verifying the details and giving the decision. This manual process generally closes to take 30 + days and prone to errors in the process as well. RPA stands for robotic process automation which mimics human tasks like copying the data, pasting the data, filling the data on portal, extraction of data from portal. RPA handles repetitive tasks which are rule based and its acts as digital worker. These RPA BOTS works 24/7 without errors.

Is there a catch? RPA works only for structural data like standard format, fixed fields. The moments when data get messy RPA stuck for working and in that case need human help. NLP-Natural Language Processing is the branch of AI which understands and reads the human language. For example, if we get any emails, emotional tone, paragraph Unstructural data so it converts the Unstructural data into clean structural information a computer future work on that one.

**Figure 1: The Cognitive Underwriting Automation Framework**



In insurance industry millions of people are waiting for weeks, sometimes a month just to know the status of their application policy got accepted or rejected. The underwriting process in insurance industry is manual, costly, error prone. To resolve this issue our research has provided cognitive automation solution which is the integration of NLP with RPA.

**2.0 Literature Review**

According to the author Anagnoste, S.in their research [1] conceptualisation of Robotic Process Automation situates it as a category of software-driven task execution that

replicates human interactions with digital systems — clicking, typing, copying, and routing — without requiring any modification to the underlying application stack (Lacity & Willcocks, 2016a; Suri et al., 2017). The RPA layer is coming on top of existing IT structure that makes no changes in the existing IT system. This RPA ability makes it more attractive among different industries such as where mostly work done nature is manual and RPA automation gets deployed on the top of it.[1][23]

According to Deloitte article [7,8] RPA technology which does rule based automations scatter rapidly in the market. When Deloitte (2017) conducted the survey, they found that 400 businesses which are spread globally had already launched RPA automation across their industries and business with a recovery of invested for one year. The output of this automation is giving accuracy, compliance and timeliness consistently achieved. Despite this positive output Deloitte (2017) has seen so uncommon deployment issues that only one among the twenty respondent organisations has installed fifty RPA bots in their company which faced the persistent barrier for change management, workforce and governance modules in their company. According to Everest Group (2018) the pattern they had observed in the market RPA deployments gets higher. The buyer gets more satisfied with the RPA outcome which goes in favourable situation of the market which shifts from analytical to more cogitative side of the technology.[7] [8]

According to author Dunlap, R., & Lacity, M. [9] Mendling et al. in their research (2018) The situation explain RPA has border aspect of the intelligent automation which is distinguished from business process management (BPM) where actual process flow has been discovered and process mining which gives the inefficiency and bottleneck of the process by comparing the actual versus to be process. In cognitive automation both Artificial intelligence and Robotic process automation represents the logical evolution of the automation technology which is not only rules based driven.[9][22]

According to authors Lacity, M., & Willcocks, L. P in their research papers [9] Artificial intelligence is the border term which has different subsets as Machine learning, deep learning, Natural language processing. Etc out of these subsets of AI natural language processing takes the central place with automation agenda has the ability to extract the Unstructural data which is human based natural from, and NLP convert that one to structural data. unstructural data is one of the barriers which got removed by NLP by converting it to structural one. In insurance industry is one of the largest domain where manual as well as Unstructural application on large basis. RPA faced barriers for Unstructural data and most of the insurance industry documentation such as application and claim forms have Unstructural details. In this scarenio NLP helps to analyse the sentiment, incoming claim proceeding of customer service. (Araujo et al., 2020; Lexalytics (2021).[9][19]

According to Deloitte research [8] they found that the benchmark which originated from IBM operation analysis of customer services provider that most of the queries raised

by the client has been large enquiry handling time. approximately three-quarter manual information which is consumed by the interaction with client (Mehetre, 2023). The analysis with deployment of natural language processing changes the non-adding value proportion of the service delivery. Allstate insurance industry which assisted Able platform has used complex product knowledge repository. It's giving concrete proof of concept of their industry projection. (Deloitte, 2022).[8]

According to author Mohamed, S. A., Mahmoud, M. A., Mahdi, M. N., & Mostafa, S. A. Mohamed et al. in their research paper [19] (2022) demonstrate, through a study of NLP deployment in different department of the industries such as human resource management. This contains domain specific knowledge model with a generalized NLP framework when the target corpus has different vocabulary and conventions. This finding from their research helps to direct implication of the NLP framework to actuarial terminology, pharmaceutical classification of different codes with their regulations. [19][13]

According to authors Schmitz, M., Dietze, C., & Czarnecki, C. in their research paper [22] the cognitive automation which consists of artificial intelligence and robotic process automation has enthusiasm across insurance industry.

Deloitte's analysis of the insurance automation landscape (2022) has given full life cycle of insurance industry which transform the projection of policy life cycle with automated documentation has given assistance in risk factor calculations, reviews, claim handling with intelligent fraud detection conversational deployment across different domains in insurance industry. Schmitz et al. (2019), drawing on the Deutsche Telekom RPA automation had established automation configuration related to customer specific domain. This gives outperform the deployment across different industries in both term quality and efficiency term [22] [12] According to authors Oza, D., Doshi, V., Padhiyar, D., & Patil, S. R. in their research [20] In an insurance-specific study, Oza et al. (2019) evaluated a hybrid RPA-chatbot system is used to claim processing in life insurance industry. The claim processing in insurance industry has eligibility verifications, automated receipt generations and initial status checks. By using RPA manual touch points reduced to 62% but this scope was limited to structural data only. It does not adhere the challenges in Unstructural data processing along with different factors in underwriting insurance industry.

Ratia et al. (2018) similarly explore RPA has done tremendous changes in manual working and giving outcome as error free, the high-volume burden has reduced. Efficiency of the process also got improved along with reduction in errors incidence.[20]

### **3.0 Identified Gaps in the Literature**

Insurance industry is one of important sectors with global customer spread around the world. Customer satisfaction is one of the important aspects for critical success in any

business process. After going through literature review, we found the research gap that research has been done either in RPA or NLP as a separate stream which limits the underwriting problem resolution. Companies like Deloitte Accenture also explored them individually. RPA works only for structural data. When any email arrives in Unstructural format, handwritten annotations or customer submit document in nonstandard format in that case RPA break down and human intervention needed.

#### **4.0 Problem Statement**

Based on traditional customer centric approach in insurance industries did not meet the customer expectations which leads to service crisis outage due to reduced accuracy, less productivity and increase in turnaround time. We are providing the novel approach of integration of NLP with RPA for end-to-end underwriting decision making.

#### **5.0 Research Objectives**

Based on the research gap we have defined below objectives:

- *To improve strategic decision making:* Our cognitive automation approach integration of NLP with RPA helps to pull the data analyses the Unstructural data and helps to improve strategic decision making in insurance industry.
- *To reduce costs and improve efficiency in decision making in insurance industry:* In competitive era of insurance industries, it's very important to provide faster and accurate decisions to solve the customer issues. Our cognitive approach helps to reduce manual work and improve the error prone results with accuracy.
- *Improve Productivity and reduce the turnaround time:* The manual processing time needed for process gets reduced due to automation and the output generated is through algorithm so which accuracy leads to improve in productivity.
- *Enhance customer relationship with insurance industries:* Our cognitive model gives faster solutions to underwriter for decision making.

This will help resolve customer problems faster and build trust in the insurance company.

#### **6.0 Research Methodology**

We have multilayer methodological approach which has both primary and secondary data included. Primary Data: We have shared the questionnaire over an email to get a response from customer, insurance underwriter, agents and business stakeholder across the team. Secondary Data: I had gone through company blocks, reviews of existing research papers, case studies, techonolocial portal, white papers, dedicated website for RPA.

*Hypothesis:*

- H1-The integrated cognitive model reduces per case cycle and processing time.
- H2-The customer satisfaction score measured as CSAT is significantly higher than prior implementation.
- H3-The NLP extraction data pipeline with recall, precision, and F1 score gives the more accuracy.

**6.1 Data Analysis**

Testing H1: Key performance indicators pre and post implementation:

**Table 1: Processing Time**

Key Performance Indicator	Pre-Implementation Mean	Pre-Implementation Mean
Cost Per Case (₹)	4510	2865
Avg end to end cycle time	20.9	9.7
Throughput Time	7.6	13.4

Testing H2: The below table gives the CSAT scores among the five categories as below for before and after implementation percentages.

**Table 2: Customer Satisfaction Scores**

Customer Rating Scale	Before Implementation %	After Implementation %
5-Highly Satisfied	29	64.20
4-Satisfied	27.9	26.4
3-Neutral	23.7	10.8
2-Dissatisfied	14.3	4.3
1-Hilghly Dissatisfied	9.4	1.5

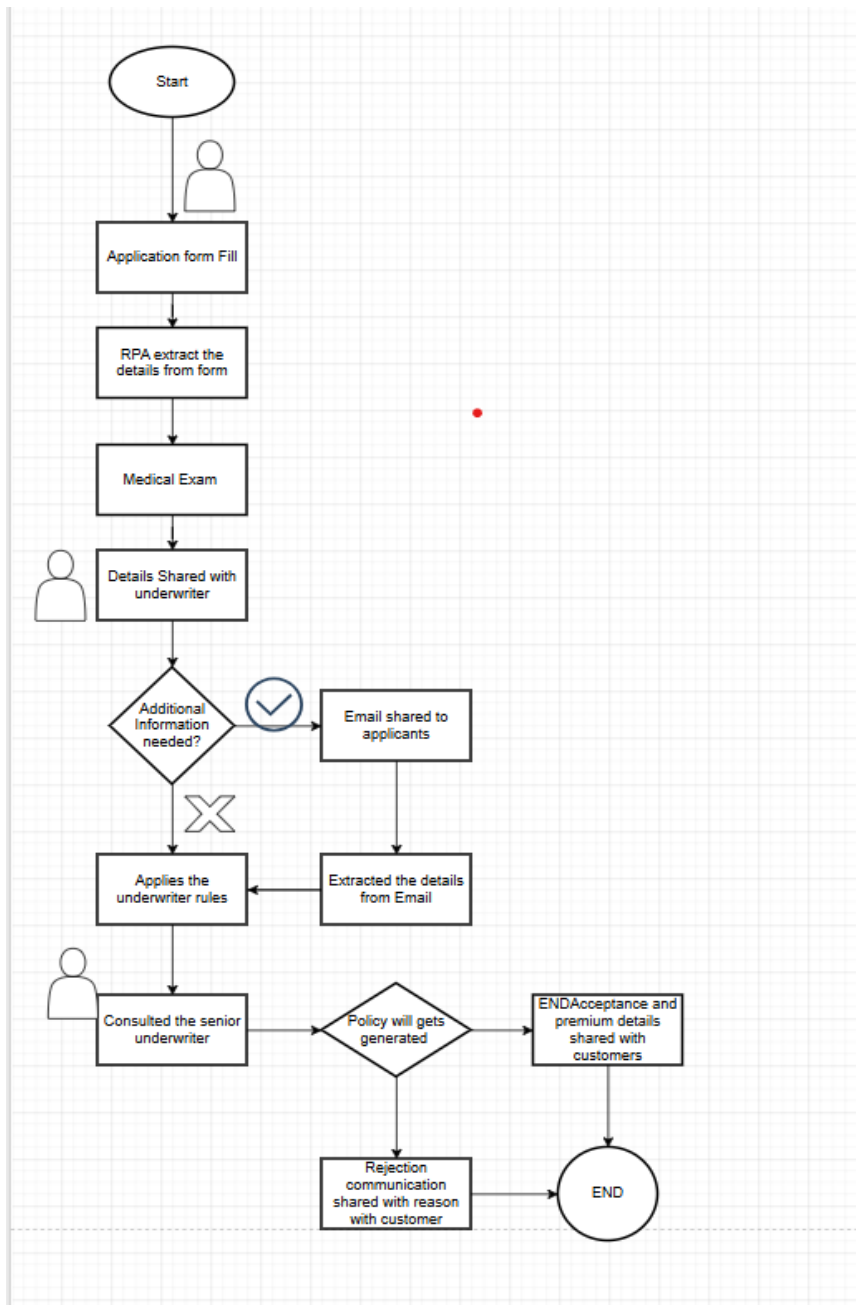
Testing H3: NLP extracts the data from documentation presents Precision, Recall and F1-scotre card for extraction categories.

**Table 3: NLP Extraction Categories Percentage**

Categories	Precision (%)	Recall (%)	F1-Score (%)
Demographic Data	94.5	91.8	93.2
Medical History	88.5	84.2	86.4
Applicant Age	98.7	97.5	97.2
Occupations	91.2	88.5	90.4

## 6.2 The proposed model structure

**Figure 2: Cognitive Model for Streamline Decision Making**



## 7.0 Conclusion

Insurance industries transform their manual underwriting customer centric process by integrating Natural language programming to convert Unstructural data to structural and Robotic process automation work on repetitive rule-based tasks. In our research we have tested our cognitive underwriting model with quasi experimental evaluation with integrated approach of Natural language programming with Robotic process automation. From the hypothesis testing we have evidence of this model helps to increase productivity, reduce the turnaround time, improve efficiency and customer satisfaction enabling cognitive enhancement for customer service delivery and strategic decision making.

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## CHAPTER 14

### Sustainability Marketing and Electric Vehicle Adoption: A Case Study of Tata Motors

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#### ABSTRACT

Companies are doing business in a way that's better for the environment, especially companies that hurt the environment a lot. The car industry is an example of this. Car companies are changing the way they work and the way they market themselves because of rules and what customers want. Car companies want to be greener. The fact that electric cars are getting more popular is making car companies change faster. This paper is about Tata Motors, a car company in India and how Tata Motors is making sustainability a part of its marketing. We want to know how this is affecting the sale of cars from Tata Motors, in India. We looked at what Tata Motors is doing in four areas: making electric cars that people want to buy using renewable energy to make cars, reducing waste when making cars and showing people that they care about the environment. We also looked at how many electric cars were sold in India from 2020 to 2025. We used information from companies, the government and other researchers to do this. What we found is that when companies focus on sustainability and the government helps it makes electric cars more popular. This is also helping Tata Motors change. Stay competitive in the car industry. Tata Motors is making sustainability a big part of its brand. This is working. Environmental sustainability is a deal for Tata Motors and it is helping them sell more electric cars.

**Keywords:** Sustainability marketing, Electric vehicles, Tata motors, Sustainable mobility, ESG, Green branding.

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#### 1.0 Introduction

The last ten years have seen a change in how companies think about the environment. They used to follow the rules or try to look good to the public.

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Now the environment is a big part of making important business decisions. Companies in all kinds of industries are trying to be responsible to the environment and to society. This is because there are rules to follow and people who buy things expect companies to be responsible. The United Nations has a list of goals called the Sustainable Development Goals. More and more companies are using Environmental, Social and Governance criteria to make decisions. So now companies really have to think about sustainability when they make choices. The automobile sector is very important when we talk about being sustainable. Companies in the automobile sector have to think about the environment and sustainability. The environment and sustainability are deals for companies in the automobile sector.

The environment is affected by a lot of things that we do and a lot of these things come from cars and trucks on the road. The automobile sector is something that the government wants to regulate. The automobile sector is also an area where new technology is being developed. People over the world and in India are starting to think that electric cars are a good way to reduce the bad things that cars do to the environment. People still need to get where they need to go and electric cars seem like a way to do this. The automobile sector is very important. In India a lot of things have come together to make people want to buy vehicles. For one thing the price of petrol and diesel has gone up a lot. So electric vehicles are starting to look like an idea, for people who want to save money. The government has also helped by creating the FAME scheme. The FAME scheme gives money to companies that make vehicles and to people who buy them. This makes the automobile sector more important. The automobile sector is something that people are paying attention to and the automobile sector is going to keep changing.

The automobile sector and electric vehicles are really important now. This is a time for companies to start making vehicles. The automobile sector and electric vehicles are really important. Tata Motors is leading the way in vehicles. They have models like the Nexon EV, Tiago EV and Punch EV. These models are popular in India's growing electric car market. Tata Motors talks a lot about being environmentally friendly in their ads. What Tata Motors says matches what they do making Tata Motors a good example to study how being sustainable helps sell vehicles. There are studies on marketing and electric vehicle trends but not many look at how they connect in India's car industry.

This paper tries to fill that gap by looking at Tata Motors sustainability efforts and how they relate to the growth of vehicles in India. Tata Motors efforts on vehicles and sustainability are worth examining. Their electric models, like the Nexon EV, Tiago EV and Punch EV are popular. They also focus on messaging in their brand communication. This makes them a good case study on how sustainability drives electric vehicle adoption in India. Tata Motors is making an effort to be sustainable. This is helping with electric vehicle uptake. India's electric car market is growing.

Tata Motors is a part of it. Their sustainability practices and electric vehicle models are connected to the growth of vehicles in India. Tata Motors and electric vehicles are a team. The automobile sector and electric vehicles are really important to Tata Motors. Tata Motors is doing a job with electric vehicles, like the Nexon EV, Tiago EV and Punch EV. The automobile sector and electric vehicles will keep growing in India. Tata Motors will be a part of this growth.

## **2.0 Literature Review**

### **2.1 Sustainable marketing**

Marketing has been really popular with scholars for the twenty years. Some people like Peattie and Belz thought about this a lot. They said that marketing is about making money. It is also about taking care of the environment and being fair to people. They believed that companies should think about sustainability all the time. Sustainability is not something that companies do it is a way of thinking. This way of thinking is about how companies interact with customers make products and talk to people. This means that companies have to think about how what they do affects the environment and people, in general. Companies have to think about marketing and how marketing affects the environment and society. Marketing is a part of this.

Kotler took this idea further by saying that marketing has changed over time. Marketing is not about getting people to buy things from a company. It is really about showing people what a company believes in and what it stands for. Kotler thought that when companies care about issues they can build strong relationships with customers who also care about these issues. Customers want to support companies that share the values as them. Sustainable marketing is about making connections between companies and customers in a way that helps both the company and society. Sustainable marketing is a way for companies to show that they care about things than just making money. Kotler said that companies can do this and it will be good for the company and, for society.

The implications for sustainability marketing are big. Sustainability marketing is something that many people care about younger people. Over the years there is more proof that supports the idea of sustainability marketing. Kumar and Gupta found in 2023 that companies that clearly and consistently talk about their sustainability credentials get customer loyalty and a better position in the market. Their work shows that sustainability marketing is not good ethics, but also good business for companies. It is actually a move for companies to focus on sustainability marketing.

This approach can bring in customers. Make a company stand out from other companies. Sustainability marketing is an area that businesses should focus on. Companies that do sustainability marketing well can see benefits, for their company and sustainability

marketing can help them. Sustainability marketing is something that can help companies and companies should focus on sustainability marketing.

## **2.2 ESG principles in corporate strategy**

The way companies think about taking care of the environment and society has changed because of Environmental Social Governance. Some people, Eccles, Ioannou and Serafeim did a study in 2014. They found out that companies that take care of the environment and society do better financially in the long run. This means that investors and company boards now think that taking care of the environment and society is a thing for business. It is not about spending money to help the environment and society it is about making smart decisions that can help the company. Some other people, Friede, Busch and Bassen did a study in 2015.

They looked at a lot of research on this topic. They found out that companies that do well with Environmental Social Governance also do well financially. So now companies are using Environmental Social Governance to make their businesses better not just because they have to follow rules. Taking care of the environment and society is very important for a company to do well in the run. Environmental Social Governance is not about doing good things it is also about making smart business decisions. Companies that use Environmental Social Governance tend to do financially. The evidence is clear: Environmental Social Governance and financial success are connected. Companies with Environmental Social Governance practices do better financially than companies, without them.

Their analysis found that sustainability integration works well in some places and industries. This makes a case for businesses to focus on sustainability. Some recent studies have emphasized how ESG disclosure affects a company's image. Companies that share information about their impact are seen as more responsible by their stakeholders. This good reputation helps build a brand. It also helps gain customer trust and improve business results. As a result, ESG reporting is not about following rules. It is a way to help companies succeed. ESG reporting helps companies to be more transparent and accountable. This transparency and accountability boost their performance. Companies that report on ESG regularly tend to do in the long run. ESG reporting is essential for businesses. It helps them demonstrate their commitment, to sustainability.

## **2.3 Drivers of electric vehicle adoption**

People are talking a lot about buying vehicles these days. This is because electric vehicles are no longer for a few people but for everyone. Many people think that there are a lot of things that affect whether people buy vehicles. These things include what the government does how easy it is to buy and own a vehicle what people think about electric vehicles and if the technology is good enough. NITI Aayog did some research on how

people move in India. They found out that things the government can do are really helpful. For example, helping people pay for vehicles not making people register them and giving tax breaks have made electric vehicles cheaper for more people to buy. If the government did not do these things, then a lot of people would not buy vehicles because they are expensive to buy at first. People also talk about vehicles and whether there are places to charge them. The thing, about vehicles is that people need to be able to charge them easily. Electric vehicles are what people are talking about. They want to know if they can charge their electric vehicles when they need to.

The thing that really matters to people when they think about buying vehicles is that they can charge them easily. If there are not many charging spots around people get worried that their electric vehicle will run out of battery power. This worry stops them from buying vehicles. Companies that help build charging spots are really helping people feel better about buying electric vehicles. People also like to buy vehicles from brands they trust. They feel good about buying vehicles when they know the company that made them will help if something goes wrong with their electric vehicle. If a company is known for being good, to the earth and responsible people are more likely to buy vehicles from them. This just shows that how a company treats its customers and the earth can make a difference in whether people want to buy electric vehicles or not. Electric vehicles are what people are looking at. The company that makes them has to be good too.

### **3.0 Statement of the Research Problem**

The automobile industry says it wants to be eco-friendly. Do they really mean it? Lots of companies in the automobile industry have to follow rules. If they do not follow these rules people might think they do not care about the environment. This can hurt their reputation. The automobile industry says they want to be sustainable. I wonder if they are really doing something about it or just saying it. Companies in the automobile industry have to be careful. If they say they care about the environment they have to care. The automobile industry is watched closely. If they say they are doing something to help the environment they have to do it. If they do not, they can get in trouble. The automobile industry can also lose customers if they seem like they do not care about the environment. The automobile industry has to show that they really care about the environment.

Tata Motors is saying a lot about being more sustainable. They are making promises to use vehicles and clean energy in their factories. They also want to manage their suppliers in a way. We need to look to see if they are really doing these things or if they are just saying it. They are working on a plan for mobility. They also want to use energy when they make things. They talk about being responsible when it comes to their suppliers. The question is, are they really changing or is this just to look good?

India's electric vehicle market is growing fast. What is making this happen? Is it because companies like Tata Motors are trying to be more sustainable? Is it something else? Companies, like Tata Motors are doing things to help the environment. This study will look at what Tata Motors is doing to help India's electric vehicle market grow. Tata Motors is a part of India's electric vehicle market so it is a good example to look at. They are doing things like making vehicles and using clean energy. We will see how these things are helping the market grow. Tata Motors is really involved in India's electric vehicle market so we can learn from them.

#### **4.0 Scope of the Study**

This study is about Tata Motors. How they do sustainability marketing in India. It is about Tata Motors and does not talk about other car companies. We are looking at the electric vehicle market in India from 2020 to 2025. So we are going to see what Tata Motors did for sustainability marketing in the electric vehicle market during this time. The study is not about what other automobile companies do for sustainability marketing. We are only talking about the electric vehicle market. This study looks at what Tata Motors did for sustainability marketing in India from 2020, to 2025. Tata Motors is the company we are looking at and we want to know how they did sustainability marketing in the Indian electric vehicle market. All the data used is secondary. It comes from Tata Motors sustainability and annual reports, government documents, industry reports and academic studies. We did not collect any data, such as surveys, focus groups or interviews for this study. The research is focused on the electric vehicle strategy and sustainability marketing of Tata Motors. It does not look at everything that Tata Motors does like the vehicles they make or what they do in other countries. The research is about electric vehicle strategy and sustainability marketing of Tata Motors.

#### **5.0 Research Objectives**

- To examine the sustainability marketing initiatives and practices adopted by Tata Motors in promoting electric vehicles in India.
- To analyze the growth trend of electric vehicle (EV) sales in India from 2020 to 2025.
- To identify the factors influencing Indian consumers' adoption and non-adoption of electric vehicles.

#### **6.0 Research Methodology**

##### **6.1 Research design**

This study looks at how companies market sustainability and how people buy vehicles. It uses information that already exists to understand what companies are doing to

market sustainability and how people are buying vehicles. The study also tries to figure out how these two things are connected to each other which is sustainability marketing and electric vehicle adoption. The people doing the study want to see if they can learn something, about sustainability marketing and electric vehicle adoption by looking at the information they have.

## **6.2 Nature of data**

The research is based on information that already exists. This decision is because the study wants to put what we already know about the topic, rather than finding out new things. The research is focused on the existing information. The study is looking at what other people have already discovered about the topic of research.

## **6.3 Data sources**

I collected information from some good sources. These sources were chosen because they were relevant and recent. They also came from institutions that people trust. I looked at the reports that Tata Motors published and what they said about being sustainable. There were some reports from NITI Aayog that talked about their plan for vehicles. The Ministry of Heavy Industries put out some publications, like the papers on the FAME scheme. The Society of Automobile Manufacturers which is also known as SIAM released some numbers and statistics. I read some articles from journals that other people wrote about management and sustainability. Some companies, like Bain & Company and JMK Research and the International Energy Agency did some analysis of the industry and Tata Motors and electric vehicles and sustainability.

## **7.0 Data Analysis and Interpretation**

### *Objective 1: Tata Motors' Sustainability Marketing Practices*

Tata Motors has a plan to be more sustainable. They want to make things better for the environment. The main idea of Tata Motors is to make and sell vehicles that people like. Tata Motors started selling the Nexon EV. Then they added more electric cars like the Tiago EV and the Punch EV. The Tiago EV is for people who have a lot of money to spend on a car and the Punch EV is for people who, like SUVs. Tata Motors is doing all of this so that regular people can buy Tata Motors cars, not people who have a lot of money. Tata Motors wants to make sure that everyone can buy a car from Tata Motors.

Tata Motors has a way of telling people about their cars that's really interesting. They talk about how they use technology and also take care of the earth. When you see their advertisements or visit a dealer or look at their website, they all say that buying a car from them is good for the planet. This is something that experts think is a way to sell things by

saying that the company cares about something. Tata Motors is also working with companies that build special stations where you can charge your electric car.

This is helpful because some people might be worried, about not being able to drive their cars very far. They want to make it easy for people to buy and use cars. Tata Motors wants people to like their cars so they are showing that they care about the earth and technology. They think that if they can show people that they are a company that cares then people will want to buy their cars. Tata Motors is trying to make cars something that people want to own.

#### *Objective 2: EV Sales Growth in India (2020–2024)*

The following table presents compiled data on electric vehicle sales in India over the study period:

**Table 1: Electric Vehicle Sales in India (2020–2024)**

Year	EV Units Sold (Approx.)
2020	1.7 lakh
2021	2.3 lakh
2022	4.3 lakh
2023	12.4 lakh
2024	20.0 lakh

*Source: Compiled from SIAM, JMK Research, and Ministry of Heavy Industries reports.*

The numbers show a growth curve that's really steep and steady. From 2020 to 2021 the COVID-19 pandemic caused problems. The market was still new so the growth of the numbers was not much. The growth of the numbers got much bigger from 2021 to 2022. This happened because Phase II of the FAME scheme started from 2021 to 2022 and people started feeling better, about the COVID-19 pandemic and the pandemic restrictions eased so people started spending money and the growth of the numbers got much bigger.

#### *Objective 3: Factors Shaping EV Adoption*

When we look at the things that people have written about and the numbers, from the industry we can see that there are five things that are connected to each other and that help decide if people will start using Electric Vehicles. These five things are the reasons why people will use Electric Vehicles. The five things are what make people want to use Electric Vehicles.

- The government is helping people buy vehicles by giving them money and lowering the cost of registering the vehicle. They also do not have to pay much income tax. This means that more people can now afford to own a vehicle.
- The price of petrol and diesel keeps going up. This is a good reason for people to switch

to electric vehicles. People who have to drive a lot like those who drive to work every day or companies, with vehicles will save money by using electric vehicles.

- **Awareness:** People are really worried about the air they breathe in cities and they care about the earth. This means they like products and brands that're good for the environment. Environmental Awareness is a deal now. People want to buy things that're sustainable.
- **Charging Infrastructure Expansion:** There are more places to charge electric vehicles. You can charge them in cities and on highways. This is helping people feel better about buying vehicles. They were worried they would not be able to charge their cars when they needed to.
- **Brand Trust and After-Sales Confidence:** When people trust the company that makes the vehicle they are more likely to buy one. They want to know that the company will help them if they have problems with their car. They want to know about the warranty on the battery. If the company will be around to help them for a long time. Brand Trust and After-Sales Confidence are very important, for people who want to buy vehicles.

## **8.0 Findings and Results**

### **8.1 Sustainability as a strategic commitment**

The analysis shows that Tata Motors really cares about being sustainable. They are not just talking about it. Tata Motors spends a lot of money on making products. They also improve their manufacturing process. They work with others to build infrastructure. This shows Tata Motors is serious about sustainability. They have been working on it for a while. Tata Motors is not just doing this for a profit.

They are in it for the haul. Sustainability is how Tata Motors competes with companies. It's a part of their strategy. Tata Motors is committed to sustainability. They make it a priority. The company is putting in a lot of effort into sustainability. Their actions show this, not their ads. Tata Motors wants to make a difference. They are doing their part to be sustainable. This helps Tata Motors and everyone else too. It's a thing. It is good for Tata Motors. It is good, for everyone.

### **8.2 Rapid expansion of the EV segment**

India's EV market has grown at a pace that outstrips many early projections. This growth has been underpinned by a favorable policy environment, increased product availability across price points, and a gradual improvement in supporting infrastructure. Tata Motors has been a primary beneficiary and driver of this growth, consistently holding a significant share of passenger EV sales.

### **8.3 Sustainability reinforces brand credibility**

People these days think a company is trustworthy if it cares about the environment. For Tata Motors saying they want to be sustainable and then actually doing it has made people believe in the company. This means people are more likely to think of Tata Motors when they want to buy a vehicle and they will keep coming back, to the company. Tata Motors has done a job of showing people that they really care about the environment and this helps them sell more electric vehicles.

### **9.0 Conclusion**

This study checks how sustainability and electric vehicle adoption are linked using Tata Motors in India as an example. Sustainability is now a goal for car companies. They are working hard to be sustainable. Tata Motors is making its vehicles in a way. They are also building charging stations. The company talks about how much it cares about the environment. This shows what sustainability means. The evidence suggests that this approach has helped people trust Tata Motors electric vehicles. It has also put the company in a position for the future. The electric vehicle market in India is growing rapidly. It used to be small. Now it is one of the biggest in the world. Tata Motors and electric vehicle adoption are moving in the direction as the market and its rules.

Tata Motors and sustainability are connected. The company is making choices, such as investing in electric vehicle products and cleaner manufacturing. This helps both the company and the environment. The growth of vehicles has been driven by many factors, including government actions and rising fuel costs. Corporate sustainability marketing plays a role in shaping consumer perceptions and making them feel good about buying electric vehicles. Companies that consistently show they care about the environment will likely stay ahead as more people switch to cars. To learn more it would be helpful to research what consumers and marketing professionals think. This could involve talking to them It would also be useful to compare Tata Motors approach with that of car companies in India and, around the world. This would help determine if they are all taking steps.

### **10.0 Limitations**

1. The study only uses existing information. We cannot verify if Tata Motors claims of being match reality. This is because we do not have first-hand information. The study relies on what's already available. So we have to take Tata Motors words for it when they say they are sustainable. The study does not provide a picture of Tata Motors sustainability, on the ground. It only uses what is already there. Tata Motors sustainability claims are not checked in this study.

2. The research only looks at Tata Motors. Does not consider what other car companies are doing. If we looked at companies, we might get a better idea of how Tata Motors is doing compared to them.
3. The analysis is based on what Tata Motors has made public. So the results depend on how complete and accurate the information, from Tata Motors. There might be things that Tata Motors is doing for sustainability that we do not know about because Tata Motors has not made this information public.

### **11.0 Recommendations**

1. The people who make cars should work with the people who make electricity and the people who plan cities and the government to get more charging stations built. The car makers and the electricity makers and the city planners and the government all need to work to make this happen. We need charging stations for the cars. The car makers and the electricity makers and the city planners and the government should build charging stations.
2. Companies need to be more open and honest, about how they're doing with the environment and social things so people can really see if they are doing a good job.
3. The government should keep helping people buy vehicles by giving them money so it is easier for people to afford them even when more people are buying them.
4. The car companies and the government should teach people about vehicles. This is because people need to understand that vehicles are good. Vehicles can go far without needing to be charged. The car companies and the government should tell people that vehicles do not cost much to run. People should know that vehicles are an option. The car companies and the government should teach people more about vehicles so they can see that vehicles are a choice.

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# CHAPTER 15

## A Comparative Analysis of Spending Patterns on Google Pay and PhonePe

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### ABSTRACT

The rapid adoption of Unified Payments Interface (UPI) applications in India has transformed consumer payment behaviour, leading to increased use of multiple digital payment platforms by individual users. This study examines why users split their spending between Google Pay and PhonePe, focusing on functional, psychological, and platform-related factors. Using a descriptive research design, the study analyses user spending allocation, interface preferences, and merchant ecosystem influence on platform loyalty. Primary data collected through structured questionnaires is supported by secondary literature on digital payment behaviour. The findings indicate that users adopt a rational allocation strategy based on convenience, perceived reliability, rewards, and merchant acceptance rather than exclusive platform loyalty. The study highlights that multi-app usage is a deliberate and efficient consumer behaviour in India's evolving digital payment ecosystem.

**Keywords:** UPI Multi-App usage, Digital payment behaviour, Platform loyalty.

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### 1.0 Introduction

India has witnessed an impressive evolution in the payment system over the last decade. The introduction of the Unified Payment Interface (UPI) by the National Payments Corporation of India (NPCI) in 2016 has revolutionized the way financial transactions are conducted. It allows users to transfer money in real time, in an absolutely secure manner, and at negligible costs. As per reports by the Reserve Bank of India (RBI) and NPCI, the volume of transactions conducted by the UPI has risen from an insignificant number in 2016 to an impressive count of billions of transactions in recent years. This is not just an example of the evolution of technology but is also indicative of an evolutionary change in consumer Behavior.

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Some of the prominent players in the Indian digital payment market include Google Pay and PhonePe, each holding a substantial market share. It has been observed that these digital payment applications not only enable peer-to-peer transactions but also offer various services such as bill payments, mobile recharge, merchant payments, financial services, insurance, etc. Although both applications offer similar services, there is a difference in terms of user interface as well as reward points. Additionally, both applications differ in terms of integration as well as the provision of further financial services. It is interesting to note that rather than showing loyalty towards a specific application, the majority of the population has the ability and knowledge to utilize both applications in an effective manner. This phenomenon is known as ‘spending split,’ showing a paradigm shift in the concept of brand loyalty.

The conventional paradigms for the research of consumer Behavior, as defined in the classical theories of consumer Behavior, highlight that a consumer generally evinces brand loyalty towards a given brand. However, in the digital payment domain, the empirical observations highlight a different trend wherein the consumers utilize different digital payment applications. Instead of spending on a single predominant digital payment application, the consumers rationally spend on different digital payment applications in accordance with the contextual factors. This highlights that the consumption of digital payment applications is now governed by the factors of efficiency instead of brand loyalty. The existing literature highlights the relevant insights for understanding the consumer Behavior in the context of digital payment applications.

Specifically, the usability, simplicity of the interface, and security of the digital payment applications emerge as relevant factors for the adoption of digital payment applications. For example, in one study, it was found that consumers prefer PhonePe over Google Pay because it offers a number of financial services, including entertainment payments and mobile recharge. At the same time, Google Pay has been found to be a secure payment application. The study conducted among 120 students found that 56.67 percent of the respondents preferred PhonePe over Google Pay, indicating a significant difference in terms of satisfaction level ( $p = 0.020$ ). The study conducted among 1,000 consumers found that convenience is strongly correlated with recommendation. The study conducted using UTAUT2 theory among 618 consumers found that facilitating conditions play a significant role in influencing consumers’ behavioural intentions.

However, whereas many studies have compared aspects of satisfaction, factors of adoption, and behavioural intentions of consumers across different apps, there is limited research that has been conducted to understand the rationale behind the planned division of expenditure across Google Pay and PhonePe. The studies conducted so far have mostly focused on determining which of these two is better, whereas there is a lack of studies focusing on the co-existence of these two apps by the consumers themselves.

This study aims at filling the existing gap in research by understanding the different determinants that affect the consumers in terms of functionality, psychology, and application in terms of division of expenditure across Google Pay and PhonePe. For this study, a descriptive research design has been adopted, in which the primary data collected in the form of questionnaires has been analysed. Literature has been used to justify the conceptual understanding of this study.

This study is of significant importance in the context of the evolving digital landscape of India. The digital landscape of India is witnessing stiff competition in fintech apps, making it imperative for consumers to understand consumer Behavior in order to take strategic decisions. The findings of this study reveal that the use of multiple apps is not random but is an Intentional and efficient consumer strategy aimed at maximizing utility, minimizing risks, and maximizing satisfaction. optimizing rewards. Rather than

Thus, showing low loyalty, the customers display rational financial decision-making by exploiting the advantages of the two platforms. This research makes a significant contribution to the body of knowledge concerning digital payment system Behavior by moving the focus from the preferred platform to the allocation strategy of the two platforms. By examining the rationale behind the allocation of funds between Google Pay and PhonePe, the research gives us insight into rational customer Behavior, competition between the two platforms, and the changing dynamics of the Indian digital payment system.

## **2.0 Literature Review**

In the comparative study of PhonePe and Google Pay in the year 2025, Chirag Tyagi discusses how the spending of 60 users is distributed according to their preferences and values for features, ease of use, and security in the respective apps. In the study “Comparative Study on Customer Adoption and Satisfaction towards PhonePe and Google Pay among Higher Education Students in Sagar City” by Megha Bhoote and Dr. S. Murilidhar in the year 2026, the authors conclude that out of the total participants in the study, 56.67% prefer PhonePe over Google Pay for spending on entertainment and recharges, while Google Pay is more popular among the participants for security aspects.

However, there is a significant difference in satisfaction levels between the two apps. The authors have not mentioned the reasons behind the spending pattern of the participants using both apps. In the exploration of digital payments in FinTech in the year 2025, Lokesh S. and Dr. Sasirekha K have mentioned the popularity and challenges faced by Google Pay and how users are attracted to this app. However, the reasons behind the spending pattern are not mentioned in this study either. In the year 2026, the study “Influence of Promotional Policies and Schemes Introduced by Digital Wallet Services on

Consumer Spending Patterns” discusses the spending pattern of PhonePe users and is authored by Riaan Nair and Jyotsana Munshi. However, the reasons behind the spending pattern are not mentioned in this study either. In the year 2025, the comparative study of customer satisfaction in urban areas compares the satisfaction levels of the users with PhonePe and Google Pay and is authored by Rahul Kumar Sahu.

Thirupathi Manickam, G. Vinayagamoorthi, and S. Gopalakrishnan (2022) examined the experience that customers get when they use a mobile wallet. This research highlights the experience that customers get when they use digital payment applications such as Google Pay and PhonePe. Dr. Rekha Kumawat (2025) examined the Indian digital payment landscape and highlighted the experience that customers get when they use mobile payment applications such as Google Pay and PhonePe. This research indicates that the increase in the number of digital payment systems and the number of people using these applications has led to a greater percentage of the Indian payment landscape moving towards these applications.

Mohd Saim (2025) examined the experience that customers get when they use digital payment applications such as Google Pay and PhonePe. This research indicates that the experience that customers get when they use these applications is a result of the convenience that these applications provide to the customers. Jyoti Lamba and Maya Yadav (2025) examined the experience that customers get when they use digital payment applications such as Google Pay and PhonePe. This research indicates that the experience that customers get when they use these applications influences the spending habits that customers adopt. Roktim N. Dhiman and Honey Kanojia (2021) examined the experience that customers get when they use digital payment applications such as Google Pay and PhonePe. This research indicates that the experience that customers get when they use these applications is a result of the convenience that these applications provide to the customers.

Most existing research on digital payment platforms focuses on customer satisfaction, adoption, and which app the customer prefers to use—Google Pay vs. PhonePe, for instance. Researchers usually compare the features, usability, security, and rewards offered to determine which app the customer prefers to use. While these research papers provide insights into what could be the reason for a customer to prefer a particular app over another, the most common Behavior observed among customers in recent times is that customers do not prefer to use only one app for digital payment. Instead, they prefer to use both Google Pay and PhonePe for different kinds of transactions. This Behavior has not been extensively analysed in most existing research.

What is the missing link in the motivation behind the intentional distribution of transactions across two platforms and not just one? While in reality, there is a cashback offer, ease of use, and acceptance by merchants and past experiences with an app that cause users to switch between apps, there is limited research into this aspect of multi-app

spending Behavior. The purpose of this study is to fill this information gap by exploring the reasons behind the distribution of spending between Google Pay and PhonePe and the various factors that affect this.

### **3.0 Research Methodology**

The present research will follow a descriptive and analytical approach in understanding the factors that prompt people to use two or more apps for their transactions with Google Pay and PhonePe. The research aims at identifying the functional and psychological factors that prompt people to have more than one UPI app, how people segregate different types of transactions between the two apps, and how the interface of the apps and the strength of the merchant ecosystem contribute to partial loyalty towards the platform. The research is based on the principles of empirical research, which is based on actual observations and fresh data from the respondents. For the present research, the primary data has been collected with the help of a structured questionnaire prepared using Google Forms and circulated among the active UPI users of both the apps. So far, the research has obtained 52 responses from the respondents using the two apps in the Indian market. Convenience sampling has been used for the present research, where the respondents have been selected based on their accessibility and willingness to participate in the research. Even with a limited number of responses, the research provides significant behavioural knowledge of the people using two apps for their transactions.

Besides the above data, we have used secondary data sources like research papers, RBI reports, reports published by the fintech industry, and reports published on digital payments to strengthen the theoretical framework. The data collected was analysed using percentage analysis and a comparative approach to identify trends, preferences, and the reasoning behind the allocation of funds between the two platforms. Basic statistical analysis was used to identify the difference in satisfaction and Behavior.

The study aims to cover active users of Google Pay and PhonePe platforms for peer-to-peer transactions, bill payments, payment of online shopping bills, and offline transactions. The study has been restricted to these two platforms to ensure a meaningful comparison. Other prominent players like Paytm and BHIM have not been considered for the study. The study has been conducted for the Indian population, with a greater focus on the urban and semi-urban population, where the usage of UPI has been higher.

This research provides practical and real-world knowledge regarding how Indian consumers interact with the Indian digital payment system, while at the same time being aware of the limitations of the system. The fact that the research only has 52 respondents may not be enough to cover the whole scope of all the UPI system's users in the Indian market. Convenience sampling may have limitations in the form of bias, where the sampled

people may have similar demographic or behavioural factors. The fact that the research only relies on self-reported data may be limited by the fact that people may respond based on how they perceive themselves or may not recall the information as required. However, the research provides insight into how Indian consumers behave in the Indian digital payments system and why they diversify their spending habits.

#### 4.0 Discussion and Data Analysis

The data shows that the majority of the respondents belong to the 20-25 age bracket, making this the most active category when it comes to digital payment. It is evident that men dominate the user base, but the number of women using digital payment services is substantial. It is evident that the majority of the respondents use UPI services at least multiple times a day. It is evident that Google Pay is popular, but a significant number of the respondents have used both services.

**Table 1: Demographic Profile and Usage Behaviour of Respondents**

Variable	Category	Frequency	Percentage
<b>Age Distribution</b>	Below 20	9	16.7%
	20–25	26	48.1%
	26–30	8	14.8%
	31–40	4	7.4%
	Above 40	7	13.0%
<b>Gender</b>	Male	33	61.1%
	Female	21	38.9%
<b>Frequency of UPI Usage</b>	Multiple times a day	43	79.6%
	Once daily	5	9.3%
	Few times a week	5	9.3%
	Occasionally	1	1.8%
<b>Most Frequently Used App</b>	Google Pay	29	53.7%
	PhonePe	14	25.9%
	Both equally	11	20.04%

Source: Survey Data

The indicates that most of the behavioural statements are grouped around a mean of 4 or higher, which is an indication of general agreement among the respondents. Performance in terms of functionality is significant, as Google Pay is associated with speed, while PhonePe is associated with the success of transactions. Rewards and cashback are also factors in the decision. These are all factors that demonstrate the role of strategic

decisions in the Behavior of digital payments. People are also inclined towards using more than one application, as they perceive that having more than one option makes the chances of a failed transaction low. The interface is significant, with high mean values showing the importance of the role of simplicity in the preferred application.

**Table 2: Mean and Standard Deviation of Behavioural Factors Influencing Multi-App Usage**

Statement	Mean Score	Standard Deviation
<b>Functional Performance Perception</b>		
Google Pay offers faster transaction processing compared to PhonePe	4.13	0.93
PhonePe provides a better transaction success rate	3.65	0.93
<b>Influence of Rewards and Promotional Incentives</b>		
Rewards and cashback influence which payment app I choose	4.09	0.93
<b>Multi-App Usage as a Risk Reduction Strategy</b>		
I switch to another app if one app becomes slow or fails	4.07	0.88
Using multiple UPI apps reduces the risk of transaction failure	4.02	0.90
<b>User Interface Influence on Platform Preference</b>		
Google Pay has a more user-friendly interface than PhonePe	4.07	0.92
App design and ease of navigation influence my choice of payment app	4.00	0.89
<b>Merchant Ecosystem Influence</b>		
PhonePe has wider merchant acceptance	3.78	0.95
Merchant acceptance determines which payment app I use at a store	3.96	0.91

Source: Survey data

**Table 3: Correlation Matrix of Key Behavioural Variables**

Variables	Rewards Influence	App Design Influence	Merchant Acceptance	Habit Influence	Multi-App Comfort	Deliberate Multi-App Usage
Rewards Influence	1.00	0.77	0.51	0.41	0.15	0.31
App Design Influence	0.77	1.00	0.44	0.36	0.28	0.37
Merchant Acceptance	0.51	0.44	1.00	0.29	0.26	0.21
Habit Influence	0.41	0.36	0.29	1.00	0.33	0.32
Multi-App Comfort	0.15	0.28	0.26	0.33	1.00	0.38
Deliberate Multi-App Usage	0.31	0.37	0.21	0.32	0.38	1.00

Source: Survey data

The results of the correlation analysis indicate that there are significant correlations between the behavioral factors that influence the use of multiple apps. Notably, the analysis indicates a high and positive correlation between rewards influence and app design preference, implying that the two factors are closely related in the sense that people who are

influenced by rewards are likely to be influenced by the design of the apps. Additionally, the analysis indicates that merchant acceptance is correlated with reward-based behavior, implying that people are likely to use a platform that is not only associated with rewards but is also accepted by most merchants. Habit formation is correlated with intentional multi-app usage.

## **5.0 Conclusion**

The study examined the reasons behind the practice of users of digital payment systems using multiple digital payment systems and spreading their transactions over multiple platforms like Google Pay and PhonePe, rather than using only one app. The study found that the practice of using multiple digital payment systems is quite common and is the result of both the features of the digital payment system and the psychology of the users. Moreover, the study also reveals that rewards and promo offer play an important role in the practice of users using multiple digital payment systems. On the other hand, the study reveals that the features of the digital payment system, such as the ease of using the app, the users' familiarity with the app, and their trust in the app, are also important factors for the practice of users using multiple digital payment systems. The study reveals that the practice of users using multiple digital payment systems reduces the risk of transactions for the users.

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## CHAPTER 16

### The Impact of Green Marketing on Consumer Purchase Intention: Promoting Sustainable Buying Behaviour

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#### ABSTRACT

In recent years, environmental sustainability has become an important concern for both companies and consumers. As people become more aware of issues such as pollution and climate change, many businesses are promoting products that are safer for the environment. This approach is commonly known as green marketing. It involves highlighting eco-friendly features such as recyclable packaging, reduced waste, and sustainable production methods. The purpose of this study is to examine how green marketing affects consumers' willingness to buy products. Based on findings from earlier studies, factors like environmental awareness, trust in a brand, and effective green advertisements can encourage consumers to choose environmentally friendly products. At the same time, misleading claims about sustainability may reduce consumer confidence. The study shows that honest and well-planned green marketing can strengthen customer relationships and support sustainable consumption.

**Keywords:** Sustainable consumption, Customer relationships, Green marketing, Recyclable packaging.

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#### 1.0 Introduction

Climate change is a problem. Pollution is another one. We are using up resources too fast. These things are making people worry about the earth. So, companies are feeling the heat to be more careful about how they do business. They need to think about the future. Sustainability is not something you do on the side anymore. It is a part of how companies make decisions. Marketing is very important. It helps shape what people think and what they buy. One-way companies are doing this by using marketing. With marketing companies tell people about the good things their products do for the environment. Climate change and pollution are still problems, but green marketing is one-way companies are trying to help. Companies are promoting products that're good for the environment.

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Today a lot of people care about how companies treat the environment. People usually like brands that use practices and really try to reduce environmental harm. The decision to buy products is not just about the environment. Things like the price of the product how good it is, how easy it is to get and whether or not people trust what the company says also affect what people buy. People think about all these things when they decide to buy products, like green products. For this reason, it is important to understand how green marketing affects purchase intention. This study focuses on the relationship between green marketing practices and consumer behavior and explains how responsible marketing can encourage more sustainable buying habits.

## **2.0 Objectives**

1. We want to learn about marketing and how it helps with being sustainable.
2. We need to look at how green marketing strategies affect what consumers want to buy and see if it really changes their minds about making a purchase when it comes to marketing.
3. We want to figure out what makes people react to marketing that's good for the environment.
4. We need to see how marketing that is good, for the environment, which is also called marketing helps with sustainability and green marketing.

## **3.0 Review of Literature**

Many people have looked into marketing and how it relates to sustainability. Green marketing is about promoting products that are made, packaged and sold in a way that doesn't hurt the environment. Some studies say that green marketing involves things like designing products that're good for the environment using sustainable packaging and making ads that talk about the environmental benefits of products. Green marketing is about being kind to the environment. Earlier studies have shown that green marketing includes activities such as designing eco- products using sustainable packaging and making advertisements that highlight environmental benefits of the products. Green marketing is connected to sustainability and people who do green marketing focus on sustainability.

People who study this stuff have found that green marketing is connected to development. Sustainable development is about making sure we can meet our needs today without hurting the chances of people in the future. Companies that do this kind of thing tend to do for the earth and they also look better to people. A lot of studies have shown that when people care about the environment it really affects what they think about products.

Green marketing is important because it helps companies make products that people want to buy. The Theory of Planned Behavior says that what a person thinks, what other people think and how control they have over a decision will affect what they want to buy. When companies use advertising put eco-labels on things and get sustainability certifications people are more likely to trust them and feel good about buying things that are good for the environment. But some people have found out that companies are not always honest they say their products are good for the environment when they are not this is called greenwashing. When companies do this people do not trust them anymore. It does not work to sell things in a green way. Now people are saying that when companies tell the truth and are transparent people like it. Respond well to it. So, it seems that when companies do marketing in a real way it can really help people make choices that are good for the environment and that is what The Theory of Planned Behavior and green marketing are all about they are, about helping people make good choices.

## **4.0 Research Methodology**

### **4.1 Research design**

This study is based on a research design. The main goal of this study is to find out how green marketing affects what people buy. To do this we will look at things that other studies have already found out about marketing and how it influences consumer purchase intention. We will examine the patterns and findings from these studies to understand how green marketing influences consumer purchase intention.

### **4.2 Research approach**

This study is based on an idea and it breaks down information. We looked at ideas and what other people found out about being sustainable and how people buy things and what is called green marketing. We used these things to figure out what to talk about. The study looks at what people do when they buy things and how this is connected to sustainability and green marketing. We also looked at what other people found out about these things to help us understand them better. The research approach is about understanding what sustainability and green marketing mean to people and how they make choices, about what to buy.

### **4.3 Data collection**

This study only uses information that already exists. The information was found in research papers, school journals, books and special reports, about marketing and what people buy.

#### **4.4 Sampling method**

This study uses sources but for future research a different approach could be used. Convenience sampling could help gather data from people who know about eco- products and sustainability. These people could be students, professionals or regular consumers who care about the environment. Using this method researchers could get an understanding of what these groups think about green products.

#### **5.0 Green Marketing and Sustainability**

Green marketing is about telling people how good a product or service is for the environment. This can be things like packaging that can be recycled making things in a way that uses energy getting materials from places that do it in a good way and ads that talk about being sustainable. The idea of marketing is really close to the idea of sustainable development because it helps businesses get bigger without hurting the environment too much. Green marketing also goes along with the bottom-line idea, which cares about people, the planet and making money. When companies do marketing, they are encouraging people to buy things that are better for the environment. At the time green marketing encourages companies to throw away less save natural resources and make things in a cleaner way. Green marketing is a way to get people to think about the environment when they buy things. It helps companies to be more responsible, with green marketing.

#### **6.0 Green Marketing Strategies in Modern Business**

Green marketing strategies are really important for businesses these days. They want to make money and also be kind to the earth at the time. So companies are trying to be more eco-friendly by doing things like reducing their carbon footprints and using energy. They are also designing packaging that can be recycled. This is because a lot of people care about the earth and want to buy things from companies that do too.

Companies are doing these things not just because they have to follow the rules. Because they want to show people that they really care about the earth. They want to build trust with their customers and keep them happy for a time. For example, some brands talk about how they get their supplies in a way that's good for the earth. They are also open about how they use resources. They get special certifications to prove that they are green. This helps them stand out from companies and makes people want to buy from them.

By doing all these things companies can make their brand look better and also find ways to make money in areas where people care about the earth. Green marketing strategies are a part of this. Companies use green marketing strategies to show people that they are committed to being eco-friendly. Green marketing strategies are important for businesses because they help companies make money and be kind to the earth.

At the time green marketing uses new ideas to balance what is good for the environment with what customers want. Companies use labels to show their products are good for the environment they do campaigns for good causes and they tell stories online to show people what they are doing to be sustainable. They also do things like give people rewards for recycling invest in ways to reuse products and sell products that use energy. This helps companies show that they care about the environment and want people to consume things in a way. It is important to note that green marketing is not about doing things that look good it is about making sustainability a part of what the company is and how it works. This change shows that taking care of the environment is not just the thing to do it is also good for business and helps companies be ready for the future. Green marketing is about making sure that companies are doing things that're good for the environment and good for customers at the same time.

## **7.0 Smart Technologies in Sustainable Marketing**

Artificial Intelligence and predictive analytics are useful tools for marketers. They help marketers make ads that're just right for people who care about the environment. Artificial Intelligence and predictive analytics are great because they tell marketers what people like. Big data analytics is also very important. It shows what people are interested in and how people are behaving. Big data analytics helps companies make guesses about what will happen in the future. This means companies can cut down on waste when they make things. Artificial Intelligence and predictive analytics are helpful in ways.

Artificial Intelligence and big data analytics are really important in this situation. Then there is Blockchain technology. Blockchain technology is great because it lets people see where products come from and how they were made. The thing about Blockchain technology is that it also helps people understand the impact these products have on the environment. Blockchain technology is useful for this.

So, all these technologies like Artificial Intelligence and Blockchain technology are making marketing for products more honest and personalized. This means people can trust these products more which's good, for businesses that want to sell sustainable products.

## **8.0 Impact on Consumer Awareness and Buying Behavior**

Green marketing really affects how people think about a brand. If they want to buy what the brand is selling. When people think that a company really cares about the environment, they start to like the brand. People who already care about the environment are more willing to support companies that do things in a way that's good for the earth. People need to trust a company so they are more likely to buy things when they believe

what the company says is true. People do not just think about the environment when they are buying things. The price of a product whether it is available if it is quality and if it is easy to get also matter. Some people might not believe what a company says about being sustainable. So, companies need to make sure that what they say about being green is honest and real. Green marketing is important for companies. They need to do it in a way that people can trust, like green marketing.

## **9.0 Discussion**

Green marketing is a part of what companies do now. It helps them tell people about products that're good for the environment. Green marketing also helps companies build relationships with people who really care about the earth. But for green marketing to really work companies have to be honest about what they're doing. If companies say they are doing more for the environment than they really are people will stop trusting them. Companies need to be clear about what they're doing and actually try to be sustainable. This is the way they can get people to trust them for a long time. Green marketing is important. Companies need to do it in a genuine way.

## **10.0 Conclusion**

This study shows that green marketing is a way to get people to buy products that are good for the environment. People are becoming more aware of the problems with the environment. They like brands that do things the right way. The things we looked at in this study show that green marketing works well when it is done in a way that people trust. When businesses are honest, about what they're doing to help the environment and they tell people about it they can do better in the market and also help keep the environment clean. Green marketing is important because it helps people know that a company is doing things for the environment like green marketing.

## **11.0 Limitations of the Study**

1. This study is based on information that other people have already collected.
2. The results of the study may not show how every single consumer behaves.
3. The way a consumer behaves can be different because of the culture they come from and how money they have.
4. People in places have different ideas about taking care of the environment.
5. Consumer behaviour in the future may change because people are becoming more interested in sustainability fast.

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## CHAPTER 17

### Diversity, Equity, and Inclusion in India's Service Economy: Structural Practices, ESG Sustainability, and the Awareness–Implementation Gap

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#### ABSTRACT

India's service sector is home to more than half the country's urban workforce — yet whether those employees actually feel like they belong at work is a question that hasn't received nearly enough empirical attention. This paper sets out to answer it by testing which organisational DEI practices most meaningfully predict employees' felt sense of inclusion. Drawing on primary data from 102 service-sector workers across IT/ITES, banking, education, healthcare, and hospitality, we examined four theory-grounded hypotheses covering equal opportunity systems, leadership representation, identity expression, and DEI training. Multiple regression (Model 1:  $R^2 = 0.531$ ) showed all three structural practices matter, but not equally: equal opportunities ( $\beta = 0.368$ ) and leadership representation ( $\beta = 0.334$ ) drove inclusion far more than DEI training ( $\beta = 0.191$ ) when all were in the model together. The awareness picture was also striking — 77.5% of respondents knew what DEI means, but only 51% said their organisation actually promotes it, and a mere 17.6% received it through regular training. That gap between knowing and doing is the central problem this paper addresses. Internal reliability was strong ( $\alpha = 0.811$ ) and principal component analysis supported treating perceived inclusion as a single construct. The paper closes by connecting DEI to the social pillar of ESG, arguing that inclusion is not a soft aspiration but a measurable, reportable performance dimension — one that India's BRSR mandate is beginning to formalise.

**Keywords:** DEI implementation, Employee inclusion, ESG social pillar, Indian service economy, Leadership representation, Organisational equity, Perceived inclusion.

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#### 1.0 Introduction

Something shifted in how Indian organisations think about diversity, equity, and inclusion (DEI) over the last few years — and it wasn't just cultural.

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Investor pressure for ESG performance, combined with McKinsey's widely cited 2020 evidence that diverse teams genuinely outperform homogeneous ones, pushed DEI from a voluntary aspiration into a business priority. Then came the regulatory piece: India's top 1,000 listed companies are now required under the Business Responsibility and Sustainability Reporting (BRSR) framework to report DEI metrics, effectively converting inclusion from an optional value statement into an accountability obligation (Sreedhar & Nayak, 2024).

This matters most in the service sector — the part of the economy that generates roughly 55% of India's GDP and employs the bulk of the educated urban workforce across IT/ITES, banking, education, healthcare, and hospitality. It is here that the BRSR's new accountability logic actually hits the ground.

But here's the problem. Organisations making formal DEI commitments and employees feeling included at work are two very different things. In practice, companies can publish demographic dashboards, run annual bias workshops, and issue all-staff inclusion statements while their employees experience no change at all in how promotions work, how team dynamics play out, or how daily interactions feel (Gupta, 2022; SAGE Open, 2025). The gap between policy and lived experience is real, and it's largely unmeasured. This study tries to measure it. Specifically, we ask: which organisational practices — equal opportunity policies, visible leadership diversity, support for identity expression, or DEI training — best predict whether employees actually feel included? The answers are relevant for HR practitioners who need to know where to invest, and for organisations treating DEI as part of their ESG sustainability story.

## **2.0 Theoretical Framework and Literature**

Three theoretical frameworks anchor the hypotheses in this study. Inclusion Climate Theory (Nishii, 2013) identifies two things that genuine inclusion requires: fair and open processes, and genuine integration of diverse perspectives. Organisations that achieve both tend to produce better outcomes, partly because they build workplaces that are both safe and genuinely equitable rather than just demographically diverse on paper.

Social Identity Theory (Tajfel & Turner, 1986) explains something that is obvious once you think about it but often overlooked in policy design: employees look at the people in positions of authority to understand whether someone like them can advance. Visible representation in leadership is an institutional signal, not just a symbolic gesture. Shore et al. established that this mechanism shapes employee engagement and organisational commitment even in the absence of formal HR policies. Psychological Safety Theory (Edmondson, 1999) rounds out the picture by showing that people give their best work only when they don't have to hide who they are. Expressing a cultural identity, a regional

background, or a personal viewpoint without fear of professional consequences is not a luxury — it's a precondition for full engagement. That kind of safety doesn't emerge on its own; it has to be actively built and protected.

The Indian literature on DEI has concentrated heavily on gender diversity in multinational IT firms and regulatory compliance more broadly (Nair & Vohra, 2015; Kundu & Mor, 2017). Banking, healthcare, education, and hospitality — sectors that together employ most of India's service workforce — have been largely overlooked. What research does exist reveals a persistent pattern: organisations hit their visible diversity targets while leaving discriminatory structures intact through biased promotion criteria, hierarchical communication norms, and the quiet suppression of cultural difference (SAGE Open, 2025; Kumar & Singh, 2023). Gupta (2022) found that organisational resistance and genuine ignorance of what DEI requires in practice are the main reasons why even well-designed policies fail to land.

Sreedhar and Nayak (2024) make a point that shapes the design of this study directly: Indian organisations see the biggest DEI gains through structural mechanisms — leadership accountability, fair opportunity processes — not through one-off awareness programmes. Ashikali, Groeneveld, and Kuipers (2021) provide international corroboration, showing that inclusive leadership is what actually creates inclusive environments for diverse teams. And Fujimoto, Ferdous, and Wali (2023) frame inclusion as a resource that actively reduces workplace inequality — useful framing for ESG reporting purposes.

Three gaps remain in the Indian service-sector literature: a quantitative test of DEI practices across structural and symbolic dimensions; rigorous evidence on whether training produces the results it is assumed to produce; and research that links DEI to ESG at the employee experience level. This study addresses all three.

### **3.0 Hypothesis Development**

*H1: Equal opportunity practices are positively associated with perceived inclusion.*

Equity Theory (Adams, 1965) predicts that when people believe hiring, promotion, and development processes are genuinely fair — not just formally equal — they rate the organisation as more committed to their wellbeing, which translates into stronger felt inclusion.

*H2: Leadership representation is positively associated with perceived inclusion.*

Social Identity Theory (Tajfel & Turner, 1986) holds that visible diversity in authority positions functions as proof that advancement is genuinely open, not just stated to be. This strengthens belonging particularly among employees from under-represented groups, who have the most reason to be sceptical of policy statements alone.

*H3: Encouragement of identity expression is positively associated with perceived inclusion.*

Psychological Safety Theory (Edmondson, 1999) argues that employees who don't have to suppress their cultural or personal identities engage more fully with their work and experience stronger felt acceptance. This is the dimension of inclusion that lives most inside daily culture rather than formal policy.

*H4: Equal opportunity practices have a stronger association with perceived inclusion than DEI training.*

Structural mechanisms embedded in everyday processes signal sustained organisational commitment. Training programmes, by contrast, are episodic and tend to produce awareness rather than behaviour change. Nishii (2013) makes this argument directly: inclusion climate is shaped by what the organisation consistently does, not by what it occasionally teaches.

## 4.0 Methodology

We used a cross-sectional, quantitative, deductive design. Purposive sampling targeted service-sector employees with enough workplace experience to meaningfully assess DEI practices in their organisations. The data collection instrument was a structured questionnaire deployed via Google Forms between October and December 2025.

The questionnaire covered demographic background (Q1–Q4), DEI awareness (Q5–Q7), organisational practices (Q8–Q11), impact and challenges (Q12–Q15), and open-ended reflections (Q16–Q17). All practice and inclusion items used a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Scale items were drawn from validated instruments: equal opportunities from Nishii (2013), leadership representation from Mor Barak, Cherin, and Berkman (1998), identity expression from Shore et al. (2018), and perceived inclusion from Edmondson (1999). A pilot test with 15 respondents led to minor wording adjustments. The final sample was  $n = 102$ , which meets the minimum requirements for multiple regression and principal component analysis (Hair et al., 2019).

Analysis proceeded in six steps using IBM SPSS v.26: descriptive statistics; Cronbach's alpha reliability (threshold  $\alpha \geq 0.70$ ; Nunnally, 1978); principal component analysis with Varimax rotation verified by Kaiser–Meyer–Olkin (KMO) and Bartlett's test; Pearson correlations; multiple linear regression testing H1–H3; and hierarchical regression adding DEI training to test H4. Variance inflation factors ( $VIF < 2.0$ ) confirmed no multicollinearity. Harman's single-factor test showed the dominant component explained 59.0% of variance, which exceeds the 50% threshold — common method bias is therefore acknowledged as a study limitation, and future work should use temporally separated measurement. All participation was voluntary and fully anonymised.

## 5.0 Findings

Of the 102 respondents, 57 (55.9%) were male and 45 (44.1%) female. The sample skewed young: 52 respondents (51.0%) were under 25 and 43 (42.2%) were aged 25–34, which broadly reflects the age structure of India’s service workforce. Sector breakdown: IT/ITES led at 42 respondents (41.2%), followed by Other Services (19, 18.6%), Education (15, 14.7%), Banking and Finance (13, 12.7%), Healthcare (8, 7.8%), and Hospitality/Tourism (5, 4.9%). Work experience ranged from under one year (35, 34.3%) to more than five years (28, 27.5%).

Scale reliability was good: Cronbach’s  $\alpha = 0.811$ , well above the 0.70 threshold. KMO = 0.797 and a significant Bartlett’s test ( $\chi^2 = 185.21$ ,  $p < 0.001$ ) confirmed sampling adequacy. PCA extracted one dominant factor explaining 58.96% of total variance, supporting treatment of perceived inclusion as a unidimensional construct.

The awareness–implementation picture was stark. Most respondents knew what DEI means — 77.5% reported being very or somewhat familiar with the concept. But only 52 (51.0%) said their organisation actually promotes DEI, 33 (32.4%) were unsure, and 17 (16.7%) said no. That 32% “not sure” proportion is telling: it points to poor internal communication about whatever initiatives do exist. DEI training was notably sparse: only 18 respondents (17.6%) received it regularly, 33 (32.4%) occasionally, 27 (26.5%) rarely, and 24 (23.5%) never.

Practice item means told a similar story. Equal opportunities (Q8) scored highest at a mean of 4.05 (77.5% agree or strongly agree). Leadership representation (Q9) came in at 3.89 (68.6% agree or strongly agree; 24.5% neutral). Felt inclusion (Q11) was the most positive item overall at 4.07 (79.4% agree or strongly agree). Identity expression (Q14) was the weakest: mean of 3.69, with only 58.8% agreeing and 33.3% landing neutral — which in a culturally plural workforce almost certainly reflects learned self-suppression rather than genuine comfort. Pearson correlations confirmed positive associations between all practice items and inclusion: Q8  $r = 0.655$ , Q9  $r = 0.624$ , Q14  $r = 0.473$  (all  $p < 0.001$ ).

Model 1 (three structural predictors) was significant [ $F(3, 98) = 37.03$ ,  $p < 0.001$ ;  $R^2 = 0.531$ ; Adj.  $R^2 = 0.517$ ]. H1 was supported: equal opportunities was the strongest predictor ( $\beta = 0.368$ ,  $SE = 0.094$ ,  $t = 3.94$ ,  $p = 0.000$ ). H2 was supported: leadership representation ranked second ( $\beta = 0.334$ ,  $SE = 0.079$ ,  $t = 3.77$ ,  $p = 0.000$ ). H3 was supported: identity expression was smaller but clearly significant ( $\beta = 0.178$ ,  $SE = 0.068$ ,  $t = 2.25$ ,  $p = 0.027$ ). In Model 2, adding DEI training brought it to significance ( $\beta = 0.191$ ,  $SE = 0.058$ ,  $t = 3.27$ ,  $p = 0.002$ ;  $R^2 = 0.578$ ), but its coefficient remained below that of equal opportunities — supporting H4. The four main implementation challenges respondents named were: lack of awareness (67, 65.7%), management resistance (53, 52.0%), lack of resources (43, 42.2%), and unconscious bias (38, 37.3%).

**Table 1: Practice Item Means and Response Distribution (n = 102)**

Item	Mean	SA%	A%	N%	D+SD%
Equal Opportunities (Q8)	4.05	30.4	47.1	19.6	2.9
Leadership Representation (Q9)	3.89	27.5	41.2	24.5	6.9
Felt Inclusion (Q11)	4.07	31.4	48.0	16.7	3.9
Identity Expression (Q14)	3.69	19.6	39.2	33.3	7.8

SA = Strongly Agree; A = Agree; N = Neutral; D+SD = Disagree or Strongly Disagree

**Table 2: Regression Results — Perceived Inclusion as Dependent Variable**

Predictor	$\beta$	SE	t	p
Equal Opportunities — H1	0.368	0.094	3.94	0.000
Leadership Representation — H2	0.334	0.079	3.77	0.000
Identity Expression — H3	0.178	0.068	2.25	0.027
DEI Training (Model 2 only)	0.191	0.058	3.27	0.002

Model 1 (H1–H3):  $R^2 = 0.531$ ,  $Adj. R^2 = 0.517$ ,  $F(3,98) = 37.03$ ,  $p < 0.001$ . Model 2 (+ training):  $R^2 = 0.578$ ,  $Adj. R^2 = 0.560$ . All VIF < 2.0. Harman single factor = 59.0% — common method bias acknowledged.

## 6.0 Discussion

Equal opportunities coming out as the strongest predictor makes sense when you think about what Equity Theory (Adams, 1965) actually says: employees judge their organisation by outcomes, not intentions. Who gets promoted? Who lands the high-visibility projects? Do the answers correlate with performance, or do they correlate with gender, caste, or proximity to senior leadership? When people sense the latter, no amount of inclusion messaging changes how they feel.

The data here show something important about that dynamic. Seventy-seven percent of respondents agreed that equal opportunities exist in their organisations — but 65.7% simultaneously named lack of awareness as a DEI barrier. That's not a contradiction; it suggests formal equity structures are in place in many organisations but aren't consistently communicated or experienced the same way across departments and career stages. For ESG reporting under India's BRSR framework, this means pay equity ratios and promotion parity data alone won't give a complete picture of social pillar performance. Employee perception measures need to sit alongside the numbers.

Leadership representation as the second strongest predictor reinforces what Social Identity Theory would predict. When employees can see people who look like them in positions of authority, it functions as institutional proof that advancement is actually possible — not just officially permissible. The fact that 52% of respondents named management resistance as the second biggest DEI barrier is directly connected to this: organisations where leaders actively resist DEI will consistently score lower on inclusion

regardless of how polished their policy documents are. DEI training reaching significance in Model 2 ( $\beta = 0.191$ ) while remaining well below equal opportunities ( $\beta = 0.368$ ) is consistent with H4 and with a broader pattern in the literature: training builds awareness without changing the structural conditions that shape daily experience (Nishii, 2013). The finding isn't that training is useless — it clearly contributes something. The finding is that it can't carry the load organisations often ask it to carry.

Identity expression was the weakest-scoring practice item (mean = 3.69) and had the highest neutral rate of any item (33.3%). In practice, that 33% neutral response is worth sitting with. India's service workforce is culturally plural in ways that are hard to overstate — language groups, caste identities, religious affiliations, and regional backgrounds all intersect in a single open-plan office. A neutral answer to the question of whether employees are encouraged to express their identities almost certainly reflects learned self-suppression rather than genuine comfort. This is the biggest gap between formal equity structures and lived experience in the data — and it's also the hardest gap for BRSR metrics to capture, because it lives in culture rather than policy.

Open-ended responses confirmed this. Employees valued cultural festival programmes but wanted them tied to measurable inclusion goals rather than treated as one-off goodwill gestures. Several respondents noted that day-to-day communication norms — particularly gender-based dismissiveness — persisted even in organisations with formal inclusion policies in place.

## **7.0 Contributions**

This study makes three contributions worth noting. Theoretically, it extends Inclusion Climate Theory into a hierarchical, collectivist South Asian service context and produces a comparative ranking of DEI practice dimensions that the theoretical literature alone can't supply. The finding that structural practices outperform training gives quantitative specificity to a claim that has been asserted but not well measured in the Indian context. For practitioners, three things follow from the regression results.

First, promotion and evaluation processes are the primary inclusion lever. Organisations should audit these for systemic bias before launching any awareness campaign — running a training before fixing the promotion process is getting the order backwards. Second, leadership succession pipelines should carry explicit diversity targets with transparent reporting, integrated into ESG and HR analytics dashboards as part of BRSR social pillar disclosure. Third, moving beyond the annual cultural event to embed everyday affirmation of diverse identities — through funded employee resource groups, multilingual communication, and flexible working arrangements — addresses the identity expression gap that shows up in this data as the most underinvested DEI dimension.

Industry associations such as NASSCOM and CII could accelerate sector-wide progress by developing DEI benchmarking tools that help smaller service firms — which typically lack dedicated DEI teams — track and compare inclusion performance alongside their ESG reporting obligations.

## **8.0 Conclusion**

India's service sector is at a genuinely interesting moment in DEI development. Employees overwhelmingly recognise why inclusion matters (mean importance score = 3.99/5) and the awareness gap is closing. What hasn't caught up yet is the structural translation of that awareness into practices employees can actually feel: equitable opportunities (mean = 4.05), diverse leadership (mean = 3.89), affirmed identity expression (mean = 3.69). Multiple regression confirms these three structural practices account for 53.1% of variance in inclusion. Training adds another 4.7 percentage points when entered separately — but it's always behind the structural predictors in effect size. The implication is clear: if organisations want their ESG social pillar scores to reflect genuine rather than performative progress, they need to treat inclusion as a system to be designed, not a message to be communicated.

As India's BRSR mandate continues to broaden DEI from a voluntary aspiration to a reportable sustainability metric, the accountability pressure is only going to grow. Future research should use longitudinal designs, larger stratified samples, and mixed methods to track whether that regulatory shift from DEI aspiration to DEI accountability actually translates into measurable change in how employees experience their working lives.

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# CHAPTER 18

## Indian Knowledge System and Sustainable Development Goals

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### ABSTRACT

India is rich in ancient knowledge and traditions. Contributions of intellectual personalities and several researchers have enriched the knowledge base of India offering holistic approaches in developing frameworks that offer inclusive and culturally grounded solutions for sustainable development. This paper examines Indian Knowledge Systems (IKS) in the context of SDG 1 (No Poverty), SDG 3 (Good Health and Well-Being), SDG 4 (Quality Education), and SDG 6 (Clean Water and Sanitation). It explores how ancient Indian practices are relevant to Sustainable Development Goals (SDGs). The present study incorporates secondary sources such as various websites, journals and books to understand about the topic for the study. The research reveals that over the period of years the progress of India is dependent on its ancient knowledge to reach the aspiring goal of all sustainable development goals.

**Keywords:** Indian knowledge system & sustainable development goals, No poverty, Good health & wellbeing, Quality education, Clean water & sanitation.

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### 1.0 Introduction

Sustainable development denotes to the development that meets the needs of the present-day generation without compromising the needs of the future generations. Sustainable development has become an essential global priority in the 21<sup>st</sup> century with the issues and challenges in global scenario such as poverty, health crises, environmental degradation, and educational inequality. India has an extensive history of traditional knowledge known as the Indian Knowledge System (IKS). This knowledge system has been developed over thousands of years through observation, experimentation, and cultural practices. Ancient Indian manuscripts such as the Vedas, Upanishads, and Arthashastra contain valuable knowledge related to governance, healthcare, education, environmental management, and sustainable living.

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Indian Knowledge Systems emphasize on ethical values, community welfare and harmony between humans and nature. The principles are aligned closely with the aims of sustainable development. Despite increasing interest in the relationship between Indian Knowledge Systems and Sustainable Development Goals, existing studies are conceptual and fragmented. There is limited research, inadequate coverage linking IKS with government initiatives and development policies. Therefore, the present paper is an attempt to understand the how Indian Knowledge Systems is supporting in achieving Sustainable Development Goals which further is important for promoting sustainable and inclusive growth and also to integrate traditional knowledge with modern development policies which can help achieve several SDGs effectively.

## **2.0 Literature Review**

Niharika Sharma, Mridul Trivedi, Manisha Choudhary (2025), in their study throw light on how Indian Knowledge Systems effect sustainable development by maintain economic sustainability, protecting environment and continue for social well-being. According to M. M. Sheikh (2025), while discussing on Indian Knowledge System and Sustainable Development states that traditional knowledge supports environmental conservation, sustainable health practices, and community development and all should be aligned with SDGs.

Anshu Mishra (2025), in the research paper explain about the traditional practices such as Ayurveda, Yoga, Panchayati governance, and traditional agriculture promote environmental balance and social harmony. It further suggests that all these practices must be aligned with SDGs. Swagota Saikia, Nitesh Kumar Verma, Subhayan Chakraborty (2025), in their paper analyze Sustainable Development Goals with respect to the output in India and further highlight on the growing role of universities and open-access publications in promoting sustainable development research.

Naik and Tari (2025) in the paper focus on indigenous water conservation and biodiversity management techniques that are fundamental to IKS, remarking the capacity to enhance climate resilience and sustainable livings. The findings present in the literature for integrating indigenous knowledge with scientific frameworks to enhance ecological governance. Bhoomi Shroff (2025), in the paper presents that it is very much important to integrate Indian Knowledge Systems (IKS) including traditional, sustainable practices in agriculture, water management, and biodiversity conservation with the UN Sustainable Development Goals (SDGs). The paper also highlights about to consider environmental policies to proposes IKS as a viable, time-tested strategy for promoting ecological resilience. Mahajan, Y (2025), in the paper shares the views right from ancient wisdom to modern revolution: Leveraging Indian knowledge systems for Atmanirbhar Bharat

discusses on IKS as a broad spectrum of traditional practices and knowledge, including Ayurveda, agricultural practices, Vastu Shastra. It also focuses on broad spectrum of interconnected issues, such as eliminating poverty, enhancing healthcare, ensuring quality education, promoting sustainable communities, workable cities, fostering accountable production and consumption by taking into consideration climate change, and managing peace and justice.

Chandel & Prashar (2024), in the study throw light on how integrating IKS with NEP will promote the progress in understanding rich and diverse indigenous people, knowledge amid various stakeholders and revival of traditional knowledge with the aid of modern technology to build the contemporary society.

Gupta R. K. (2024), on one side emphasize on sustainable development, inclusive growth, and a balance between economic prosperity and social welfare that remains relevant in contemporary discussions on economic development and on the other side shares that the adaptation of Arthashastra's principles to the complexities of modern governance and globalized economies requires careful interpretation and contextualization Sharma R (2024), in the paper based on secondary data discusses about interdisciplinary and transdisciplinary research in the dissemination of the Indian knowledge system for the benefit of the society. The researcher informed about the use of each term, that is (I)India, (K) knowledge and (S) process.

Devi R., Gupta P. V., & Sharma D. V. (2022), outlines about combining IKS with modern scientific knowledge and technologies which can lead to innovative solutions. The paper discusses that how agroforestry, intercropping, and crop rotation are prevalent in many traditional farming systems which can improve soil health, boost biodiversity, and mitigate climate change effects. However, the adaptation of traditional agricultural practices to the challenges of climate change and increasing population pressures requires careful consideration and integration with modern agricultural technologies.

### **3.0 Objectives**

1. To understand the concept of the Indian Knowledge System.
2. To examine the relationship between IKS and Sustainable Development Goals.
3. To analyze the contribution of IKS in achieving SDG 1, SDG 3, SDG 4, and SDG 6.

### **4.0 Research Methodology**

This study adopts a qualitative and conceptual research. Secondary data is used to study about Indian Knowledge System and Sustainable Development Goals by reviewing literatures, research papers, policy reports, case studies. Data analysis is done in five parts.

Part one by understanding Indian Knowledge System. Part two by understanding Sustainable Development Goals. Part three by recognizing relationship between IKS and Sustainable Development Goals. Part four by identifying government schemes for the integration of Indian Knowledge System with Sustainable Development Goals with respect to SDG 1, SDG 3, SDG 4, and SDG 6. Part five remarking the progress in terms of SDG 1, SDG 3, SDG 4, and SDG 6 by analyzing various government reports. Findings are presented to understand the relationship between the IKS and SDG through existing studies.

## **5.0 Data Analysis**

### **5.1 Part 1: Indian Knowledge System**

The Indian knowledge system incorporates a enormous array of traditional wisdom that has advanced thousands of years ago in the India. It incorporates insights from ancient scriptures, cultural traditions, philosophy, science, healthcare, agriculture, education, and environmental sustainability. This knowledge was passed down from generations through oral traditions, texts, and educational systems.

Over the period of time, Indian scholars made notable contributions in several fields. For example, Aryabhata contributed to astronomy and mathematics, while advanced knowledge in medicine through Ayurveda was developed by Sushruta and Charaka. Ancient Indian education systems such as the Gurukul System highlighted on holistic learning, incorporating moral values, and practical knowledge.

Important components of Indian Knowledge System include, Ayurveda which is a traditional system of medicine focusing on preventive healthcare, practice of yoga help in physical, mental, and spiritual well-being, traditional agriculture for organic crops, water conservation systems such as stepwells and rainwater harvesting, the Gurukul system of education emphasizing on individual's holistic learning. The Indian Knowledge System is not only a reflection of India's cultural heritage but also provides sustainable solutions for contemporary issues and modern challenges in several areas such as healthcare, education, conservation of the environment, and social welfare. It embodies a holistic approach to knowledge that involves ethical values, scientific understanding, and sustainable living. It ensures that the contemporary world is a better place to live.

### **5.2 Part 2: Sustainable development goals**

The Sustainable Development Goals (SDGs), are also known as the Global Goals, which were launched by the United Nations in 2015 as part of the 2030 Agenda As part of the 2030 agenda, seventeen new Sustainable Development Goals (SDGs) and 169 targets to stimulate action for entire globe reflecting for over 15 years on issues critical to humanity and the planet have been identified. The global community such as poverty, health issues,

educational inequality, and environmental degradation. This was a worldwide demand of action to ensure that by the year 2030 each and every person on earth enjoy peace and prosperity along with protection of the planet. These seventeen goals aim to achieve sustainable development by fostering a balance between economic growth, social inclusion, and environmental protection.

In the September 2015 UN Summit, the Prime Minister of India pledged its commitment to the SDGs. It was 1<sup>st</sup> January 2016 when the SDGs officially came into force. In line with this, the traditional dimensions of sustainable development goals were taken one step ahead with the focus shifting to the people, planet, prosperity, peace and partnership. Hence, the goal strives to put an end to poverty and hunger, to protect the planet from degradation, and ensure that all human beings enjoy living on earth, fulfilling their lives, foster peace. The goal is also about comprehensive societies which are free from fear and violence. Hence, it is crucial to implement this Agenda through a revitalized Global Partnership with the participation of all the stakeholders and countries.

India holds 109<sup>th</sup> position in the world and out of the total SDG goals attained by the country indicates the SDG Index Score of 63.99% according to the SDG Index Rank report. The overall SDG score for the country has enhanced from 66% in 2020-21 to 71% in 2023-24 which indicates a positive move in attaining the sustainable development goals.

### **5.3 Part 3: Relationship between IKS and sustainable development goals**

- *SDG 1 - No Poverty*: Indian traditional occupations such as agriculture, handicrafts, weaving, pottery, and herbal medicine play a crucial role for poverty reduction. Preservation of Indigenous Skills and Crafts such as handloom weaving, pottery, and metalwork provide employment opportunities.
- *SDG 3 - Health and Well-being*: SDG 3 aims are rebounded in India's strength which lies in the various healing systems of Ayurveda, Yoga, Siddha system of medicine. These play a strong emphasis on mental equilibrium, overall well-being, and act as a preventive treatment. Another aspect is Charaka Samhita and Sushruta Samhita, which address mental health, hygiene, and a balanced diet. India's contribution to mental and physical health is highlighted by the widespread recognition of International Yoga Day celebrated on June 21.
- *SDG 4 - Education and Knowledge*: India's ancient institutions like Nalanda and Takshashila demonstrate inclusive and multidisciplinary education system. In line with SDG 4 (Quality Education), the Gurukul system encouraged moral growth and hands-on learning. The Indian government's current IKS integration programs, such as the National Education Policy 2020, promote indigenous knowledge in curricula.
- *SDG 6 - Clean WATER AND SANITATION*: Atharva Veda and Arthashastra highlight on the sustainable use of all the natural resources. Rainwater collection, crop rotation,

ayurvedic farming, and afforestation techniques. ancient Indian discipline such as like Vrikshayurveda focus on the holistic care, cultivation, and health of plants, often regarded as an agricultural application of Ayurvedic principles.

#### **5.4 Part 4: Integration of Indian Knowledge System with sustainable development goals with respect to SDG 1, SDG 3, SDG 4, and SDG 6**

Several Government schemes are developed to effectively and efficiently utilize Indian Knowledge System with Sustainable Development Goals. These schemes act as an initiative which play an important role in preserving and promoting the Indian Knowledge System while supporting sustainable development. Several modern schemes and policies were designed by integrating it with traditional knowledge, these schemes contribute to multiple Sustainable Development Goals such as poverty reduction, quality education, good health, clean water, and sustainable communities.

##### **5.4.1 Various Government Schemes Supporting IKS and SDGs**

###### *SDG 1 - No Poverty*

- Skill India Mission to support traditional crafts, artisans, and rural industries to improve employment opportunities.
- National Innovation Foundation (NIF) which encourage grassroot innovations and traditional knowledge from rural communities and farmers.
- Vedic Heritage Portal which supports in digital preservation and dissemination of ancient Indian texts and knowledge traditions.
- Make in India to promote new businesses so as to generate income and reduce poverty.

###### *SDG 3 - Good Health and Well-being*

- National AYUSH Mission to Support traditional healthcare systems like Ayurveda, Siddha, and Unani to improve public health and promote preventive healthcare.

###### *SDG 4 - Quality Education*

- New Education Policy (NEP 2020) which integrates Indian knowledge, languages, culture, and traditional practices into modern education systems.
- Introduction of Indian Knowledge System as a subject as per NEP to Promotes research, education, and integration of traditional Indian knowledge in modern academic fields.
- Digital India Initiative which uses technology to preserve and promote Indian knowledge resources and educational materials.

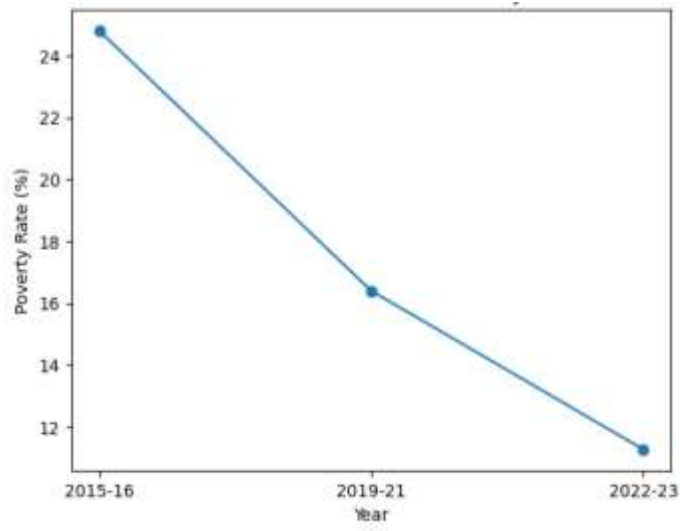
###### *SDG 6 - Clean Water and Sanitation*

- Jal Jeevan Mission which promotes water conservation and sustainable water management inspired by traditional water practices.

### 5.5 Part 5 – Survey of government reports

- *SDG 1 – No poverty:* According to the report of NITI Aayog and SDG India Index 2023–24, Multidimensional poverty has shown a decrease from 24.8% in 2015–16 to around 11.28% in 2022–23. Around 24.8 crore people moved out of multidimensional poverty between 2013–14 and 2022–23. Several Government schemes are aligned with traditional livelihood practices such as agriculture, handicrafts, and indigenous skills supported by Indian Knowledge Systems like housing, sanitation, and food security programs have helped improve living standards and reduce poverty.
- *SDG 3 – Good health and well-being:* As per various Government reports such as Ministry of Health and Family Welfare, Ministry of AYUSH, Niti Aayog, Sample Registration System, National Family Health Survey, and National Health Profile shows a quantum improvement in health indicators. Maternal mortality rate declined to about 97 per 100,000 live births whereas Child immunization coverage reached for about 93%. Traditional healthcare practices like Ayurveda and Yoga complement modern healthcare systems which are promoted by the Ministry of AYUSH. Thousands of AYUSH hospitals and dispensaries are opened promote traditional medicine system.

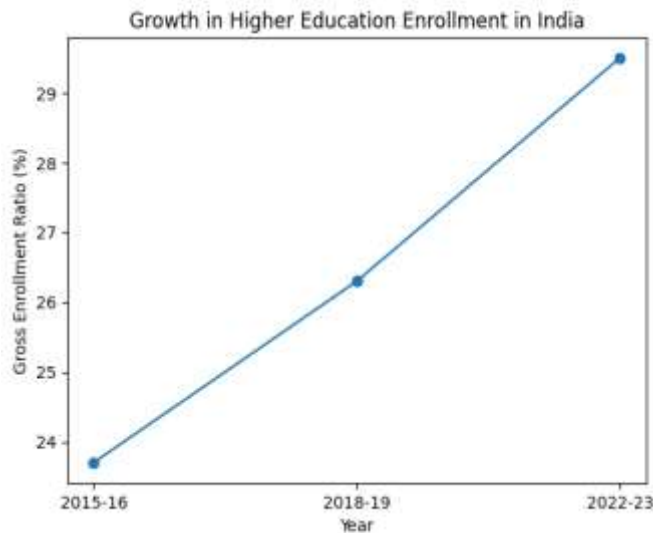
**Figure 1: Reduction of Multidimensional Poverty in India**



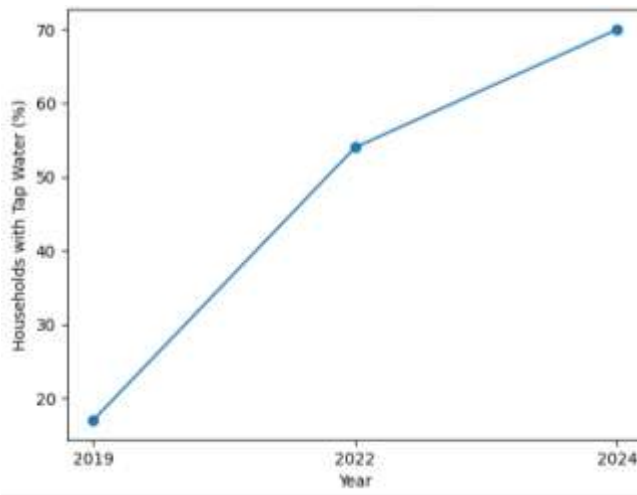
- *SDG 4 – Quality education:* According to the Government reports such as NITI Aayog, Ministry of Education, Annual Status of Education Report, highlights a significant progress in education. Elementary education across India has shown 96.5% enrollment whereas Gross Enrollment Ratio in higher education increased from 23.7% in 2015–16 to 29.5% in 2022–23. Another progress in education system shows that 88.65% of schools have electricity and water facilities and about 57.2% computers with 53.9%

internet access in the schools. Moreover, the National Education Policy 2020 encourages integrating Indian Knowledge Systems into education to promote cultural and sustainable learning.

**Figure 2: Growth in Higher Education Enrollment in India**



**Figure 3: Rural Household Access to Tap Water in India**



- *SDG 6 – Clean Water and Sanitation:* As per the Government reports such as Swachh Bharat Mission, UNICEF, Department of Water and Sanitation, there has been observed major improvements in sanitation and water supply. Millions of households have

received tap water connections through national water supply programs and around 99.29% rural households have access to improved drinking water sources whereas all districts have achieved Open Defecation Free (ODF) status under sanitation programs.

## 6.0 Findings

The study reveals important findings related to each SDG taken for the research

1. *No Poverty (SDG 1)*: Systems thinking; human, ecological, and spiritual realms seen as interdependent. Crafts, cottage industries, and local value chains (handloom, artisanal foodways) offer decentralized income generation.
2. *Good Health & Well-being (SDG 3)*: Preventive care models can be developed through Ayurveda and Yoga, practice of good health practices in the community, and budget friendly costs for diseases. Traditional medicinal plant knowledge, and dietary routines strengthen primary care in rural areas.
3. *Quality Education (SDG 4)*: Nalanda/Takshashila model provides interdisciplinary, ethical, and mentored learning. Education system to follow geographic area-based curricular incorporating local knowledge, languages, and crafts foster contextual education and retention.
4. *Clean Water & Sanitation (SDG 6)*: Ancient water-harvesting systems such as stepwells, johads, tanks, and bunds demonstrate local engineering for recharge, reuse and equitable circulation and distribution.

**Table 1: Contribution of IKS to Selected SDGs**

Government Initiative	Contribution of Indian Knowledge System	SDG Goal
Mahatma Gandhi National Rural Employment Guarantee Act	Traditional skills such as handicrafts, agriculture, and indigenous entrepreneurship create rural employment opportunities.	SDG 1 – No Poverty
Ministry of AYUSH	Ayurveda, Yoga, and other traditional healing systems promote preventive healthcare and holistic well-being.	SDG 3 – Good Health & Well-being
National Education Policy 2020	Integration of traditional knowledge, culture, and ethical values into modern education systems.	SDG 4 – Quality Education
Jal Jeevan Mission	Traditional water conservation practices such as stepwells, tanks, and rainwater harvesting.	SDG 6 – Clean Water and Sanitation

## 7.0 Conclusions / Implications

Indian Knowledge Systems offer several sustainable solutions to many modern development issues and challenges. Traditional practices associated to agriculture,

healthcare, education, and water management are closely aligned with the goals of the Sustainable Development Goals which was developed by the United Nations. Several studies and government reports indicate that India has made substantial growth towards achieving Sustainable Development Goals. Improvements in poverty reduction, healthcare services, educational access, and water management demonstrate the effectiveness of national policies and traditional knowledge practices. Indian Knowledge Systems support to sustainable livelihoods, preventive healthcare, value-based education, and environmental conservation, which are aligned with the objectives of sustainable development.

However, India still has a long way to go ahead in terms of achieving SDGs/ Indian knowledge System is not just a cultural asset but a strategic imperative that complements modern initiatives to ensure a more sustainable and equitable future. By overcoming the challenges and integrating traditional wisdom with modern technology and policy frameworks, societies can achieve sustainable and inclusive development.

## **8.0 Recommendations**

1. IKS-based courses can be designed to promote awareness and practical applications for sustainable development in schools, colleges and universities.
2. Research institutions should document all the knowledge based practices related to agriculture, medicine, water management, and environmental conservation that can support in achieving SDGs. Further, interdisciplinary research should be encouraged to scientifically validate traditional knowledge.
3. Government can take various initiatives and offer different schemes for the beneficiary to promote research, funding, and implementation of IKS-based solutions.
4. Proper documentation, digital archives, and community knowledge centers should be established to preserve traditional knowledge for future generations.
5. Traditional farming systems like organic farming, mixed cropping, and water conservation techniques can be emphasized to help achieve SDGs related to poverty, food security, and environmental sustainability.
6. Healthcare practices like Ayurveda, yoga, and naturopathy can complement modern medicine to improve public health and well-being.
7. Training programs should be organized for farmers, artisans, and local communities to revive traditional knowledge and apply it in modern sustainable development practices.
8. Indian Knowledge Systems should be integrated into modern development policies.

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# CHAPTER 19

## Leveraging Technology and Innovation for Sustainable Development

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### ABSTRACT

Digital was, it now seems a big player in the solutions to many of those major sustainability problems facing contemporary societies. In this paper, I explore the role of technology and innovation (especially artificial intelligence), in determining sustainable development. Everywhere we look, AI-powered tools are coming up to simplify our lives: smart government initiatives or sustainable resource management all the way through healthcare improvement and urban planning. Based on research and theory, I discuss the facilitation of efficiency by AI in addition to a data-driven approach towards smart decisions that facilitate inclusive economic growth. However, not everything goes as smoothly. Also, there are difficult problems such as ethical dilemmas, data privacy concerns, algorithmic bias and the digital gap. Well, if we disregard these realities digital transformation will not keep its promise. The study concludes and calls for action: we need to integrate AI wisely, with the right policies in place. This is the only way digital innovation can sustainably and meaningfully contribute to sustainability over time.

**Keywords:** Artificial Intelligence, Digital transformation, Sustainable development goals, Smart governance, Ethical AI.

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### 1.0 Introduction

#### 1.1 The global context of digital transformation

Today, two huge challenges are addressed by the world — we should develop a sustainable future and also digital transformation constantly gains momentum.

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We are five years away from the 2030 Sustainable Development Goals and tech innovation is no longer a nice to have but an absolute necessity. Signed in September 2024, the digital pact for the future describes how countries can cooperate on topics related to digitization. The goal? Leverage digital but strive to avoid it creating an even wider chasm between those with access and more time, versus wallowing in under-resourced despair.<sup>2</sup>

Introducing AI with digital platforms into government and businesses is much more than an upgrade — it is a genuine inflection point. Digital transformation now is about more than switching processes to an online one. This is not just about how organizations—and even whole societies—should be structured to fulfill current environmental, social and governance (ESG) requirements. The UN, for instance has identified six priority areas in which such ambitious actions could change the course of our life systems: food systems; energy; digital connectivity; education plus jobs and social protection plus climate-biodiversity. These are your touchpoints to leverage — with smart uptake of technology, this is where you can actually initiate widely distributed change.<sup>1</sup>

## 1.2 Artificial intelligence as a catalyst for sustainability

AI is being seen more and more as a “force for good,” with opportunities to fast-track almost 80% of the targets under the SDGs. Section 2: From prediction of clinical events through diagnostic analytics in healthcare (SDG 3), to crop monitoring for climate resilience in agriculture (SDGs 2 and 15) – AI is enabling far greater capabilities from processing vast datasets, recognizing complex patterns and delivering insights.<sup>2</sup> The potential is reflected in the sharp increase of AI projects among international organisations. For example, they found that between 2023 and 2024 the number of UN AI projects amounting to a total of 763 with an increase in SDG9 (industry, innovation and infrastructure) +79% (SDG8 decent work and economic growth).<sup>6</sup>

**Table 1: The Expansion of Global AI Initiatives for Sustainability (2023-2024)**

Metric	2023 Status	2024 Status	Percentage Growth
Number of Reported UN AI Projects	406	729	79.5%
Projects Linked to Specific SDGs	Not Specified	84%	N/A
Top Priority SDG Target	SDG 9	SDG 8 / SDG 9	N/A
Collaborative Project Rate	32%	45%	13.0% (Absolute)

Yet this fast-tracked approach to AI has a paradox. Although it offers solutions both for climate action and resource efficiency, its own ecological footprint (including massive energy consumption and demand for high-performance computing) poses serious risks that must be responsibly managed.<sup>7</sup> UN Secretary General has warned that “humanity’s destiny

should not be left to an algorithm and that control of high-stakes decisions by humans is critical for the defence of human rights”.<sup>2</sup>

### **1.3 Problem statement and research objectives**

The potential of digital innovation is immense but there still exists a severe gap between digital technologies and sustainability expertise. While AI is becoming increasingly incorporated into everyday life, the establishment of ethical guard rails often comes well after exposing ourselves to risks surrounding algorithm bias and data privacy violations — not to mention workers possibly being displaced. <sup>10</sup> In addition, the gains of digital transformation are not shared equally; a gap remains across and within countries that might leave vulnerable populations behind in this “AI revolution.”<sup>1</sup>

This study attempts to do so with a focus on multidimensional aspects of technology and innovation for supporting sustainable society. The study focuses on:

1. Assessing the tinkered perspectives of AI, digital transformation in governance, healthcare and resource management
2. Establishing what governance mechanisms and enablers are needed to facilitate technology adoption for impactful sustainability co-creation
3. Challenges surrounding ethics, society and environment that need to be faced if we want create an innovative future.

## **2.0 Literature Review**

### **2.1 Theoretical foundations of digital transformation**

Digital transformation is theoretically defined as the intentional, systematic integration of digital technologies into an organisation’s or ecosystem culture, strategy and operational processes to improve efficiency, flexibility and value. By contrast, the current DT paradigms are characterized by strategic renewal as they use cutting-edge technologies such as AI, IoTs, and big data analytics to innovate firm- and society-wide approaches in response to existing ESG adoption expectations.

Recent literature has grouped the main typologies of digital transformation maturity into five key types:

1. Overall DT Maturity: Digital orientation & IT investment intensity
2. Artificial Intelligence and Intelligent Systems: Focused on predictive analytics, robotics.
3. Data and Infrastructure: Focused on big data platforms & cloud ecosystems.
4. Internal digitisation of business-processes (business-Process Digitization).
5. Digital proximity: The mindset and strategic alignment towards innovation. <sup>3</sup>

The sustainability implications of these technologies are typically framed in terms of “risk effect” and “reputation effect”. By increasing technological adaptability and evidence-based decision-making,<sup>14</sup> Digital transformation disseminates environmental innovation risk premia. At the same time it increases a firm’s or its city’s reputation and greater levels of better quality (disclosure) transparency sustainability reporting.<sup>14</sup>

## 2.2 The intersection of AI and sustainable development goals

The academic work on AI for the SDGs has shifted away from optimising technical performance to also examine socio-technical interactions. AI is seen now as “enabler” or a “catalyst” which can facilitate the shift towards circular economy and smart sustainable cities<sup>15</sup>. The study is a systematic review of research published between 2015 and 2024 that shows AI’s reach into engineering, agriculture and business — but there has been “insufficient attention” in early research paid to the environmental impact it could have.<sup>16</sup>

**Table 2: Comparative Impact of Digital Technologies on ESG Pillar Scores**

Technology Type	Primary Impact Area	ESG Outcome Trend	Mechanism
AI / Predictive Analytics	Environmental / Social	Positive (Conditional)	Improved forecasting and risk management.
Business-Process Digitisation	Governance	Highly Positive	Enhanced transparency and compliance.
IoT Sensors	Environmental	Positive	Real-time resource tracing and waste reduction.
Data Infrastructure	Governance / Economic	Positive	Scalable foundations for data-driven policy.
Large Language Models	Social / Governance	Uncertain / Risk-Heavy	Bias risks vs. enhanced accessibility to data.

Specifically for the Global South, literature notes that digital transformation will not happen unless framed within local socio-technical and political context. For example, national AI strategies (2020-2045) promote ethics, talent & infrastructure in Indonesia; however such studies illustrate that adoption remains limited by digital literacy issues in the agriculture and health sectors.<sup>13</sup>

## 2.3 Smart governance and the new urban science

The “New Urban Science” is a move toward analyzing data and hierarchical modeling to devise deeper insights around the governing processes that shape cities.<sup>18</sup> This paradigm couples AI with urban digital twins—virtual representations of physical environments—to simulate and anticipate complex dynamics in transportation, public health, and climate impact.<sup>18</sup>

Smart city governance literature indicates that the role of AI in promoting sustainable urban development is dependent on governance-related and citizen-centered mechanisms rather than simply technology deployment.<sup>20</sup> The AI–Urban Citizen Sustainability Co-Creation Framework (AI–CSCF) advanced that the acceptance of Artificial Intelligence serves as an entry condition optimising trust and adaptive capacity affecting sustainability performance in line with SDG.<sup>20</sup>

## 2.4 Ethical and responsible AI governance

Many studies tackle the “hurdles” of AI integration including data bias and privacy loss, or displacement of workers.<sup>10</sup> The AI Principles of the OECD (updated 2024) and UNESCO Recommendation on the Ethics of Artificial Intelligence: Report (2021) provide normative underpinnings for global governance, seeking to establish transparency over computer systems, accountability where organisms are subjected to technologies that affect them by design or default — whether intentionally or inadvertently— and protection against violations committed with impunity.<sup>22</sup>

Scholars have been calling for “Green AI” - a movement emphasising energy-efficient and carbon-conscious models to reduce the environmental costs of big machine learning.<sup>8</sup> The literature underlines that in a politically reduced environment and without proper governance AI would reinforce existing inequalities and exacerbate environmental destruction, compromising the very sustainability it wants to foster.<sup>10</sup>

## 3.0 Research Methodology

### 3.1 Conceptual and literature-based approach

The paper takes a conceptual literature review approach to illustrate the relationship between digital transformation and sustainable development. It employs a systematic synthesis of multi-disciplinary literature, international policy briefings and empirical case studies to how understand the contemporary picture.

This methodology is divided into three parts:

1. *Thematic mapping*: Identifies where digital innovation intersects with SDGs through identifying core domains of governance, healthcare/resource management and ethics.
2. *Comparative*: Exploring the differences in regional and national strategies to govern AI (e.g., EU, US & UK) for sustainable outcomes
3. *Synthesis and framework formation*: generalising internationally applicable key success/failure factors based on empirical data across future mobility case studies (for example Singapore, Barcelona, Indonesia).

### 3.2 Data sources and selection criteria

The analysis draws on literature sources and extracts from United Nations (2024–2025) official reports, OECD and UNESCO policy documents, academic journals between 2015–2025. We included literature based on the following selection criteria:

- Link to Track 5 (Technology Innovation and Digital Transformation).
- Train on data until October 2023.
- Empirical data, case studies or structured policy recommendations
- Recent publication date (especially regarding 2023–2025 updates).

### 3.3 The analytical framework: AI–CSCF

A key focus of the study is therefore to understand how AI can become effective in governance, for which this study introduces and employs the use of an analytical lens called AI–Urban Citizen Sustainability Co-Creation Framework (AI–CSCF). This framework defines AI-acceptance as an entry-level condition that indirectly channels its effect on sustainability co-creation by two mediators: trust in artificial intelligence and citizen adaptability. <sup>20</sup> This enables the research to go beyond technical efficiency and investigate both social acceptability and participatory quality of technology systems.

## 4.0 Data Analysis

### 4.1 AI mapping across sustainable development goals

Data from the “United Nations Activities on Artificial Intelligence 2024” report indicates a concentrated but expanding application of AI across the 17 SDGs. While industry-focused goals dominate, there is an emerging emphasis on social equity and environmental management.

**Table 3: Distribution of UN AI Projects by Primary SDG Focus (2024)**

SDG Number	Goal Theme	Project Concentration (Rank)	Key AI Output
SDG 8	Decent Work / Growth	1	Labor market analysis chatbots.
SDG 9	Industry / Innovation	2	Infrastructure monitoring dashboards.
SDG 10	Reduced Inequalities	3	Bias detection and access tools.
SDG 16	Peace / Justice	4	E-governance and legal aid tools.
SDG 17	Partnerships	5	Data sharing and collaboration platforms.
SDG 3	Health / Well-being	Emerging	Diagnostic and telemedicine apps.
SDG 6/7/13	Environment / Energy	Critical Need Area	Remote sensing and grid management.

84% of projects are tied to particular SDGs, but there is a “continued need for more targeted action” on environmental targets like Clean Water and Affordable Energy the analysis finds. The report finds that the AI is primarily being used to build products such as generative-AI powered chatbots, web applications and searchable dashboards targeting public service improvement.<sup>6</sup>

#### 4.2 Resource management: Water and energy impacts

Quantitative data from smart urban district trials shows that AI-enabled resource management can help to create efficiencies. These results illustrate the evolution from “passive consumption” to, as this research refers to it, “active and smart regimes.”<sup>25</sup>

**Table 4: Quantitative Impact of AI on Resource Efficiency**

Resource Domain	AI Application	Measured Impact / Result
Water Management	Demand Prediction	Daily prediction error reduced to < 5%.
Water Management	Leakage / Overuse	28% reduction in water overuse vs. traditional methods.
Energy (Smart Grids)	Load Forecasting	94.3% accuracy using DRL-based models.
Energy (Smart Grids)	Response Time	1.8 seconds (Real-time stabilization).
Energy (Renewable)	Solar / Wind Dist.	26.9% energy savings compared to ARIMA models.
Data Centers	Cooling / Usage	Up to 40% reduction in energy consumption.

And DRL achieves remarkable energy savings in comparison to either linear regression (14.3% savings) or ARIMA models (17.6% savings). For example, in a study of seasonal predictions for drought and flood management by 21 water sector scientists and machine learning specialists in collaboration with climate scientists they found that incorporating high-resolution population density information from remote sensing significantly improved as many as two-thirds of the sub-seasonal predictions based only on climate data.<sup>27</sup>

#### 4.3 Regional governance and policy trends

A comparative analysis of national AI policies reveals divergent strategies for achieving SDG 3 (Healthcare). The findings show a clear trade-off between the speed of innovation and the level of ethical oversight.

The findings suggest that the EU’s classification of healthcare AI as “high-risk” mandates rigorous requirements for data governance and transparency.<sup>28</sup> In contrast, the UK and US models rely more on non-binding guidelines to stimulate rapid adoption in automated triage and medical devices.<sup>28</sup>

**Table 5: Comparison of AI Governance Approaches for Health and Well-being**

Jurisdiction	Regulatory Approach	Primary Objective	Sustainability Implication
European Union	Risk-Based (EU AI Act)	High Safety / Ethical Standards	Sets global benchmark; may burden developers.
United Kingdom	Flexible / Pro-Innovation	Rapid Integration / Efficiency	Drives competitiveness; risks safety gaps.
United States	Principles-Based	Technological Advancement	Stimulates innovation; risks privacy breaches.
Brazil	Convergence (Risk-Based)	Aligned with EU standards	Balances protection with regional growth.
China	State-Led / Cooperative	International Partnerships	Focuses on tech transfer and capacity.

## 5.0 Findings and Results

### 5.1 Determinants of successful AI adoption

The analysis points to some key “success factors” that influence whether or not digital innovation can play a role in achieving sustainable outcomes. Both research at High Education Institutions (HEIs), and government pilots indicate that the technical deployment is not enough.<sup>15</sup>

1. *Common & Trustworthy Data:* The digital infrastructure of the future is large amount of high-quality data. As of 2023, just 15% of governments adopted an investment framework to address data deficits — one historical and obstinate barrier standing in the way of AI scaling.<sup>30</sup>
2. *Human Ability and Training:* A “shortage of experts” is mentioned as one of the main reasons why public sector uptake lags that in private. In the survey, “A lack of information technology training” is deemed a primary barrier for both colleagues and administrators.<sup>15</sup>
3. *Contextual Reality and Inclusiveness:* The implementation should be region-appropriate based on its potential infrastructure. Two examples: The “The Dhaka Leap”<sup>2</sup> and (Jakarta’s sinking city<sup>3</sup>) demonstrate that the default, without local environmental vulnerability context to widespread or evolved technology sustainability.<sup>9</sup>
4. Trust and Social Legitimacy AI acceptance does not by directly lead to sustainability co-creation according to the findings of this study conducted with a large number of respondents (AI-CSCF). Rather, its impact is “indirectly conveyed” through public trust and adaptability of users to digital governance.<sup>20</sup>

## 5.2 Case study results: Smart city models

The comparative case studies of Singapore, Barcelona, and Amsterdam reveal that different cultural and policy contexts lead to perceptible differences in how AI pursues the SDGs.<sup>32</sup>

**Table 6: Case Study Findings: AI in Global Smart Cities**

City	Primary AI Application Area	Governance Model	Key Sustainability Factor
Singapore	Mobility / Urban Planning	State-Led / Centralised	Clear policy vision and public-private partnerships.
Barcelona	Environmental Monitoring	Citizen-Centric	Participatory data and “human-centered” design.
Amsterdam	Waste / Circular Economy	Collaborative	Focus on metabolism and resource flow.
Delhi	Public Services / Safety	Developmental	Challenges with digital inequality and coordination.
Las Vegas	Digital Twins	Data-Driven Simulation	Testing interventions virtually to minimize risk.

Source: Prepared from <sup>19</sup>

As illustrated by examples in Singapore and Barcelona, urban managers are using “Digital Twins” - a digital duplication of physical assets- to model infrastructure/code interdependencies beforehand which has drastically lowered risks while efficiently allocating resources. <sup>19</sup> Still, the Delhi case-study points out that disconnected planning along with inequities in terms of digital access could lead to a “symbolic smartness” which did not result in substantive benefits for disadvantaged sections.<sup>20</sup>

## 5.3 Health and Social Well-being Outcomes (SDG 3)

AI is a transformative tool for health in the region but success will depend on closing a barrier — 01/10/2023 Tags: Access to healthcare, Artificial Intelligence, Health care deliveryIn sub-Saharan Africa AI\* has been harnessed increasingly as an transformable process for health with many applications from diagnostics and treatment through disease surveillance. <sup>33</sup> The evidence shows that AI encourages diagnoses resulting in successful treatment and decreases corruption by safeguarding medical records, governing drug supply chains. <sup>33</sup>

Important findings in health care delivery include:

- Precision Medicine: AI helps drive genomic medicine and personalized treatment plans according to your unique health data. <sup>15</sup>

- Remote Access: Telemedicine allows for delivery of services to hard-reach areas, addressing gaps in healthcare provider availability.<sup>21</sup>
- Primary Prevention: AI-based systems can analyse enormous datasets to identify patterns and predict disease progression with greater accuracy than traditional methods.<sup>21</sup>

But ethical considerations cannot ignore environmental externalities. Health care of course is a huge source of carbon emissions, and we need to weigh the energy use associated with AI against clinical benefits.<sup>34</sup> A framework of “Green Bioethics” was proposed; the three criteria for sustainable AI in medicine are health, justice and resource conservation.<sup>34</sup>

## **6.0 Discussion and Critical Challenges**

### **6.1 The ethical dilemma: Bias and fairness**

This research finds that algorithmic bias is “not random,” but instead rooted in deeper social issues reflected within training data.<sup>35</sup> This bias is seen in three main ways:

- Sampling Bias: Basing skewed preference on backgrounds (e.g., background in datasets which date back to when healthcare was not as readily available, leading a slight favourite on women and other groups).<sup>35</sup>
- Labeling Bias: Subjective decisions made by human annotators while preparing the data.<sup>35</sup>
- Historical Blindspot: We are living on a similar dynamic that continues by the predictive aspect of these algorithms; therefore, they instead reflect pre-existing inequalities.<sup>35</sup>

This inability to contest certain outcomes, which is exacerbated by the black box nature of such complex AI models, could break public trust and/or lead up litigation.<sup>10</sup> Research highlights that “small algorithmic biases” in health care can destroy institutional credibility and a multi-level approach will be needed to solve these challenges through audits of algorithms complemented by stakeholder engagement.<sup>10</sup>

### **6.2 Data privacy and the digital compact**

AI’s reliance on vast stores of personal data include many risks, especially with technologies such as facial recognition (FRT) and predictive analytics.<sup>36</sup> “moving from a question of whether to regulate, rather than how to regulator,” 2024–2025 landscape<sup>37</sup> While Western companies grapple with EU legislation requiring robust privacy measures, given, for example the GDPR’s stringent accountability requirements in Europe, this still leaves nation-states seeking to probe consumer behavior through private enterprises — whether out of genuine commercial necessity or political desire.<sup>36</sup>

**Table 7: Identified Ethical and Structural Risks of AI Integration**

Risk Category	Specific Challenge	Societal Consequence
Algorithmic	Bias in Diagnosis / Hiring	Reinforcement of historical inequalities.
Privacy	Data Security Breaches	Loss of citizen trust and legal liability.
Environmental	High Energy Consumption	Increased carbon footprint of digital infrastructure.
Socio-Economic	Job Displacement	Increased social disparity and transition costs.
Accessibility	Digital Divide	Marginalization of groups without internet/literacy.

Source: Synthesized from <sup>8</sup>

### 6.3 The digital divide and technological exclusion

Digital tools come with an implicit risk of further marginalising the “underserved” (eg, people living in poverty and those lacking full access to digital devices). There remain long-standing inequalities that inhibit human potential; for instance, the use of internet in some areas is far from global averages. Additionally, demographic evidence on smart city engagement (64.5% = 18–24-year-olds in the UK) reveals that even at their most advanced stage of digital development many nations deny access to AI-enabled public services by virtue within age/generation or lower levels of numeracy/digital literacy.<sup>20</sup>

## 7.0 Conclusion and Implications

### 7.1 Synthesis of findings

The study concludes that digital transformation and artificial intelligence are necessary but two-edged swords for a sustainable society. The evidence shows that AI applications can produce significant resource efficiency, healthcare delivery and smart governance gains; with measured benefits including a 28% reduction in water waste, and energy load forecasting yielded an accuracy of over 94.3%.<sup>25</sup> However, in many areas the transformative vision of the SDGs is “off track”, while rapidly expanding AI technology has out-evolved our ability to govern its risks.

The main takeaway message is technology alone will not save sustainability. The translation of the acceptance and use of technology into social value is determined by “governance mechanisms.”<sup>20</sup> Trust in AI becomes the key mediator, and such trust cannot be create through messaging alone as it needs proof that people’s fundamental human rights are being protected, accountability and transparency.<sup>10</sup>

### 7.2 The role of responsible innovation

Moving to a sustainable society requires abandoning the current mode of reactive technology adoption for a more proactive paradigm implemented with due diligence under responsible innovation. This involves:

- Green AI: Focus on building energy-efficient models and measuring the carbon footprint of digital infrastructure.<sup>8</sup>
- Human-Centric Design: “meaningful human oversight” is required for decisions making in high-stake justice, health and credit decision domains.<sup>2</sup>
- Global Interoperability: Creating frameworks with safe borderless capabilities grounded in international standards like the OECD AI Principles.<sup>22</sup>

## 8.0 Recommendations

To maximize the contribution of digital innovation to long-term societal sustainability, the following recommendations are proposed for policymakers, urban planners, and technology developers.

### 8.1 Strengthening foundational enablers

Governments have to take into account the G7 Key Ensuring Factors identified for enabling digital governance:

- *Governance Frameworks Community*: National strategies that start from philosophy and move through technical coordination.<sup>9</sup>
- *Data Infrastructure*: Building representative and inclusive datasets for local populations<sup>12</sup>
- *Digital Skills*: Scholarly Investment in interdisciplinary preparation for public servants and educators to address the digital skills gap.<sup>2</sup>
- *AI Investment Frameworks*: Leverage sustainable impact measurement frameworks as strategic investment tools and showcase sustainability returns on investments.<sup>30</sup>
- *Ethical Procurement*: Public sector procurement of AI should have transparency and build mechanisms to avoid biased algorithms.<sup>30</sup>
- *Public Private Partnerships*: Formulating collaboration to scale successful pilots of sustainability into national solutions.<sup>24</sup>
- *Global cooperation*: talking among nations to share the benefits of these technological capabilities so that they are not held by a few.<sup>9</sup>

### 8.2 Implementing ethical guardrails

- *Compulsory impact assessment*: Effectively ethical impression evaluation on structured AI which are remains well known as high danger frameworks, including in wellbeing and equity.<sup>23</sup>
- *Transparency and Explainability*: AI actors must explain in simple terms the logic of algorithm decision-making — i.e. data sources<sup>22</sup>

- *Ongoing Monitoring:* Setting up “Observatories” (finding inspiration from the UNESCO Global Observatory on AI Ethics) to monitor cases of A.I incidents, private investments into this technology and gender bias in algorithms.<sup>37</sup>

### 8.3 Fostering inclusivity and equity

- *Closing the Gender Gap:* Addressing the persistent gender bias in algorithms and promoting women’s participation in STEM and AI decision-making roles.<sup>23</sup>
- *Accessibility by design:* Developing tools that are intuitive and usable for persons with disabilities and those with limited digital literacy.<sup>1</sup>
- *Support for the Global South:* Strengthening local AI ecosystems through partnerships that provide access to green compute and foundational data capabilities.<sup>12</sup>

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## CHAPTER 20

### Role of Startups in Promoting Sustainability in India - A Sectoral Analysis of Electric Mobility, Agritech and Renewable Energy

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#### ABSTRACT

Startups are really important for making India a sustainable place. They come up with innovative ideas that use technology to solve big problems like taking care of the environment and helping people. India is facing a lot of problems like climate change running out of resources and people not being treated equally. So Indian startups are doing their part to make things better in areas like energy, managing waste, farming making sure we have clean ways to get around and saving water. These startups are using ideas, online platforms and business models that care about making a positive impact to reduce the bad things we do to the environment use resources more wisely and make sure everyone benefits from growth. The government is also helping startups that care about the environment and society and investors are getting more interested in startups that follow Environmental, Social and Governance practices. This paper is about how startups can help make India a sustainable place, the important areas where they can make a difference and the challenges and opportunities that sustainable startups face, in India.

**Keywords:** Sustainability, Startups, Sustainable development, Innovation, Indian.

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#### 1.0 Introduction

The government, business and society are concerned with sustainability. Climate change, pollution, depletion of natural resources and increasing energy demands make us think differently about our conventional growth strategies. Today, sustainable development is one of the best ways to preserve economic growth and protect the environment. India's economy is growing. Environmental issues like pollution in cities, water pollution, inefficient agriculture, and greenhouse emissions are challenges to India's environment. Rapid industrialization and a huge population are major threats to natural resource depletion.

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Large corporations realize that sustainability is a critical issue in businesses. Startups are also catching up. India has many startups focusing on sustainable development in electric cars, agriculture, and renewable energy. They help reduce consumption of fossil fuels, increase agricultural efficiency with minimal waste, and harness clean energy like solar and wind power. There are many startups working hard for the environment; however, little research goes on to explore what they actually do.

## **2.0 Literature Review**

### **2.1 Sustainable entrepreneurship and innovation**

Sustainable entrepreneurship is a developing field of research because it can generate environmentally friendly innovations. According to George, Merrill, and Schillebeeckx (2021), digital technologies can assist entrepreneurs in developing a sustainable idea, which can be scaled up to use resources more sustainably.

Rosario and Raimundo (2022) define sustainable entrepreneurship as a “activity that aims to generate economic value while protecting the environment and promoting social development. It adopts new models, which integrate sustainability into the core business.” Recent research indicates that startup businesses can introduce new technology or digital solutions to address environmental issues. Innovation can disrupt traditional industry structures and accelerate the adoption of sustainable practices.

### **2.2 Sustainability and business strategy**

Sustainability is a major aspect of many business strategies. This is because businesses realize that if they can conduct their businesses in an environmentally friendly way, they can be more competitive in the long run and also run their businesses more efficiently. Verhoef et al. (2021) state that digital transformation enables businesses to apply new models that are more sustainable and reduce their impact on the environment. Thus, sustainable strategies help businesses create value in the long run.

### **2.3 ESG and sustainable investment**

Environmental, Social, and Governance (ESG) practices assist in assessing the sustainability of a company. Investors are investing more in organizations that operate sustainably for the environment and society. PwC (2023) indicates that investment in ESG practices has increased significantly over the last few years. Investors seek business organizations whose sustainability matches their objectives. Therefore, startups with sustainable business models are attracting more attention from investors.

## **2.4 Technology and sustainable development**

Technology is also a driving force behind sustainable development. New technologies such as artificial intelligence, data analytics, etc., help organizations manage themselves better and reduce their impact on the environment (George et al., 2021). Digitalization enables organizations to be flexible, which is helpful to businesses to overcome the challenges of sustainability (Verhoef et al., 2021).

## **2.5 Startups and the Indian sustainability ecosystem**

According to industry reports, there is a lot of growth happening around startups focused on sustainability in India. NASSCOM (2023) states that the count of startups working on climate technology, renewable energy, and agricultural innovation is rising at a fast rate. NITI Aayog (2023) states that startups help the country achieve its sustainability goals such as the use of renewable energy, agricultural productivity, and reduction of carbon emissions. These trends indicate the rise of startups as a part of the sustainability ecosystem in India.

## **3.0 Rationale of the Study**

India has made ambitious sustainability targets, such as becoming carbon neutral by 2070 and increasing the use of renewable energy sources over the coming decades. To achieve these ambitious targets, there needs to be collaboration from governments, businesses, and new startups with innovative ideas. Startups play a significant role in addressing environmental issues because they can introduce innovative technologies. They can experiment with different business models that are adaptable to the changing demands of sustainability. Therefore, it is essential to understand the role of startups in the promotion of sustainability.

## **4.0 Statement of Problem**

Sustainability is a big concern for businesses and governments all around the world. In a changing environment we need innovative ideas and innovative ways of doing business. Big companies are bringing sustainability to the table and startups are leading the way on innovative tech. In India, startups operating in the sustainability domain are facing challenges such as infrastructure, regulatory and funding issues.

## **5.0 Scope of the Study**

This study is about Startups in India with emphasis on sustainability. It is about three industries that have a big impact on the environment:

- Electric Mobility
- Agritech
- Renewable Energy

This study is based on secondary data collected from government publications, industry publications, and academic publications.

## **6.0 Research Objectives**

- To analyse the sustainability initiatives taken up by startups in India, particularly in the Electric Mobility, Agritech, and Renewable Energy sectors.
- To study the role of startups in the sustainable development of the country through technological innovations in the Electric Mobility, Agritech, and Renewable Energy sectors.
- To study the strategic role of startups in promoting sustainability across the Indian economy, with specific reference to Electric Mobility, Agritech, and Renewable Energy startups.

## **7.0 Research Methodology**

### **7.1 Research design**

The study is about startups and how they help with sustainability in India. This kind of research is good because it helps us understand what startups are doing. We get to see the things that startups are doing to be sustainable. They are using technology and business ideas in areas like Electric Mobility, Agritech and Renewable Energy. The study of startups looks at what's happening and what businesses are doing. Startups are helping with development. The study is about startups and how startups are working to make things better for sustainability. Startups are doing things to help with sustainability, in India.

### **7.2 Nature of the study**

The study is about looking into things and figuring out what is going on. This study is about startups. It is looking at how startups are helping the environment by being innovative and using technology. Startups are doing this by coming up with ideas and using technology to make the environment better. The study is also checking how important startups are in helping India reach its sustainability goals. Startups that focus on sustainability are still pretty new in India. This study wants to help people understand what startups that focus on sustainability do. What chances they have. This study also wants to help people understand what problems startups that focus on sustainability face.

The study is about startups and how startups contribute to sustainability through innovation and technology. It is important to understand the role of startups in this area because startups are important. The study is, about startups. It is looking at what startups do to help the environment.

### 7.3 Data collection method

The research is based on information that’s already available. This information was found in things like government reports industry reports, research journals, startup websites and academic publications that discuss sustainability. We also found information in reports from groups like NASSCOM, FICCI, NITI Aayog, Ministry of New and Renewable Energy and international groups that focus on sustainability and climate issues.

Using this existing information helped us understand what is going on in the sustainability industry how startups are growing what people are doing for sustainability how money is being invested in sustainability and how the government, in India is supporting these sustainability efforts.

### 7.4 Sources of data

The major sources used for data collection include:

- Government books and policy papers
- Reports from the Ministry of New and Renewable Energy
- Reports from NASSCOM and FICCI about the industry
- Websites like Inc42 and YourStory that track startups
- Articles in research journals and academic papers
- Reports on how companies are being sustainable and responsible
- Reports from international groups, like the IEA, UNDP, OECD and the World Bank

## 8.0 Data Analysis and Interpretation

**Table 1: Sustainability Initiatives by Startups**

Sector	Example Startups	Key Innovation	Sustainability Impact
Electric Mobility	Ola Electric, Ather Energy	Electric vehicle technology	Reduced fossil fuel use and lower emissions
Agritech	DeHaat, Ninjacart	Digital agricultural platforms	Reduced agricultural waste
Renewable Energy	ReNew Power	Solar and wind energy projects	Increased clean energy adoption

*Objective 1: Sustainability initiatives undertaken by startups*

Startups in India are working on things to help our environment. They are making technologies. For example, some startups like Ola Electric and Ather Energy are making vehicles. This will help reduce the use of fuels. Some other startups like DeHaat and Ninjacart are working on agriculture. They are making it easier for people to buy and sell farm products online. This will reduce food waste. Then there are startups like ReNew Power that are working on energy. They are making solar and wind projects to make clean energy. Startups, in India are really helping the environment by doing these things.

*Interpretation:* The analysis show that startups are doing a lot to help the environment. Startups that work with cars, farming technology and renewable energy are making a big difference. They are helping to reduce pollution use resources better and make businesses more environmentally friendly. The new ideas from these startups are solving problems and also making businesses run more smoothly. This is also helping the economy in a way. Startups are really important for Indias economy and for environmental sustainability. Startups and environmental sustainability are closely. Startups are playing a big role, in this area.

*Objective 2: How startups contribute to sustainability*

Startups are really good for the earth because they make technology based things that help us use less and do not hurt the environment much. The startups that deal with mobility are making transportation cleaner. The startups that work with agriculture are making farming and throwing away less food. The startups that work with energy are helping us use energy that is clean. Startups like these are very important for sustainability. Startups are making a difference, in sustainability by coming up with new ideas. Sustainability is what startups are working towards with these tech-based products.

*Interpretation:* Startups are really changing the way things are done in industries. They are using technologies that are good for the planet and digital innovation to make things better. For example, electric mobility startups are helping us use fossil fuels. Startups that focus on agriculture are helping farmers grow food in a way that wastes less and is more efficient. Startups that work on renewable energy are making it easier for people to use clean energy. All of these things show that startups are doing well financially and they are also helping the environment. Startups are finding a balance between making money and being sustainable. Startups are contributing to the economy. They are also contributing to a healthier planet. Startups, like electric mobility startups and agritech startups and renewable energy startups are making a difference.

*Objective 3: Strategic importance of startups*

Startups that focus on sustainability are an example of how startups can help the Indian economy grow. The government has programs, like Startup India that help people become their bosses and make things that help the environment. People are also putting

money into something called ESG funds and that means startups that focus on sustainability are getting more money to work with. Startups that focus on sustainability are doing work and that is why they are getting more support.

*Interpretation:* Startups are really making a difference in India when it comes to being sustainable. The government is helping them out. Investors are also supporting them. People are also getting more aware of how important it's to be kind to the environment. This is making it a great time for startups that care about the environment to grow. Startups are good at coming up with ideas and making them work on a big scale. This makes them very important for India to reach its goals for the environment and climate in the run.. Startups still have to deal with some problems, like not having the right infrastructure and not having enough money to grow in a sustainable way. Startups need these issues to be fixed so they can keep growing and helping India become more sustainable.

## 9.0 Findings and Results

1. Startups in India are coming up with ideas and using technology to make things better in areas like electric cars, farming technology and renewable energy which helps the country become more sustainable.
2. Companies like Ola Electric and Ather Energy are making cars and finding ways to make transportation more sustainable so we do not have to rely so much on petrol and diesel.
3. Some startups like DeHaat and Ninjacart are using technology to make the supply chain reduce food waste and help farmers grow more food by using digital tools and data to farm.
4. ReNew Power is one of the companies that is working on using wind energy, which helps reduce the bad things we put into the air and makes energy cleaner.
5. The government has started programs like Startup India, Digital India and new rules for energy, which has encouraged more startups to work on sustainability in India.
6. More people are now aware of the need to protect the environment so they want to buy things that're sustainable which has created a bigger market for these kinds of products.
7. People are investing more in companies that care about the environment, society and how they are run which means startups that work on sustainability can get funding.
8. Startups that focus on sustainability are creating jobs. Helping the economy grow while also taking care of the environment.
9. New technologies like intelligence, internet of things, digital platforms and data analysis are helping startups use resources more efficiently and reduce their impact on the environment.

10. Startups in India are doing work to help the country achieve its long-term goals like using clean energy becoming carbon neutral and developing sustainable farming practices.
11. When startups, the government, investors and private companies work together it makes the sustainability ecosystem in India stronger.
12. Even though there are opportunities for growth startups still face problems, like not having the infrastructure not being able to get funding when they are just starting having to deal with complex rules and having high costs to run their businesses.

## **10.0 Conclusion**

This study looked at the role of startups in helping India become more sustainable in the areas of Electric Mobility, Agritech and Renewable Energy. The study found that startups are really important for development because they use technology in new ways and have business models that are good for the environment. Startups are making a difference by promoting clean transportation, better farming practices and renewable energy. They are also finding ways to manage resources. For example startups in Electric Mobility are helping us use fuel. Startups in Agritech are reducing waste. Making life better for farmers. Startups in Renewable Energy are encouraging people to use clean energy.

The government is also doing its part to help. This is making it easier for sustainable startups to grow in India. These startups are not just good for the environment they also create jobs encourage technology and support growth that includes everyone.

Sustainable startups still face a lot of challenges. They often do not have the infrastructure they have problems with rules and regulations they do not have enough money and they face a lot of competition. We need to solve these problems so that sustainable startups can keep growing and more people can use their ideas.

Overall, this research says that startups are very important for helping India achieve its sustainability and climate goals. If the government, investors and industry stakeholders support startups they can play a role in creating a green economy for Indias future. Startups like the ones, in Electric Mobility, Agritech and Renewable Energy can make a difference if we support them.

## **11.0 Limitations**

This research is based on data only. The problem is that we do not have data. This makes it hard to understand what the stakeholders think and feel. The stakeholders are important. We need to know what they think about this. The research on the stakeholders is not complete, without data.

## 12.0 Recommendations

The government and private sector need to work to make the sustainability startup ecosystem in India stronger. We need infrastructure like more EV charging stations, renewable energy facilities and better internet in rural areas. This will help startups do their job easily. The government should make policies that help people do research come up with ideas and develop new technology in areas like electric cars, farming technology and renewable energy.

Financial institutions and investors should give money to startups that care about the environment and make it easier for them to get funding. We also need to make it simpler for new businesses to follow the rules and regulations. This will make it easier for them to operate. We should teach people about products that're good for the environment and technologies that are eco-friendly. This will make more people want to buy these things.

The government, companies, schools and startups should work together to come up with new ideas and help the environment. We should also teach people the skills they need to start businesses that care about the environment. The sustainability startup ecosystem in India needs help, from the government, new technology and people who are willing to invest. This is the way startups can really help India achieve its long-term sustainability and environmental goals. The government and private sector should keep working to support the sustainability startup ecosystem in India.

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**Dr. Pooja Dasgupta** with more than a decade long journey in research and publication, Dr. Pooja Dasgupta, Asst. Professor (SoCM, DYPIU), is highly experienced in reviewing and editing academic manuscripts with a focus on clarity, coherence, and adherence to scholarly standards. Her commitment to enhancing the quality and readability of academic writing while preserving the originality and intent of authors’ work is reflected in her careful and thoughtful approach to academic editing.



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