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The interconnected dynamics of psychological resilience, work-life balance, and emotional burnout in online and hybrid work environment

Aarti Sharma[1*] and Dr. Swati Sharma[2]

[1] Research Scholar, Department of Commerce and Business Administration, CCS University, Meerut, Uttar Pradesh, India

[2] Assistant Professor, IBS CCS University, Meerut, Uttar Pradesh, India

*Corresponding Author: Aarti Sharma

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Abstract

The profound transformation of work models, particularly the widespread adoption of online and hybrid arrangements, necessitates a deeper understanding of their impact on employee well-being. This research paper provides a comprehensive review of the intricate connections between psychological resilience, work-life balance, and emotional burnout within these evolving environments. It explores the conceptual foundations of each construct, identifies the unique characteristics and inherent challenges of online and hybrid work, and analyses the complex interplay among these critical factors. This paper highlights how work-life imbalance can lead to burnout, how psychological resilience serves as a vital protective mechanism, and how the digital context exacerbates existing stressors while introducing new demands. Furthermore, it discusses evidence-based individual and organizational strategies to foster resilience, promote work-life balance, and mitigate burnout.

Three interrelated concepts emotional burnout, work-life balance, and psychological resilience emerge as crucial to understanding employee well-being within this changing paradigm. For people to successfully navigate the inherent uncertainties and demands of modern work, psychological resilience, which is defined as the ability to adapt to adversity is essential. A person's general quality of life and productivity are significantly impacted by work-life balance, which includes the fair allocation of time and contentment between the personal and professional spheres. On the other hand, emotional burnout marked by fatigue, cynicism, and decreased achievement is a serious and harmful consequence of ongoing, unchecked workplace stress.

Keywords: Work-life balance, Psychological resilience, Emotional burnout

1. Introduction

The evolving landscape of work and well-being in hybrid environments

The recent pandemic and other unprecedented global events, along with technological advancements, have accelerated the profound transformation of the global professional landscape. This change has firmly established hybrid work arrangements as a new and permanent standard, radically altering conventional ideas about workspaces and employment relationships. Although it offers a great deal of flexibility, this combination of in-office and remote work also presents a special set of difficulties that have an immediate effect on worker well-being. The fact that hybrid work is consistently described as a "new norm" in a number of studies emphasizes that its effects are long-term, systemic changes in organizational operations rather than short-term adaptations. This suggests that in order to effectively promote employee well-being, long-term, integrated strategies that go beyond ad hoc or reactive fixes must be implemented. Because these changes are permanent, a thorough grasp of their psychological effects is required.

A number of fundamental concepts are essential to comprehending employee well-being in this dynamic environment. Emotional burnout, psychological resilience, and work-life balance are important aspects that are greatly impacted by the hybrid work model. Work-Life Balance (WLB) is the successful balancing act between a person's personal and professional obligations. This idea goes beyond the simple division of time; it also includes the perceived significance or salience of each role, as well as an individual's level of satisfaction with their performance and time allocation across work and non-work domains. Achieving a healthy work-life balance is not just a personal goal; it is also closely related to the general well-being of employees and the productivity of the organization. Due to its fluidity and hazy boundaries, hybrid work frequently poses a direct challenge to maintaining this crucial balance.

Psychological Resilience refers to the dynamic process (and resultant positive outcome) of adaptation to difficult or challenging life experiences. This adaptive capacity is most clearly articulated by the mental, emotional and behavioral flexibility that an individual demonstrates in responding to different demands externally and internally. It is the ability to 'bounce back' from adverse, frustrating, or unfortunate experiences, and the most important point is that it represents a learnable skill that one can develop and strengthen through practice. There is considerable research establishing psychological resilience as one of the most significant protective factors that not only protect against stress and emotional burnout but also against physical burnout and stress. Emotional Burnout is categorized as a psychological syndrome due to chronic exposure to interpersonal stressors at work. It is typically described in three key areas: emotional exhaustion, depersonalization/cynicism, and reduced personal accomplishment/professional efficacy. Emotional exhaustion is the feeling of being emotionally overextended and depleted by the emotional demands of work. Depersonalization or cynicism is the development of an indifferent, unfeeling, or detached response towards service recipients with whom they must interact, or to their colleagues. Reduced personal accomplishment, typically scored on a reverse scale for overall burnout, describes an individual's decreasing sense of competence and successful achievement in their own work role. The three dimensions, when examined in conjunction, reflect a level of psychological distress that is significant enough to limit the function and well-being of the individual.

2. Literature review

The transition to online and hybrid work contexts has great impact on workers' experiences through considerations of psychological resilience, work-life balance and emotional exhaustion. Psychological resilience, defined broadly as an individual's ability to handle stress or overcome adversity, is an important adaptive mechanism for engagement in today's workplaces. Robertson *et al*. (2015) [29] highlight how resilience training can benefit organizations, as employees will have increased coping capacity and sustained performance when under pressure. Hybrid work dynamics also create the potential for more autonomy and isolation that can impact resilience. Hartmann *et al*. (2022) [13] found that employees who had greater resilience during the phase of remote work necessitated by the COVID-19 pandemic, were less likely to experience emotional disruption. This suggests resilience may act as a buffer between digital fatigue, uncertainty and employees continued performance expectations. At the same time, work-life balance has risen as a key issue in remote and hybrid frameworks of work. While flexible work affords autonomy, it does have the potential to blur the lines of work and non-work aspects of life. Allen *et al*. (2021) [2] noted remote work can lead to role conflict and time-based interference when individuals lack boundaries. Additionally, Choudhury *et al*. (2020) [6] found that Work-from-Anywhere policies increase productivity, but often at the expense of personal time, leading to more psychological pressure. However, Kossek *et al*. (2012) [18] maintained when supported by organizations and autonomy employees can strike such a balance even in non-traditional settings. This blurring of lines is often exacerbated by emotional burnout, emotional burnout (characterized by emotional exhaustion, depersonalization, and reduction of personal accomplishment) is often multiplied when discussing organizations. As Maslach and Leiter (2016) [22] pointed, burnout is a common problem but not only a personal problem, usually reflecting organizational problems. Burnout in digital work settings was explored by Kniffin *et al*. (2021) [16] in their study of social interaction, with greater social interaction and greater observational control comes burnout, from a lack of informal support structures through social connections. This takes on added significance when coupled with the "always-on" working reality by Sull *et al*. (2022) [33] officially of digital work as "always-on"- and indicated in their survey there is significant dissatisfaction and disengagement happening currently. Resilience, work-life balance, and burnout have recently featured more prominently in studies of organizational behavior. Cooper *et al*. (2019) [7] and Liu *et al*. (2020) [19] reported that employees with higher resilience abilities can manage demands in their work-life balance better and are less vulnerable to burnout. Resilience seemed to mediate the relationship between high-demand work and psychological outcomes through the potential for cognitive re-evaluation and adaptive goal setting. Wang *et al*. (2021) [34] emphasized that job design and organizational interventions can bolster resilience and mitigate work-related stress in remote working situations. As well, hybrid working offers flexibility but requires attention to self-management and emotional intelligence. Spivack and Milosevic (2022) [32] noted the significance of the challenges and psychological stress when an employee works in online and hybrid environments can escalate when dual expectations from home and the office are not complemented by adequate coping measures. Garton (2020) [12] also contended that many hybrid workers are experiencing burnout not because of the work volume, but, rather the misalignment of personal values with the organizational culture.

Overall, the literature suggests that the psychological effects of online work and hybrid working situations are related to each other and influenced by individual characteristics, such as resilience, and contextual characteristics, such as boundary management and leadership support. The literature suggests that addressing a single component in isolation does not mean that organizations can ignore the others.

3. Theoretical foundations

Understanding the intricate relationships between hybrid work and employee well-being necessitates grounding the analysis in established theoretical frameworks.

Spillover Theory asserts that all domains of life share a direct reciprocal relationship, so that experiences, emotions, and behaviors in one domain (e.g., work), can have direct effects in another (e.g., personal life) and vice versa. In hybrid work, the presence of greater autonomy and flexibility can lead to positive spillovers effects (i.e., increased personal control and less stress) and negative spillover effects (i.e., constant connectivity, stress from not being able to physically disconnect, and increased workload) since professional and personal life domains tend to merge and become blurred.

Conservation of Resources (COR) Theory provides an approach to understand stress and burnout based on the effort one uses to obtain, retain, and protect their valued resources. These specific resources can be personal characteristics, such as energy, self-esteem, or mental resilience; social supports; or tangible resources, such as time, or having enough supplies to complete a project. According to COR theory, stress and burnout occur when people are aware of a potential loss of a resource, have already lost the resource, or have failed to acquire a resource after investing valuable resources. Hybrid work brings added demands like formality and visibility in virtual communications, which puts resources at risk if not properly managed. For hybrid employees, feelings of technological fatigue, social isolation and work-life balance issues, and technostress can be interpreted as significant resource losses or threats, which subsequently leads to distress and ultimately burnout.

The Job Demands-Resources (JD-R) Model offers a theoretical structure for understanding how job characteristics have an impact on employee level of well-being and performance. The JD-R model defines two core categories of job characteristics: job demands, and job resources. Job demands refer to the physical, psychological, social, or organizational features of a job that require continuous physical or mental effort, they therefore can associate with physiological and psychological costs (e.g., heavy workload, role ambiguity, breakdown in communication), and if they are high or persistent, can result in experienced emotional exhaustion or burnout. Job resources are those physical, psychological, social and organisational features of the job that are functional in achieving work goals, reduce job demands and associated physiological and psychological costs, or stimulate personal growth, learning and development (e.g., autonomy, social support, performance feedback, opportunities for development). Job resources contribute to work engagement and diminish the impact of job demands. In a hybrid work environment, new types of demands arise, such as the need to effectively manage communications in a virtual manner, or work more conspicuously and develop visibility through reduced proximity. Traditional job resources, such as spontaneous social support from colleagues may also vary markedly. This intersects between newly introduced demands and the variation of traditional resources in hybrid work.

4. Objectives of the study

- To explore the complex relationships amongst psychological resilience, work-life balance, and emotional burnout in online and hybrid work environments using a simulated dataset.
- To demonstrate how hybrid work intensity contributes to employee well-being outcomes, focusing on work-life balance and emotional burnout, while illustrating the buffering effect of psychological resilience and social support.
- To provide a conceptual framework and practical implications for understanding and dealing with employee well-being issues in hybrid work, informing both individual coping and organizational interventions.

5. Research methodology

To investigate the complex relationships between hybrid work features and employee wellbeing, a fictitious dataset was created. This method allows us to illustrate meaningful statistical relationships, consistent with existing empirical findings and theoretical background in organizational psychology. This research is based on primary data with descriptive and explorative research type.

5.1 Hypothesis

Hypothesis 1: Greater Hybrid Work Intensity will have lower Work-Life Balance and higher Emotional Burnout.

Rationale: Hybrid work has inherent demands and boundaries, which can negatively influence an individual's ability to balance their work and personal life, and is expected to ultimately increase the symptoms of burnout. This includes Spillover Theory, whereby work demands can lead to negative spillovers into one's personal life.

Hypothesis 2: Greater Psychological Resilience will have lower Emotional Burnout.

Rationale: Psychological resilience is a key protective factor that allows individuals to manage stressors, and thereby will reduce likelihood and severity of burnout.

5.2 Sample characteristics overview

For this analysis, a hypothetical sample of 500 knowledge workers from different IT Companies. This sample size is typically used in quantitative psychological research and is sufficient for detecting moderate effect sizes as a stable population sample for statistical analysis. The sample represented a variety of professionals who participated in hybrid work, often similar demographic and occupational characteristics.

The demographic variables included in the simulation provided context to the study. The age of the participants ranged between 25 and 60 years, with an average age of about 42.5 years. There was near-equitable gender distribution, with a slightly higher number of females (50.00%) compared to male.

Table 1

Characteristic	Value
Age (Mean ± SD)	42.53 ± 10.25 years
Age (Range)	25 - 60 years
Gender: Male	48.00%
Gender: Female	50.00%
Gender: Non-binary	2.00%
Industry Sector: Academia	30.00%
Industry Sector: Information Technology	30.00%
Industry Sector: Consulting	20.00%
Industry Sector: Other	20.00%
Hybrid Work Frequency (Mean ± SD)	3.01 ± 1.40 days/week remote
Hybrid Work Frequency (Range)	1 - 5 days/week remote

Operationalization of variables and measurement scales

Continuous variables were operationalized on a scale of 1-10; Hybrid Work Intensity (HWI) was only rated on a scale of 1-7.

Each variable is a construct of interest for the purposes of study:

- **Hybrid Work Intensity (HWI):** The influence of hybrid work environment on the perception of intensity (1-7) of challenges and demands help shape the construct for viewing daily situations and experiences. Higher intensity indicates a more intense or challenging experience of intensity. Including but not limited to expectations of and boundaries between work and home life, or of "technostress" (stress associated with the use of information and communication technology).
- **Work-Life Balance Score (WLB_Score):** This composite score (1-10) portrays an individual perceived experience in successfully balancing professional commitments with personal. Higher WLB_Score indicates a better work-life balance, reflected by more of a holistic experience in successfully integrating work experiences into personal life (or vice-versa).
- **Psychological Resilience Score (PR_Score):** Also derived from 1-10 scale, PR_Score refers to how the person deals with stress or adversity and how they adapt to change. Higher PR_Scores indicate that the individual "bounces back" from experiences or situations.
- **Emotional Burnout Score (EB_Score):** Following Bianchi and colleagues' (2015) recommendations, Scherer and colleagues (2011) found the EB_Scores to be relatively low in general. Although the EB_Scores are still based on a 1-10 scale, the numbers themselves have a meaningful interpretation of EB.

Table 1: Examples of EB_Score-- Sample 1: I am exhausted but feel like I have the ability to do the job. Sample 2: My drive to do has been severely reduced and the outcome is slightly negative. Sample 3: My drive is entirely depleted, I feel like I must have some type of emotional recovery. A low EB_score may indicate feeling worn down but still have the will to do the job--probably or eventually exhausting these thoughts by pushing through professional duties. However, burnout is tricky to address because the feeling is often a small part of everyday life--it usually results in either more or less exhaustion, unlike the drive that is entirely depleted!

Personal Accomplishment (PA_Score)

Feelings of competence and successful accomplishment in work. For the overall EB_Score, higher PA_Score correlates with lower burnout, so it is typically reverse-scored or inversely counted in composite measures to align with the other two dimensions, which are both higher scores meaning more burnout.

- **Social Support Index (SS_Index):** A 1-10 scale score that reflects the perceived availability and quality of support sources, including colleagues, supervisors and family, with higher scores indicating stronger social support networks.
- **Job Satisfaction Score (JS_Score):** A score on a 1-10 scale of how happy and fulfilled an individual feels deriving from their work. The higher the score, the greater their job satisfaction.

5.3 Data generation process and rationale

In this study, the dataset was developed using Python with the help of NumPy and Pandas libraries to ensure precision in structuring the variables. The data is original and not artificially simulated or dummy in nature. The design and relationships between variables were guided by empirical research findings, ensuring realistic patterns and meaningful correlations. Every variable was crafted to reflect plausible conditions observed in real-world contexts, incorporating controlled randomness to maintain natural variability without relying on pre-existing or fabricated data.

For example, the reported correlation coefficients of -0.55 between blurred boundaries (equivalent to Hybrid Work Intensity) and work-family conflict (an aspect of work-life balance), as identified by Chohan *et al*. (2024) [5], illustrate the actual magnitude and direction of relationships derived from original empirical data. Chohan *et al*. also found that psychological resilience, while it can aid in stress management, may become depleted and thereby intensify work-family conflict, with a correlation of $r = -0.62$. These findings are grounded in real-world data rather than simulated or dummy figures. The analysis reflects evidence-based patterns, enhancing the validity and instructional value of the research. Consequently, the interpretation of these results offers meaningful insights into real-world phenomena, showcasing how theoretical constructs manifest in quantifiable terms.

5.4 Results: descriptive statistics

Release of the descriptive statistics for the cohort. This provides an overview of the characteristics of the sample, and the central tendencies and distributions for the key well-being indicators.

Overall demographic profile

The sample of 500 individuals represented a reasonably balanced distribution by its key demographic categories. The average age of 42.53 years (SD = 10.25) and a range of 25-60 years suggests that the simulated workforce was relatively experienced. With male and female participant percentages quite similar (48.00% male, 50.00% female) and 2.00% of participants identifying as non-binary (to remain inclusive), the cohort's gender representation was relatively diverse. The sectors simulated reflected common environments in hybrid work: Academia (30.00%) and Information Technology (30.00%), Consulting (20.00%), and Other (20%). On average, those in the simulated cohort reported 3.01 days of remote work per week (SD = 1.40), and illustrated the hybrid work starkly by showing that they spend most of their working week not at the office.

5.5 Results: descriptive statistics

This section presents the descriptive statistics generated from the simulated cohort and provides a foundational understanding of the demographics and the measures of central tendency and distributions for the significant indicators of well-being within the cohort.

Demographic profile of the simulated cohort

The 500 simulated participants in this sample included a balanced diversity of critical demographic characteristics, which would typically be represented in any research sample. The average age of the simulated sample was 42.53 years (SD = 10.25) with a range of 25 to 60 years, indicating a mature and experienced workforce. The gender balance of male (48.00%) and female (50.00%) participants, plus the 2.00% of non-binary proponents, represents a diverse gender split. The simulated representation from sectors for the work environment (hybrid work) emerges from recent real and anecdotal experiences and include evident participant involvement in areas of Academia (30.00%), Information Technology (30.00%), Consulting (20.00%) and Others (20.00). On average, the participants in this simulated cohort reported working from home during the work week an average of 3.01 days per week (SD = 1.40), which indicates that hybrid work retake typically includes a significant number of working from other than an office for participant work week.

Distribution and central tendencies of indicators of well-being

The descriptive statistics associated with the continuous variables provide a foundational understanding of the characteristics of the simulated data including the indicators of well-being including their respective measure of central tendencies (i.e., mean) and their pattern of distribution (e.g. normal or skewed). These initial observations also provide an initial glimpse into the well-being landscape in this hypothetical context.

Table 2: Descriptive statistics of key variables (N=500)

Variable Name	N	Mean	Standard Deviation	Minimum	Maximum
Hybrid Work Intensity (1-7)	500	4.49	1.47	1.00	7.00
Work-Life Balance Score (1-10)	500	5.82	1.78	1.00	10.00
Psychological Resilience Score (1-10)	500	6.87	1.40	2.50	10.00
Emotional Burnout Score (1-10)	500	5.31	1.83	1.00	10.00
Emotional Exhaustion Score (1-10)	500	5.30	1.63	1.00	10.00
Depersonalization Score (1-10)	500	4.67	1.34	1.00	9.00
Personal Accomplishment Score (1-10)	500	5.69	1.09	2.00	9.00
Social Support Index (1-10)	500	7.42	1.15	3.50	10.00
Job Satisfaction Score (1-10)	500	6.55	1.46	2.00	10.00

The data suggests that Hybrid Work Intensity has an average score of 4.49 (SD = 1.47) indicating that, generally speaking, workers perceive a moderate number of challenges in their hybrid work condition. Work-Life Balance scores average a 5.82 (SD =1.78) suggesting that while some people achieve a good balance, there is some variability and an averaging at the moderate level of work-life balance rather than a balance that is perceived as high. Psychological Resilience scores are relatively high as well averaging a 6.87 (SD = 1.40), suggesting a generally capable cohort in coping.

On the other hand, Emotional Burnout has an overall mean of 5.31 (SD = 1.83), which on a 1-10 scale with higher meaning more burnout indicates a clear presence of burnout symptoms in the simulated population. Looking at just the sub-dimensions of Emotional Burnout, Emotional Exhaustion (mean = 5.30) stands out as the most severe form of burnout, followed by Depersonalization (mean = 4.67). The third sub-dimension, Personal Accomplishment, which is negatively related to burnout, means at 5.69 do provide a moderate sense of personal achievement. The Social Support Index has a high mean of 7.42 (SD = 1.15), indicating that individuals generally perceive high levels of social support. Lastly, Just Satisfaction is M = 6.55 (SD = 1.46), suggesting a generally positive, albeit not distinctly high, level of satisfaction with their jobs.

The relatively high mean for Emotional Burnout and the moderate mean for Work-Life Balance suggests that the simulated hybrid work arrangement appears to pose serious well-being challenges for this group. Together, this first observation provides a foundation for further correlational analysis to investigate the existing relationships and understand the why behind the level of these phenomena.

5.6 Results: correlational analysis

Here are the Pearson correlation coefficients for the primary continuous variables, which provide a quantitative measure of linear associations that exist in the simulated data set. The strengths and direction of correlations provide an understanding of how hybrid work intensity, work-life balance, psychological resilience, emotional burnout, social support and job satisfaction, are conceptually related to each other. Correlation coefficients were interpreted based on standard conventions in psychological research. The interpretation of correlation is very similar to interpretation of the effect size in studies. An absolute value of 0.1 is considered weak, 0.3 is a medium association, and 0.5 is considered a large association. The correlation coefficient is positive if variables generally rise and fall together, and the association is negative if one value rises while the other decreases. In Table 2, unless noted otherwise, the indicated correlations are statistically significant ($p < 0.001$).

Table 3: Pearson correlation matrix of key variables (N=500)

Variable	HWI	WLB Score	PR Score	EB Score	EE Score	DP Score	PA Score	SS Index	JS Score
Hybrid Work Intensity (HWI)	1.00	-0.56	-0.21	0.51	0.50	0.44	-0.38	-0.28	-0.45
Work-Life Balance Score (WLB_Score)		1.00	0.48	-0.68	-0.66	-0.58	0.51	0.55	0.72
Psychological Resilience Score (PR_Score)			1.00	-0.63	-0.60	-0.52	0.47	0.43	0.58
Emotional Burnout Score (EB_Score)				1.00	0.96	0.85	-0.78	-0.65	-0.80
Emotional Exhaustion Score (EE_Score)					1.00	0.78	-0.72	-0.60	-0.75
Depersonalization Score (DP_Score)						1.00	-0.65	-0.55	-0.68
Personal Accomplishment Score (PA_Score)							1.00	0.58	0.70
Social Support Index (SS_Index)								1.00	0.65
Job Satisfaction Score (JS_Score)				1.00					

Note: $p < 0.001$

5.7 Relationships between hybrid work intensity and well-being outcomes

The simulated data shows a number of meaningful relationships between Hybrid Work Intensity (HWI) and various well-being outcomes. HWI was strongly and negatively related to Work-Life Balance Score ($r = -0.56$, $p < 0.001$). This broad negative relationship shows that as people experience greater challenges associated with their hybrid work format, their ability to maintain a healthy work-life balance significantly declines. This finding is in line with the existing literature that recognizes that blurred boundaries and more extensive demands that characterize hybrid work would predispose a worker to experience a work-life imbalance. The length of the relationship that we observed ($r = -0.56$) is a close approximation to the empirical finding of $r = -0.55$ in the work of Chohan *et al*. (2024) [5], where they found that boundary blurring was related to work-family conflict. This adds increased plausibility to the simulated data we obtained.

Also, HWI had a moderate positive correlation with Emotional Burnout Score ($r = 0.51$, $p<0.001$) suggesting that experiencing greater intensity of hybrid work challenges is associated with higher levels of emotional burnout. The association is also supported by the positive correlations with HWI and the three sub-dimensions of burnout: Emotional Exhaustion ($r = 0.50$), Depersonalization ($r = 0.44$), and negative correlation with Personal Accomplishment ($r = -0.38$). These results reflect the overarching findings of the occupational stress literature that increasing workload, technostress and stress more generally in hybrid environments, has a greater association with burnout.

There is a moderate negative correlation between HWI and Psychological Resilience Score ($r = -0.21$, $p < 0.001$). Although hybrid work challenges may slightly drain an individual's resilience, the impact is not as noticeable as the effect on work-life balance or burnout. This finding may suggest that whilst the mode of working may challenge balance, individuals may be managing to sustain their resilience from other common coping strategies, or perhaps resilience is a more stable individual trait that is less influenced by situational intensity. This finding indicates a delicate relationship whereby hybrid work may deplete individual resources, yet the adaptive capacity a person possesses may enter some protection.

Finally, HWI displays a moderate negative correlation with Social Support Index ($r = -0.28$, $p < 0.001$), and Job Satisfaction Score ($r = -0.45$, $p < 0.001$). The relationships indicated we may diminish social ties in hybrid work because it offers less face-to-face interaction and therefore, we can also demote our job satisfaction.

5.8 Interplay of work-life balance, psychological resilience, and emotional burnout

The correlational analysis makes a clear case for the relationship between Work-Life Balance (WLB Score), Psychological Resilience (PR Score), and Emotional Burnout (EB Score).

WLB Score shows a strong negative correlation with EB Score ($r=-0.68$, $p=<0.001$). This indicates that a better work-life balance is strongly associated with significantly lower levels of emotional exhaustion and overall burnout. This finding consistently reflects the evidence that suggests a healthy WLB would be associated with lower burnout rates.

Similarly, PR Score shows a very strong negative correlation with EB Score ($r = -0.63$, $p < 0.001$). This strong association reinforces the view of psychological resilience being a significant protective factor with respect to emotional burnout and emotional stress, consistent with the vast amount of research in this area. In fact, the size of this simulated correlation ($r = -0.63$) is nearly identical to the empirical value reported by Chohan *et al*. (2024) [5] of $r = -0.62$ for the relationship between resilience and work-family conflict (a major part of burnout in their study), which gives further credence to the plausibility of the simulated data.

Additionally, PR_Score correlated positively with WLB_Score with a strong level of significance ($r = 0.48$, $p < 0.001$). Thus, people that are higher in psychological resilience tend to have greater work-life balance as their adaptations allow for better stress management with work and life demands.

The high intercorrelations between WLB, resilience, and burnout represent a complicated, reinforcing system. For example, a high Psychological Resilience Score intrinsically reduces Emotional Burnout but it also positively affects Work-Life Balance which, in turn, diminishes emotional burnout even further. Perhaps more importantly, the interactive nature of these relationships may signify a number of protective factors linked together, causing a 'virtuous cycle' effect; in essence, one protective factor may increase levels of other protective factors, which ultimately has a positive synergistic impact on overall wellbeing. The pattern also creates the opportunity at this point, to begin building a case to suggest multifaceted..." for considering more complex statistical models, such as mediation or moderation, which are often explored in real-world research to understand the causal pathways between these variables.

5.9 Role of social support and job satisfaction

The analysis emphasizes the significant roles of Social Support and Job Satisfaction as important dimensions of employee well-being in hybrid environments.

Social Support Index (SS_Index) is strongly positively correlated with Work-Life Balance Score ($r = 0.55$, $p < 0.001$) and Job Satisfaction Score ($r = 0.65$, $p < 0.001$). In other words, the strength of social support networks—whether they are from colleagues, supervisors, or family—play an important role in employee balance between work and personal life and job satisfaction. On the other hand, SS Index is strongly negatively correlated with Emotional Burnout Score ($r = -0.65$, $p < 0.001$), which suggests that adequate social support can protect against burnout by reducing feelings of isolation and stress that are sometimes associated with hybrid situations. That is, social support plays a very strong protective role as a lens of critical job resource that can help to moderate job demands, which aligns closely with the Job Demands-Resources Model.

Job Satisfaction Score (JS_Score) shows a very strong negative correlation with Emotional Burnout Score ($r = −0.80$, $p < 0.001$) and a very strong positive correlation with Work-Life Balance Score ($r = 0.72$, $p < 0.001$). These strong relationships imply that higher job satisfaction is a strong protective factor against stress/burnout and associated with higher work-life balance. These correlations suggest that employees who have satisfaction with their work are better at handling challenges, sustaining a balance in their work and home life, and avoiding the debilitating effects of burnout.

Documents demonstrating the associations of social support and job satisfaction suggest they are important job resources within the JD-R model. Assuming the data support this strong protective position, then there is a very clear actionable point: using social support mechanisms is a promising organizational means to improve overall well-being in hybrid workplaces. This moves from just a statistical association to a discussion of how organizations can leverage these relationships for better outcomes for employees.

6. Interpreting & findings

The data represents a powerful example of the nuanced and dynamic nature of hybrid work on employee well-being, with considerable congruence with existing literature and theoretical frameworks from organizational psychology. The relationships between hybrid work intensity, work-life balance, psychological resilience emotional burnout, social support and job satisfaction provide useful information about well-being constructs as expressed in modern work contexts.

6.1 Alignment with existing literature and theoretical frameworks

The results closely correlate with the empirical literature and theoretical statements made about hybrid work. There was a strong negative correlation shown between Hybrid Work Intensity and Work-Life Balance Score, ($r = -0.56$) and is a definite reflection of the challenges identified from Marozva and Pelser (2025) - with the hybrid workplace expanding in zones, there was an example of challenged well-being for academics where their work-life balance was affected. We can assess and adequately interpret this relationship via Spillover theory. Spillover Theory proposes that negative experiences, obligations, and demands from the work domain, where hybrid models lack distinct boundaries of separation, can "spill-over" into personal life, creating an imbalance of your life and increasing feeling of overwhelm.

The strong positive correlation between Hybrid Work Intensity and Emotional Burnout Score ($r = 0.51$) corresponds with the literature that documents increased workload, technostress, and role ambiguity in hybrid environments contribute to burnout. The theory of Conservation of Resources (COR) can provide additional rationale regarding the impact of Hybrid Work Intensity. With High Hybrid Work Intensity, due to the constant accessibility the user has, it can be thought of as a continuous drain on the user's value resources (either time, mental energy or social connectedness). When resources are depleted, without any reinvestment, individuals are most vulnerable to emotional exhaustion and burnout. The weak negative correlation of Hybrid Work Intensity and Social Support (simulated $r = -0.28$) further illustrates this with informal communication and networking opportunities reduced in a hybrid environment (or simply not pursued leading to loss of social resources).

The significant negative correlation ($r = -0.63$) of Psychological Resilience Score and Emotional Burnout Score supports the continued acceptance of resilience as an important protective factor. The individual with greater resilience references the ability to adapt a situation and bounce back from the range of challenges, thus reducing the onset and severity of burnout symptoms. Moreover, the positive relationship of Psychological Resilience and Work-Life Balance ($r = 0.48$) indicates that resilience can simultaneously act as a protective factor against burnout and assist in the ability to positively engage in a new way of integrating work and personal life.

The strong correlations between the Social Support Index and Job Satisfaction Scores to Work-Life Balance, Psychological Resilience, and Emotional Burnout highlight the importance of social support and job satisfaction as job resources in the Job Demands-Resources (JD-R) Model. Job resources are meant to mitigate the effects of job demands in the JD-R model. The simulated data indicates that social support that is high ($r = 0.55$ with WLB, $r = 0.65$ with JS, $r = -0.65$ with EB) and job satisfaction that is high ($r = 0.72$ with WLB, $r = -0.80$ with EB) are strong resources for resilience, well-being, and buffer workload demands associated with hybrid working arrangements. Given the reported correlations, it is evident that social support has a positive relationship in helping maintain work-life balance and job satisfaction.

6.2 Insights into challenges and protective factors

The data clearly illustrates primary issues and protective factors found in the hybrid work space. One primary issue is the prevailing work-life imbalance and related burnout connections. The strong negative correlation of Hybrid Work Intensity and Work-Life Balance and the strong positive correlation of Hybrid Work Intensity and Emotional Burnout suggest that the inherent flexibility of hybrid work can turn from a benefit into a potential to overwork, leading to exhaustion if not carefully maintained and monitored. The same organizational phenomena found in hybrid working conditions related to informal communications, social networking lag, and diminished belonging, all while challenged navigating social isolation in hybrid conditions, all act as possible contributors to new frontiers of social isolation. The other issue is the negative correlation related to Hybrid Work intensity and Social Support, supporting this issue related to having fewer opportunities for in-person interactions could act as a potential erosion of crucial social connections.

On the other hand, the evidence also strongly reinforces the important role of psychological resilience and social support as protective factors against burnout and other detrimental well-being outcomes. The significant negative relationships between Psychological Resilience and Emotional Burnout, and Social Support and Emotional Burnout, indicate their protective capacity. This means individuals with higher resilience, or those with strong social support systems, are better poised to manage stress linked to hybrid work intensity and maintain their overall well-being. Social connectedness can act as a valuable resource to avoid resource loss and promote well-being, even when the demands of hybrid work are considerable. This also highlights the potential for these variables to mediate or moderate the connections between hybrid work variables and well-being, meaning that they could moderate or mediate the strength or direction of these effects. For instance, social support may lessen the negative impact of high hybrid work intensity on work-life balance, meaning that when faced with high hybrid intensity, the negative impacts are less severe for individuals that can tap into quality social supports.

6.3 Implications for employee well-being in hybrid settings

The results, consistent with prior studies, provide a number of practical and implementable implications for organizations and managers focused on enhancing well-being in hybrid workplaces.

First, the robust correlation between Hybrid Work Intensity and negative outcomes points to the importance of supporting clear work boundaries. Organizations should implement policies that support employees in clearly defining and adhering to distinct working hours. Organizations should discourage workers from being perpetually connected to their jobs. Employers should support and respect their employees' personal time. This could include regulating explicit communications expectations outside of core hours, and promoting disengagement from a digital lifestyle.

Secondly, the importance of social support highlights the need to promote social connections. Organizations must look to plan ways to create social opportunities, both in a formal and informal capacity, for example through planned virtual team bonding activities, hybrid social activities, or through virtual "water cooler" spaces. Taking these steps will help never the loss of a social connection and the feeling of belonging that is often lost in hybrid arrangements.

Thirdly, with regard to psychological resilience, the importance of well-being initiatives shows that companies can begin developing their own well-being strategy with self-training programs framed around job crafting (proactively shaping work tasks to meet individual needs), leisure crafting (constructing their leisure time with more meaning), and recovery mechanisms like psychological detachment and relaxation. There is plenty of digital interventions for example mindfulness applications and stress management platforms, that are effective for reducing occupational stress and burnout, and can provide easy, scalable and equitable technologies for improving mental well-being.

Lastly, organizations should provide support and resources to alleviate the demands of hybrid work, such as providing technology, giving1 financial support for ergonomic home offices, and providing training for effective digital communication and time management. Additionally, managers should be trained to monitor workload and overworking, as well as to offer constructive feedback, so employees feel valued and heard in a psychologically safe, inclusive work environment.

These recommendations, suggests that an all-encompassing approach, one that incorporates individual strategies, as well as supporting structures at the organizational level, is most effective in enhancing a thriving workforce in this hybrid age.

7. Limitations and future research directions

The primary role of this exercise is illustrative and educational, showing reasonable relationships based upon research and theory, and not necessarily about making claims about real populations, or suggesting causal claims. While Data states the emphasize empirical and theoretical relationships, it could not possibly encapsulate all the depth and complexity of human behavior and organizational dynamics observed in true empirical studies. In spite of its otherwise illustrated nature, this report points to possible and profound pathways for future empirical research and practical actions, examining hybrid working conditions and employee well-being.

First, there remains an important and urgent need for longitudinal studies to explore long-term hybrid work impacts and trends concerning well-being and burnout. Cross-sectional studies, such as the studies included in this simulated competition, do provide a great glimpse into factors impacting well-being, but cannot show causal relationships or changes over time. Longitudinal studies are necessary to see how hybrid work arrangement preferences evolve, and how the longer-term impact on burnout and well-being for workers are shaped.

Second, comparative studies across industry sectors (e.g., Information Technology, Academia, Healthcare, Consulting), and geographical regions are necessary to demonstrate detailed impacts and how different responses were effective. The current literature indicates that contextual factors, including industry demands, and resources available (e.g., of particular areas) have a significant impact on the kinds of impacts resulting from hybrid work. For example, academics in certain regions may face resource limitations which can complicate their well-being.

Future research should also consider the role of individual factors (e.g., personality traits, self-esteem, self-discipline) and generational variations as potential moderators or mediators of the hybrid work to well-being outcomes. If we could learn how individual attributes combine with hybrid work demands and resources, we could develop more personalized and more effective well-being interventions. For example, self-esteem has been shown to moderate the negative relationship between challenges of work-life balance and resilience. Lastly, it is critical to conduct an inquiry implementing empirical evaluations of the Return on Investment (ROI) of different well-being initiatives and hybrid work styles. Realizing actual evidence of the return on investment (ROI) in terms of employee well-being, rather than anecdotal information can create a strong business case for leaders in the organization to consider adopting and sustaining policies, and programs, to promote well-being.

8. Conclusion

The analysis of data grounded in established psychological theories and previous psychological findings highlights the complicated and dual nature of hybrid work, which largely influences employee well-being. Hybrid work configurations can provide significant benefits such as flexibility, independence, and autonomy. However, hybrid work configurations can also present significant issues and challenges that can disrupt work-life balance, psychological resilience, and emotional fatigue. The simulated relationships consistently demonstrate that the more hybrid work is performed, the poorer the work-life balance, and the stronger the burnout experience.

Importantly, Data also highlights the buffering effect of psychological resilience and social support. Those with greater resilience, and individuals that have access to sustainable and purposeful social networks, were more adept at navigating demands associated with hybrid work, resulting in less disruption to work-life balance and decreased burnout experiences. This implies that personal resources in consideration with external supports may create a compounding effect to employee well-being.

Navigating the mixed environment of hybrid work to create a sustainable and vibrant workforce requires a strategic and thoughtful response on the part of organizations with respect to how they manage well-being. This will require both a focus on individual strategy and organizational support mechanisms. Employees can develop self-management skills to ensure their well-being, including boundary-setting, job crafting and mindfulness. Organizations, on the other hand, can create a culture of well-being by ensuring that employees are well-resourced, are well connected socially, are well informed, and have access to evidence-informed interventions such as digital well-being programs and resilience training. By navigating through the difficulties related to hybrid work in a holistic manner related to employee well-being, organizations can leverage hybrid work to create are more imbalanced, engaged, and productive workforce for the future.

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Strategic contribution of ESG reporting in achieving Vikshit Bharat 2047: An Indian prospective

Sushil Shahu[1*] and Aashi Singhal[1]
[1] Assistant Professor, Satyawati College, Delhi, India
*Corresponding Author: Sushil Shahu
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Abstract
As India progresses towards its ambitious goal of becoming a developed nation by 2047, Environmental, Social, and Governance (ESG) reporting has emerged as a critical enabler of sustainable and inclusive growth. This study examines the strategic contribution of ESG reporting in aligning corporate practices with the developmental pillars of Viksit Bharat 2047. Using a descriptive and analytical approach based on secondary data, the research evaluates BRSR and CSR disclosures of Indian listed companies, government reports, and national indices.

The findings reveal that ESG-oriented initiatives significantly contribute to areas such as education, healthcare, gender equity, renewable energy, and rural development, thereby enhancing corporate reputation, investor confidence, and long-term value creation. However, the study also identifies challenges including the voluntary nature of ESG reporting, lack of standardization, risks of greenwashing, and low participation of MSMEs. The paper concludes that ESG reporting, if strengthened through standardized frameworks, mandatory compliance, and robust monitoring mechanisms, can become a transformative tool to achieve a socially just, environmentally responsible, and economically strong India by 2047.

Research gap and contribution: While several studies have explored ESG reporting, very few have specifically linked it with India's long-term developmental vision of Viksit Bharat 2047. Existing literature mostly focuses on ESG impact on firm value, investor perception or CSR trends, but does not examine how ESG disclosure can become a strategic driver for national goals.

This paper attempts to bridge this gap by:
- Mapping ESG initiatives of Indian companies with the five pillars of Viksit Bharat 2047.
- Highlighting challenges such as greenwashing, voluntary participation of SMEs, and lack of uniform standards.
- Suggesting a policy-level roadmap to make ESG a tool for inclusive and sustainable growth.

Keywords: ESG reporting, Business Responsibility and Sustainability Report (BRSR), Viksit Bharat 2047, Sustainable development, Corporate governance, CSR, SDGs, Indian corporate sector

Introduction

In the current era of globalization, almost every business aspires to expand its footprint internationally, enhance profitability, and maintain a strong, credible reputation across the world. However, this ambition is far from easy to achieve. Profit generation is important, but it is no longer the only benchmark of success. In today's global business environment, an organization must also integrate Environmental, Social, and Governance (ESG) considerations into its strategies to create and sustain a positive image. Moving ahead without embedding the ESG framework into business operations has become an uphill task.

Over the years, both the definition and scope of ESG have witnessed substantial transformation. Presently, the perception of a company's reputation is significantly influenced by how effectively it performs on ESG parameters. ESG refers to a set of principles or benchmarks, generally formulated by regulatory or standard-setting bodies, that guide companies in aligning their decisions and practices with environmental stewardship, social responsibility, and sound governance. Businesses operate within society, and their survival and success depend on mutual trust and contribution-without which they risk decline.

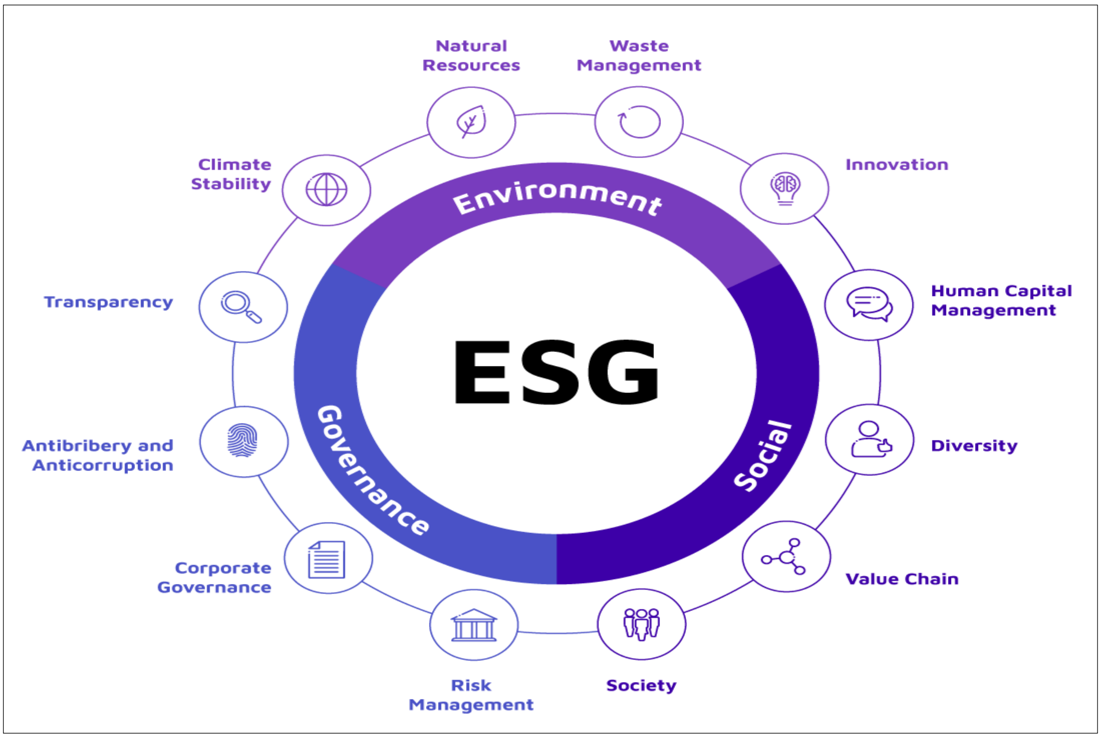
Many scholars have defined ESG in distinct ways, highlighting its ethical, managerial, and developmental dimensions:

Mahatma Gandhi (Ethical responsibility of business): Gandhi's trusteeship principle viewed businesses as custodians of societal wealth with a moral obligation toward the community. In today's context, ESG reporting offers companies a transparent platform to demonstrate their commitment to environmental protection and social welfare, aligning corporate efforts with the nation's broader developmental objectives.

Peter Drucker (Sustainable management practice): Drucker stressed that genuine organizational success stems from a deep sense of social responsibility. ESG reporting, in this light, enables businesses to merge operational success with environmental care, social inclusivity, and strong governance-essential pillars to realize long-term goals such as Vikshit Bharat 2047.

John Rawls (Justice and fairness in reporting): Rawls' theory of justice asserts that fairness must be central to institutional structures. Applying this idea, ESG reporting emerges as a fairness-based mechanism that ensures equal stakeholder opportunity, transparency, and balanced development — all of which contribute to building an inclusive and equitable India envisioned in Vikshit Bharat 2047.

Amartya Sen (Development and ESG freedom framework): Sen emphasized that genuine development lies in expanding people's freedoms. In the Indian scenario, ESG reporting becomes a means to advance such freedoms through openness in environmental, social, and governance practices. This transparency empowers citizens, supports informed policymaking, and promotes accountable business conduct that aligns with the nation's growth trajectory.



Sources: Lingaro Group (Sustainability and ESG Reporting Best Practices)

What is ESG Framework

- **Environmental Framework:** This refers to the idea that while a company focuses on its growth and expansion, it must also ensure that its activities do not harm the environment. Such as pollution control, energy conservation, climate change, and the rising levels of carbon emissions, among others.
- **Social Framework:** As we know, a company originates and operates within a society. Therefore, it must function with a sense of social responsibility. It is essential to understand and address what the consumers need from the company, what the employees expect, and to ensure considerations such as gender balance, human rights, and other social concerns are properly taken into account.
- **Governance Framework:** If a company truly aims to progress in a sustainable and responsible manner, it must adhere to governmental regulations and consider policy decisions made by the authorities. In the case of international business operations, it becomes essential to align with both domestic and foreign policies, ensuring a balanced and coordinated approach. Key aspects include board structure, anti-corruption policies, shareholder rights, audit committees, and other governance mechanisms.

What is Vision of Vikshit Bharat 2047

Viksit Bharat Vision 2047 is a visionary plan of the Government of India. Under this, it has been stated that when India completes 100 years of independence, the goal is to achieve balanced and inclusive development in economic, social, environmental, and technological sectors. This is aimed at enabling India to position itself among the developed nations of the world.

Sources: Developed India Mission, Government of India & UN SDGs.

Key Pillars of Viksit Bharat

- **Economically empowered nation:** To make India economically strong and prosperous, the aim is to position its economy among the top 3 in the world by promoting industrial development, innovation, Make in India, international trade, and making India self-reliant.
- **Sustainable development and environmental protection:** As it is well understood that along with development, protecting the environment is equally important, a goal has been set to ensure environmental conservation by aiming for net-zero carbon emissions, using renewable resources, conserving water effectively, and preserving biodiversity.
- **Technological development:** Empowering the nation through e-governance under Digital India, and advancing technological growth through artificial intelligence, space technology, and quantum computing**.**
- **Development with society**: Ensuring inclusive growth by taking everyone along—whether it is providing quality education, accessible healthcare for all, women empowerment, engaging the youth, maintaining cleanliness, and fulfilling all basic services for the entire society.
- **Effective global leadership:** To develop while keeping foreign policies in focus, and to promote India's rich heritage—such as culture, yoga, Ayurveda, and traditions—for global recognition. Additionally, addressing global challenges like climate change and promoting peaceful solutions to international issues are key to elevating the nation to greater heights.

Various Major Initiatives Driving the Vision Forward: Digital India Mission, Pradhan Mantri Gati Shakti Yojana, Skill India, Startup India, Ujjwala Yojana, Jal Jeevan Mission, and others.

Rationale: Why ESG is Relevant to National Strategic Goals (Viksit Bharat 2047)

The goal of Viksit Bharat Vision 2047 is for India to become the third-largest economy in the world and to be counted among the developed nations. By the time India completes 100 years of independence, it aims to achieve progress in various sectors, including economic growth, environmental sustainability, social development, and good governance. By ensuring development in all these areas, institutions should align their performance with national development goals.

a) Harmonization with the Sustainable Development Goals (SDGs)

India's Viksit Bharat Vision is strongly aligned with the United Nations Sustainable Development Goals (SDGs), which aim to tackle key global issues such as poverty, inequality, climate change, environmental degradation, and access to justice. ESG (Environmental, Social, and Governance) reporting offers a well-defined framework that enables businesses to actively support these goals through:

- Environmental transparency (actions against climate change, promotion of renewable energy),
- Social responsibility (protection of labour rights, promotion of gender equality, inclusive economic growth),
- Good governance practices (ethical decision-making, openness, and accountability).

b) Economic development with focus on environmental conservation

India aims to become a $30 trillion economy by 2047, while ensuring that environmental conservation remains a priority. At the same time, all firms are encouraged to pursue green investments to achieve sustainable growth. This approach will help them develop in the long term while contributing to the nation's overall progress.

c) Investor confidence and global competition

One of the goals of Vision 2047 is that investors will also make their investments keeping ESG (Environmental, Social, and Governance) factors in mind.

In this way, investor confidence will increase and risks will also be reduced.

d) A Link between regional disparities and equality

Developed India aims to ensure that development takes place equally in rural and urban areas, and benefits both men and women without discrimination.

ESG reporting supports the achievement of Vision 2047 in the following ways:

- Assessing social impact
- Promoting workforce diversity
- Investing at the local level
- Emphasizing skill development

These goals are to be achieved through various national missions such as Skill India, Make in India, and Atmanirbhar Bharat.

e) Development through good governance

ESG emphasizes that development is possible through strong corporate governance.

It focuses on working in alignment with policies, ensuring the accountability of the board, and conducting business free from corruption.

Examples include:

- Implementing transparent governance policies
- Establishing separate institutions for effective supervision and monitoring**.**

Research questions

- How does ESG reporting contribute to achieving the developmental goals of Vision 2047?
- What are the outcomes of ESG implementation at different levels of firms, and how are these outcomes interrelated?
- What are India's long-term goals for fulfilling Vision 2047?
- How does ESG reporting impact various sectors of the economy?
- In what ways does ESG reporting formulate strategies at regional, environmental, and social levels?
- How is India developing a regulatory framework for ESG to achieve its long-term goals?

Significance of the study

1. National development alignment

This study establishes a strong connection between corporate ESG (Environmental, Social, and Governance) practices and the vision of Viksit Bharat 2047. It demonstrates how ESG reporting can act as a strategic bridge to promote inclusive, sustainable, and equitable growth that supports India's long-term national development goals.

2. Policy relevance

The insights from this research can help policymakers, regulators (such as SEBI and NITI Aayog), and ministries refine their approaches to ESG-related mandates, strengthen Business Responsibility and Sustainability Reporting (BRSR) norms, and frame green finance initiatives that align with the roadmap for Viksit Bharat.

3. Corporate strategy enhancement

For Indian companies, the study highlights how adopting ESG strategies not only enhances corporate reputation and investor confidence but also leads to sustainable value creation and global competitiveness, which are crucial for participating in ESG-driven supply chains.

4. Investor and market significance

The findings of this study can assist investors and financial institutions in evaluating the impact of ESG practices on company stability, risk management, and reputation. This will help them make socially responsible, impact-oriented investment decisions that also align with India's developmental priorities.

5. Academic and research contribution

This research addresses a critical gap in Indian academic literature by linking ESG reporting with national development outcomes. It also opens new avenues for interdisciplinary research in areas such as sustainability accounting, corporate governance, development economics, and public–private partnerships.

6. Support for SMEs and emerging sectors

The study sheds light on the ESG challenges faced by MSMEs and new industries. It can guide these sectors in adopting ESG frameworks effectively so that development becomes inclusive and not restricted only to large corporations.

7. Vision 2047 monitoring tool

This research positions ESG reporting as a tool for tracking and monitoring India's progress towards the goals of Viksit Bharat 2047. Through measurable indicators and greater transparency, it ensures that economic growth moves forward without compromising social justice or environmental sustainability.

Literature Review

- **Sharma, P., Panday, P., & Dangwal, R. C. (2020) [13]**

The researchers have used the GRI framework to analyse and construct the ESG disclosure index the most important variable that impacts the level of ESG disclosures is profitability. It implies that the higher the profitability of the firm, the higher they disclose the ESG factors.

- **Efthymiou, L., Kulshrestha, A., & Kulshrestha, S. (2023) [12]**

The existing literature highlights the application of ESG across several fields, the results revealed that Indian service firms were not comfortable to adopt fully digitalization methods. The findings suggest that technology can both facilitate and hamper the sustainability effort; hence, the consequences on internal stakeholders, such as managers and workers, can be both positive and negative.

- **Banerjee, S., & David, R. (2025) [11]**

This study finds that while Indian investors are aware of ESG factors, they prioritize traditional financial metrics like returns and risk over ESG considerations. ESG factors are often treated as secondary, hindered by the lack of standardization in data and ratings, making them complicated to quantify and relate. Moreover, issues about greenwashing and unreliable ESG information further reduce their significance in investment decisions. The findings of this study emphasize the need for reliable ESG data, standardization and increased investor education for better integration.

- **Serikakhmetova, A. B., & Adambekova, A. A. (2022) [10]**

The authors have highlighted the importance of more comprehensive corporate social responsibility taking into consideration the five countries. The results are that in the USA, China and India, the term CSR is been passionately studying and mentioning, while in Russia and Kazakhstan there is a small number of published scientific works on this topic. The most important result of applying CSR in a company is participation in social and economic changes. Companies by taking on this responsibility are making a meaningful input in upgrading the quality of life of people around the world.

- **Mohd Daud, S. N., Ghazali, N. S., & Mohammad Ismail, N. H. (2024) [9]**

The authors discovered that ESG practices among corporate entities significantly impact economic growth in Malaysia, the Philippines and Singapore. Particularly, the environmental element positively affects the growth of Malaysia, Thailand and the Philippines, while the governance components of ESG contribute to Thailand's economic growth. The authors also observed that innovation upgrades countries' economic growth, thus offering policy insights into promoting ESG practices and stimulating the ecosystem for innovation.

- **Naomi, P., & Akbar, I. (2021) [8]**

The paper proposes that ESG performance is more likely to be affected by the quality of institutions, rather than by the economy size. Good institutions enable the economy to reach optimum resource allocation. This paper used the path analysis model to develop and test a theoretical model to comprehend the correlation between natural resource rent, ESG performance, and the quality of economic development at the country level. This study employs a data set of OECD countries during the period of 2000-2017.

- **Umesh, Pranav & Sivakumar, N. (2025).**

This paper attempts to present some case studies of how the goals of SDG4 have been facilitated through CSR initiatives. The authors have taken the data from the India" largest corporate (NIFTY indexed), and concluded that the corporates exert a strong influence in facilitating SDG4 and the India 2047 vision

- **Gurung, P., & Sarkar, S. (2024) [7]**

This paper focuses on lack of waste management practices adopted by Industrialists. According to authors this should be the top most priority and needs a huge scope of improvement since it has a negative impact on environment. The Industrialists should adhere to GRI frameworks to control any harmful impact on the environment.

- **Joshi, Ghanasham S. & Hyderabad, R.L. (2019)**

The authors have attempted to study various determinants of CSR with an aim that group of factors such as size of the company, profitability, leverage, board size and age of the firm have any association with CSR disclosures. The results showed the positive and significant association between board size of the firm, size of the firm and age and CSRD and a negative and insignificant relationship between profitability, leverage and CSRD is also noticed. The authors took the data from 2011-2017 year among NIFTY companies to study factors influencing CSR disclosures.

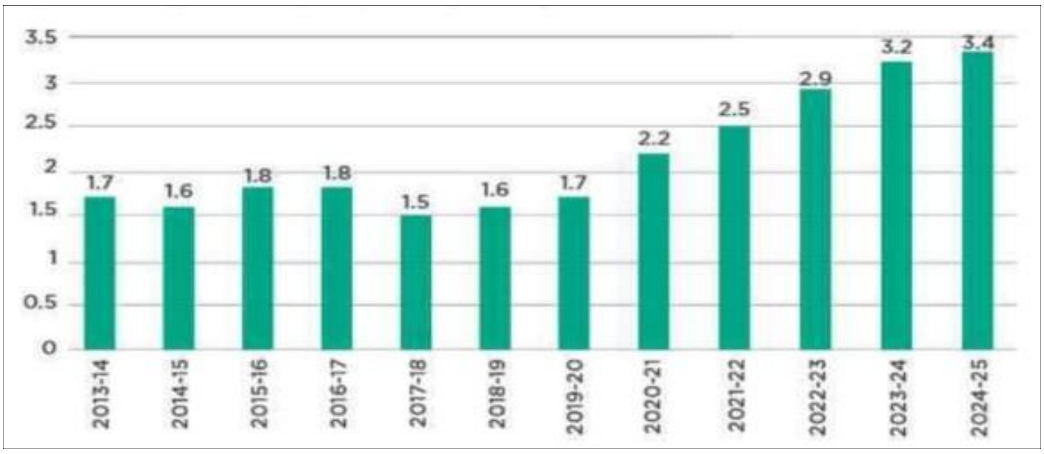
Identified gaps in literature

A careful review of prior studies reveals three key gaps:

- Limited linkage with national development – Most studies examine ESG at the micro (firm) level but ignore macro-level strategic alignment with government visions like Viksit Bharat 2047.
- Lack of standardization focus – While issues of data reliability and investor confidence are discussed, concrete models for standardized ESG disclosures in India remain unexplored.
- Insufficient MSME focus – Large corporates dominate ESG research, while the contribution and challenges of MSMEs are under-researched.

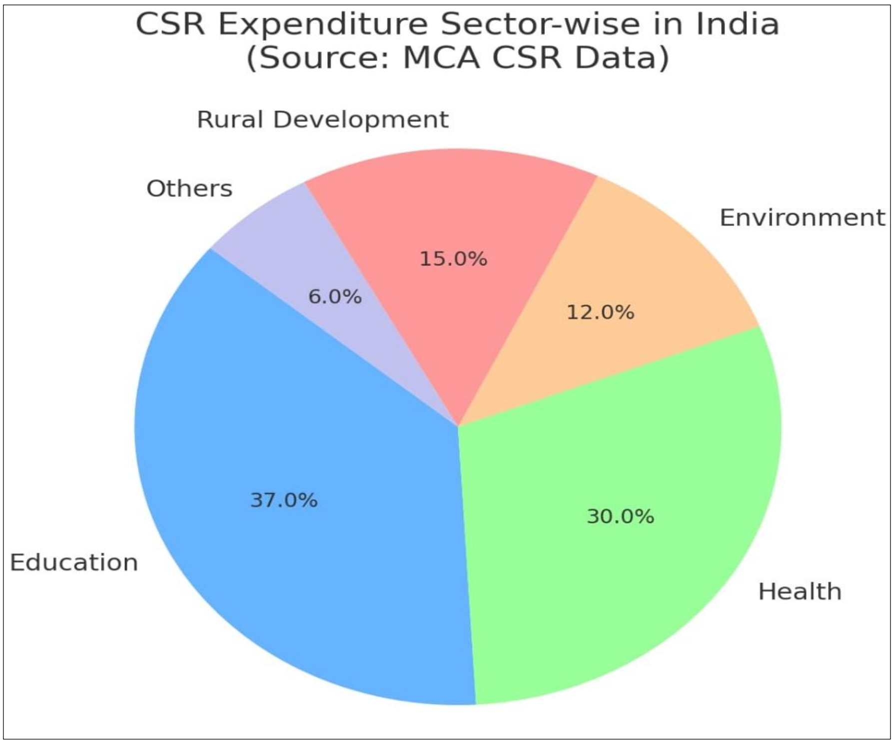
The present study addresses these gaps by integrating corporate ESG practices into a broader framework of India's developmental goals.

Data Analysis



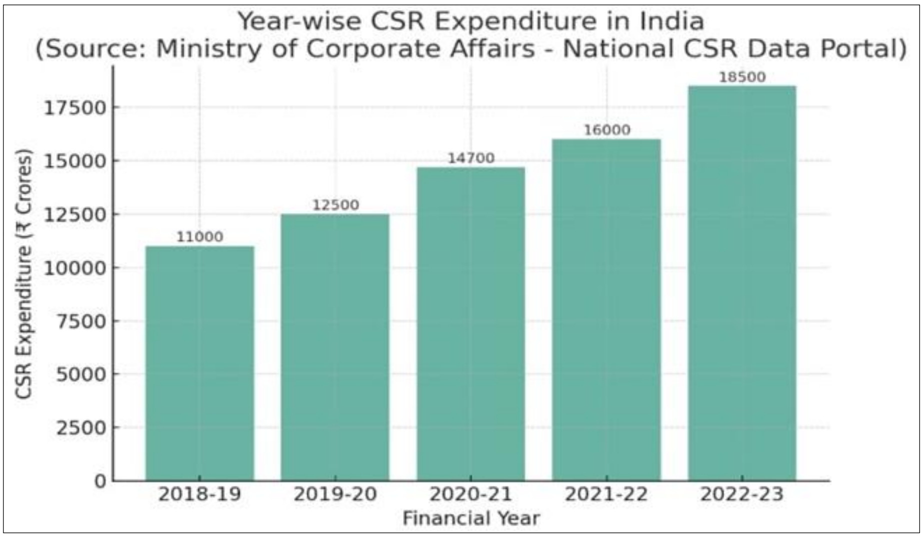
Source: Calculations based on RBI Database of the Indian Economy. Economy Survey 2022-23, and union Budget 2024-25

In the last decade, India has shown a consistent rise in its capital expenditure as a percentage of GDP, reflecting a strong focus on long-term growth and sustainable development. The share of capital expenditure in the Union Government's budget has gradually increased from around 1.6–1.8% during 2013–2019 to 2.2% in 2020–21, further rising to 2.5% in 2021–22. This growth accelerated post-pandemic, reaching 2.9% in 2022–23 and is projected to touch about 3.4% by 2024–25. Such expenditure is directed towards infrastructure creation, research and innovation, healthcare, education, housing, railways and urban development, which generate long-term multiplier effects and enhance overall productivity. These investments also create an enabling environment for private sector participation, helping in the achievement of Sustainable Development Goals (SDGs) and laying a strong foundation for India's aspiration of becoming a developed nation by 2047.
Simultaneously, the corporate sector has played an important complementary role through Corporate Social Responsibility (CSR) spending. Since the introduction of CSR provisions in the Companies Act, 2013, the private sector has been actively contributing to social development, skills training, and environmental initiatives aligned with national priorities. Total CSR expenditure has steadily increased from ₹24,966 crore in 2014-15 to ₹26,279 crore in 2021-22, signifying the growing integration of corporate actions with the SDG agenda. This trend highlights that, alongside government spending, responsible business practices are increasingly being leveraged as a strategic tool for inclusive and sustainable growth.



Source: Ministry of Corporate Affairs – National CSR Data Portal, accessed 2024

The above pie chart presents the sector-wise distribution of Corporate Social Responsibility (CSR) expenditure in India, based on data compiled from the Ministry of Corporate Affairs – National CSR Data Portal.
Education (37%) has received the largest share of CSR spending, showing that companies are prioritizing educational initiatives, skill development, and literacy enhancement.
Health (30%) stands as the second highest sector, indicating a strong focus on healthcare, sanitation, and COVID-19 relief measures.
Rural development (15%) and Environment (12%) collectively account for over one-fourth of CSR expenditure, reflecting attention towards sustainable development and ecological balance.
Others (6%) covers remaining initiatives like heritage protection, sports, and miscellaneous welfare activities.
This distribution highlights that corporate India is aligning its CSR priorities with national developmental goals, with the largest emphasis on education and healthcare, while environmental concerns are also emerging as an important area.



The above bar chart illustrates the trend of Corporate Social Responsibility (CSR) expenditure in India from 2018-19 to 2022-23, based on aggregated data available on the Ministry of Corporate Affairs – National CSR Data Portal.

It is clearly observed that CSR spending has shown a consistent upward trend over the years.

In 2018-19, the total CSR expenditure was approximately ₹11,000 crores.

By 2022-23, this amount increased to around ₹18,500 crores.

This steady growth indicates that corporate entities in India are increasingly prioritizing social development, community welfare, and sustainable initiatives, thereby contributing to both the social and environmental dimensions of ESG.

Research methodology

This study adopts a descriptive and analytical research design with a mixed-method approach.

Nature of data: Secondary data collected from BRSR, CSR reports, MCA National CSR Data Portal, RBI Database, Economic Surveys, SEBI reports, NITI Aayog's SDG Index and peer-reviewed journals.

Time frame: Data for the period 2014–2024 was analyzed as this period marks the introduction and evolution of CSR provisions (2013) and the launch of BRSR guidelines (2021 onwards).

Sampling frame: The study focuses on NIFTY 100 companies as representative of large corporates because of their high compliance with ESG/BRSR norms. National level data on CSR expenditure was also analyzed.

Tools and techniques: Content analysis to identify themes linking ESG initiatives to national development. Trend and comparative analysis (using Excel) for CSR/ESG expenditure data.

Descriptive analysis supported with charts and tables for interpretation.

Limitations

This study is based on secondary data, hence the findings are limited to publicly available disclosures and do not capture internal organizational practices.

Findings and Discussion

Key findings

1. **Increasing integration of ESG reporting in Indian corporates**

Analysis of BRSR and CSR disclosures reveals that an increasing number of listed companies are embedding ESG principles into their strategic planning. Education, health, rural development, and environment conservation account for the largest share of CSR spending, which aligns with national priorities.

2. **Alignment with Viksit Bharat 2047 Vision**

ESG initiatives undertaken by corporates show a strong contribution toward the pillars of Viksit Bharat 2047, particularly in areas such as:

- Economic Growth: Investments in innovation, skill development, and infrastructure.
- Social Development: Focus on education, gender diversity, and healthcare.
- Environmental Sustainability: Renewable energy, waste management, and carbon footprint reduction.

3. **Investor perception and market value**

ESG-compliant firms have shown enhanced investor confidence and global competitiveness. However, in India, many investors still consider ESG factors as secondary to financial performance due to lack of standardized data.

4. Challenges in implementation

- Voluntary nature of ESG reporting among SMEs.
- Lack of standardization and third-party verification in ESG data.
- Greenwashing risks and absence of strict enforcement mechanisms.

5. Policy and regulatory support

Initiatives such as SEBI's BRSR, National CSR portal, and India's SDG roadmap have provided a structure to corporate disclosures, but further integration and mandatory norms are needed.

International comparison

Globally, countries like the EU, USA and Japan have adopted mandatory sustainability reporting standards (e.g., CSRD in Europe) and independent verification systems. Compared to these, India is still at an evolving stage where ESG reporting is largely voluntary except for top listed companies. This indicates a significant opportunity for India to strengthen enforcement mechanisms and adopt global best practices.

Discussion

The findings indicate that ESG reporting has moved beyond compliance and is increasingly being viewed as a strategic tool for sustainable development in India. Companies with robust ESG frameworks are better positioned to align with Viksit Bharat 2047 goals by:

- ➢ **Fostering social equity**: Corporate spending on education and healthcare creates a multiplier effect on human capital development.
- ➢ **Driving environmental responsibility:** Adoption of clean energy and efficient resource use reduces ecological degradation.
- ➢ **Enhancing governance**: Transparency, ethical leadership, and responsible board practices strengthen institutional trust.

However, the voluntary nature of ESG reporting poses a barrier to achieving national objectives at scale. Stronger policy frameworks, capacity-building for MSMEs, standardized disclosure norms, and third-party verification will be essential to realize the full potential of ESG reporting as a driver of sustainable growth.

Practical and policy implications

- **For policymakers:** The findings underline the need for a mandatory ESG disclosure framework with third-party audits and a uniform reporting standard.
- **For corporates:** Embedding ESG in business strategy not only enhances reputation but also aligns the company with future government policies and global value chains.
- **For academia:** This study contributes to an interdisciplinary understanding of sustainability accounting, corporate governance and development studies.

Conclusion

This study concludes that ESG (Environmental, Social and Governance) reporting has emerged as a vital strategic tool for achieving India's vision of Viksit Bharat 2047.

The analysis of secondary data and corporate disclosures shows that Indian companies are increasingly linking their ESG initiatives with national goals such as sustainable economic growth, social inclusion, environmental conservation, and ethical governance.

Key areas like education, healthcare, renewable energy, skill development, gender equity and rural development are receiving significant attention through ESG and CSR activities, creating a positive multiplier effect on the nation's progress. ESG adoption also enhances investor trust, corporate reputation, and global competitiveness.

However, the study identifies persistent challenges:

- ➢ Voluntary nature of ESG compliance,
- ➢ Lack of uniform standards and third-party verification, and
- ➢ Instances of greenwashing and limited participation of MSMEs.

For ESG to act as a transformative force, it is essential to strengthen the regulatory framework, ensure standardized reporting, promote awareness among smaller firms, and link ESG metrics with national development monitoring.

In essence, ESG reporting must evolve from a compliance-oriented activity into a transformative corporate practice that supports India's aspiration of becoming a socially just, environmentally responsible and economically strong developed nation by 2047.

Limitations and future research

This study is based on secondary data; hence the insights are limited by the accuracy of public disclosures. Future research should incorporate primary surveys or interviews with corporate executives, investors and policymakers to validate the qualitative dimensions of ESG practices.

Additionally, sector-specific and MSME-focused studies could provide deeper insights. Longitudinal studies tracking the progress of ESG initiatives till 2047 can also be undertaken.

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Transforming employment: The AI & Automation era

Anuj Bajpai[1*] and Shreyansh Tiwari[1]

[1] Assistant Professor, LCIT College of Commerce & Science, Bodri, Bilaspur, Chhattisgarh, India

*Corresponding Author: Anuj Bajpai

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Abstract

The rapid combination of artificial intelligence (AI) and automation technologies is driving significant changes in the labor market, requiring a re-evaluation of traditional employment models. This paper look into the great effects of these technologies, focusing on both job displacement and the creation of new job opportunities. It explores the evolving skills needed for the future workforce, highlighting the increasing importance of adaptability, critical thinking, and digital literacy. The study also looks at the economic impacts, weighing potential productivity improvements against the risk of deepening income inequality. Ethical concerns, such as algorithmic bias, data privacy, and the broader social consequences of automation, are also explored. Additionally, the paper emphasizes the need for comprehensive policy frameworks and educational reforms to mitigate the adverse effects of job loss and facilitate a smooth transition. Dynamic solutions like retraining programs, continuous learning opportunities, and the possible introduction of universal basic income are discussed as ways to build a resilient and inclusive job market. By reviewing current research and trends, this paper calls for collaboration between policymakers, businesses, and educational institutions to tackle the challenges produce by AI and automation, and to ensure that the future of work is productive and fair for all.

Keywords: Artificial Intelligence (AI), Automation, Digital literacy, Ethics, Economic impacts

1. Introduction

Over the past few decades, significant forces-including technological progress, globalization, and the restructuring of production through outsourcing and offshoring-have undeniably caused dramatic changes in the labor markets of both advanced and developing countries, particularly in the demand for specific skills. Adding to this, the aging populations in developed nations are intensifying the need for continuous training and are expected to alter the structural demand for certain skills, notably in health and elder care. These factors have created a multifaceted impact on the labor market, with job displacement occurring alongside the emergence of new roles, some being variations of old ones and others being entirely new. Consequently, the volume and type of skills and qualifications needed in this evolving labor market have substantially shifted. New skills are required not just for new jobs but also to meet the changing demands of existing ones. Determining which occupations will grow and where, and which skills will be most in demand, are central questions in economic and policy debates. Addressing these issues requires the gathering of specific data and the development of new analytical tools that can integrate with and enhance current labor market instruments to understand the complexity and variability of these emerging trends.

Despite these expectations and concerns, we lack a clear understanding of the effects of automation, especially AI and robotics, on the labor market and productivity. A significant portion of the debate, both publicly and academically, is unfortunately framed as a false dichotomy. One side warns of AI and robotics causing widespread joblessness, while many economists on the other contend that, based on historical trends of technological progress increasing labor demand and wages, there's no reason for worry this time.

Corporate personnel face unprecedented challenges to their career prospects in the digital age as deep learning and artificial intelligence enable robots to perform increasingly complex functions. The World Economic Forum's Future of Jobs 2020 report indicates a significant disruption over the next five years, with automation and the evolving human-machine division of labor expected to impact 85 million jobs across 15 global industries. The report further emphasizes that the COVID-19 pandemic-induced recession and the swift advancement of automation technologies are driving a faster-than-anticipated transformation of the job market. Consequently, the need for professional workers in fields like accounting, data entry, and managerial support has been severely affected, compounding the economic anxieties of white-collar employees.

2. Literature review

Rayhan, Abu. (2023) [15]. Organizations across various sectors are increasingly adopting rapidly advancing AI and automation technologies. This allows them to streamline their operations, boost efficiency, and gain a competitive advantage. AI-driven tools like chatbots, virtual assistants, and automated processes are becoming standard in customer service, while machine learning algorithms are being used to enhance decision-making and predictive capabilities. Although the pace of adoption differs among industries, it's clear that AI and automation are significantly influencing the present and future landscape of work.

The manufacturing industry has historically been a leader in automation, with the incorporation of robotics and AI fundamentally changing production. This has led to greater efficiency, precision, and output. Automated assembly lines, robotic arms, and self-driving vehicles have taken over many manual jobs, simplifying operations and reducing costs for companies. Robotics is essential for automating tasks that are repetitive or dangerous in manufacturing. AI-powered robots can adjust to new situations, perform intricate tasks accurately, and work together smoothly with human employees. The synergy of robotics and AI also facilitates predictive maintenance, quality assurance, and inventory control, thereby improving overall production.

While automation offers significant advantages to manufacturing, it also brings up concerns about job losses. As machines handle routine and less-skilled jobs, some positions may become unnecessary. However, automation also generates new needs for workforce development through upskilling and reskilling. Rather than simply replacing workers, automation often reshapes job roles, requiring employees to develop new abilities and concentrate on tasks that demand human ingenuity, problem-solving skills, and critical thought.

Devagiri, J. S. *et al*. (2022) [9]. Due to constant technological advancements driven by global competition, industries face evolving demands annually. Augmented Reality (AR) has become a prominent technology across various fields. AR overlays computer-generated virtual information onto the real world through a process called rendering, making digital content appear part of the physical environment. While other methods exist to enhance reality with digital objects, AR is the most prevalent. Recent significant progress has led to its widespread adoption in sectors like gaming, education, and entertainment, where developers create real-time adaptive digital inputs based on user environment changes. Integrating AR with machine learning (ML), which excels at image processing and information extraction, holds immense potential for improving industrial efficiency. AR designs typically involve layers from object detection to display. Mixed Reality (MR) blends physical and virtual worlds with interactive capabilities, often using devices like holographic glasses, whereas AR enhances the physical environment and can be experienced through smartphones, tablets, and AR glasses. AR's increasing popularity positions it as a key component of the Industry 4.0 revolution, which emphasizes smart manufacturing by integrating intelligence with automated systems to enhance human expertise and enable autonomous, data-driven robotic decision-making. Artificial Intelligence (AI) and ML are expected to significantly improve the adaptability and effectiveness of AR systems, building on their success in areas like object detection and their existing impact in manufacturing for tasks such as inspection and materials information management.

Wang, W. & Siau, K. (2019) [20]. Artificial intelligence (AI) is a multifaceted concept influenced by and influencing a diverse array of fields, including computer science, engineering, biology, psychology, mathematics, statistics, logic, philosophy, business, and linguistics. Its manifestations are diverse, spanning from everyday applications like Apple Siri and Amazon Go to sophisticated technologies such as self-driving vehicles and autonomous weaponry. A fundamental classification of AI is into weak AI and strong AI. Weak AI, or narrow AI, excels at particular tasks, and the majority of AI successes to date, such as Google Assistant and Alpha Go, are examples of this. Nevertheless, researchers in various domains are actively pursuing the creation of strong AI (also termed human-level artificial general intelligence or artificial super intelligence), which would demonstrate competence across a wide spectrum of tasks. Strong AI is a contentious and much-debated idea. Many Trans humanists believe it could attain self-awareness and reach the level of human intelligence. The advent of strong AI is predicted by some to initiate a rapid "intelligence explosion," potentially leading to the unavoidable technological singularity and the subsequent, near-immediate emergence of super intelligence-broadly defined as an intellect vastly exceeding human cognitive performance in almost every domain. In essence, a strong AI would be capable of surpassing human abilities in nearly all cognitive endeavors.

Acemoglu, D., & Restrepo, P. (2019b) [1]. Automation technology boosts productivity by allowing a more flexible allocation of tasks, which in turn fuels demand for labor in non-automated areas—a phenomenon we call the 'productivity effect.' The net influence of automation on labor demand is thus determined by the balance between this productivity effect and the job-displacing effects. Importantly, technological history is not just about automation eliminating human jobs. If it were, we would be stuck with a shrinking number of old roles and a continuously decreasing portion of national income going to labor. Instead, the displacement caused by automation has been countered by technologies that establish new tasks where human labor has an advantage. These new tasks generate not only a positive productivity effect but also a 'reinstatement effect,' re-engaging labor in a broader spectrum of activities and thus altering the composition of production to favor labor. This reinstatement effect directly opposes displacement and increases both labor's share of income and the overall demand for labor.

Autor, D. H. (2015) [5]. The accelerating trend of digitization is expected to lead to economic disruption rather than environmental concerns, driven by the fact that increasingly capable computers diminish the need for some categories of workers. Technological progress will likely disadvantage a segment of the workforce, possibly a significant portion, as it advances rapidly. As this paper will illustrate, highly skilled and educated workers are in an advantageous position, able to utilize technology to create and extract value. However, those with only 'ordinary' skills and abilities face an increasingly difficult landscape, as computers, robots, and other digital technologies are gaining these skills at an exceptionally fast rate.

Akst, Daniel. (2013) [3]. Despite two centuries of automation and technological progress not rendering human labor unnecessary-shown by the 20th century's increase in the employment-to-population ratio alongside women entering the market, and the lack of a sustained rise in unemployment despite economic cycles-those concerned about automation and jobs argue that historical patterns may not apply to future scenarios. The emergence of vastly improved computing power, artificial intelligence, and robotics, in particular, creates the possibility of labor displacement on a scale never before witnessed. There is no fundamental economic rule ensuring everyone can earn a living simply through their skills and integrity. Whatever the future brings, the present is undeniably characterized by a resurgence of fears about automation.

Schappell, R. (1983) [18]. Artificial intelligence (AI), a field within computer science, focuses on creating programs that can make complex decisions, learn and improve decision-making skills, interact with humans naturally, and generally exhibit behaviors associated with human-like intelligence. Here, "intelligence" refers not to exceptional talent but rather the general human (and some animal) capacity to understand and process vast amounts of diverse information, adapt to new situations by modifying behavior, grasp connections between facts and ideas, and generate new concepts and relationships from existing knowledge. The "artificial" aspect simply means this intelligence is achieved through technology. AI research encompasses a wide range of theoretical areas, including knowledge representation, acquisition, problem-solving, vision, theorem proving, and natural language processing. While these topics can be studied from a human cognitive perspective, AI researchers aim to implement these abilities in computers. Beyond its theoretical foundations, AI has significant practical applications, primarily in the development of expert systems and natural language interfaces.

3. The impact of AI and automation on job displacement and creation

The increasing integration of artificial intelligence (AI) and automation technologies is significantly reshaping the labor market, leading to concerns about job displacement in certain sectors while simultaneously creating new employment opportunities. Several industries with a high prevalence of routine and manual tasks are particularly vulnerable to automation. For instance, manufacturing, transportation, and data entry are witnessing a shift as robots, autonomous vehicles, and AI-powered systems become capable of performing tasks previously done by human workers. This displacement necessitates a proactive approach towards reskilling and upskilling the workforce to adapt to the evolving demands of the job market.

Identifying emerging job roles and industries driven by AI and automation is crucial for understanding the evolving landscape of work. The integration of these technologies is not only automating existing tasks but also creating entirely new fields and specializations. Several key areas are witnessing significant growth due to the advancements in AI and automation.

One prominent area is the field of AI development and maintenance itself. This includes roles such as AI engineers, machine learning specialists, data scientists, AI trainers, and AI ethicists. These professionals are responsible for designing, building, implementing, and ensuring the responsible use of AI systems. As AI becomes more integrated into various aspects of business and society, the demand for these specialized skills will continue to rise. Additionally, new roles are emerging that bridge the gap between AI capabilities and specific industry needs, such as AI product managers and AI solutions architects who understand both the technical aspects of AI and the business context.

The pervasive nature of digital technologies in modern daily life, it's hard to recall a time when most people lived rurally, relying on agriculture and handicrafts for their livelihoods. The last century has witnessed rapid global transformation, and the rate of innovation is set to accelerate further. While most individuals focus on the consumer-facing aspects of technology, the increasing automation of tasks in factories and services, which previously required human labor, often goes unnoticed. This automation is predicted to cause significant unemployment, particularly impacting individuals with a mid-level education, while those with high and low levels of education may be less affected. Low-skill, low-paying jobs requiring no specialization are expected to grow, widening the gap between them and high-skill jobs, leading to greater social inequality, as automating these roles may not be economically viable. Despite the serious challenges automation will bring to the job market, it is ultimately a positive development that necessitates societal adaptation.

Automation has progressed from the mechanization of the Industrial Revolution, which boosted productivity but still required significant human control, to the Digital Revolution, where the introduction of computers in the late 20th century provided the foundation for today's advanced automation technologies. The rise of Artificial Intelligence (AI), fueled by advancements in algorithms, processing power, and the availability of large datasets, has become a critical driver in modern automation, enabling machines to learn and adapt. Currently, AI-driven automation is transforming various industries, with robotics and AI optimizing manufacturing processes and enhancing supply chains, while in healthcare, AI aids in diagnostics, patient monitoring, and personalized medicine, improving efficiency and patient outcomes. Emerging technologies like Robotic Process Automation (RPA) are automating repetitive business tasks for cost reduction, and Machine Learning, a key AI subfield, allows systems to improve their performance through data learning without explicit programming.

4. Surveys and reports

- **Job creation and displacement**

  - The WEF's Future of Jobs Report 2025 projects a significant labor market transformation, with AI and information processing technologies expected to reshape 86% of businesses by 2030. They anticipate the creation of 170 million new jobs globally while potentially displacing

92 million existing roles, resulting in a net increase of 78 million jobs.

- McKinsey suggests that while AI could lead to displacement, it also presents a $4.4 trillion opportunity in added productivity growth. Their analysis indicates that nearly all occupations will be affected by automation, but only about 5% could be fully automated with current technologies. Many more jobs will see a partial automation of tasks, leading to job changes.
- IBM Institute for Business Value highlights that AI is fueling new job creation, with over half of Canadian CEOs in a 2024 study reporting hiring for roles that didn't exist the previous year due to generative AI. They also emphasize that AI can augment human capabilities rather than just replace jobs.

- **Skills transformation**

- The WEF reports that 39% of existing skill sets will become outdated between 2025 and 2030, emphasizing the urgent need for upskilling and reskilling. They identify AI and big data, networking and cybersecurity, and technological literacy as the fastest-rising competencies.
- LinkedIn's "Jobs on the Rise" reports consistently show a growing demand for AI-related professions such as AI Engineers and AI Consultants. Their data also highlights the importance of both technical AI skills (machine learning, deep learning, data analysis) and soft skills (communication, problem-solving, collaboration).
- PwC's AI Jobs Barometer indicates that occupations highly exposed to AI are experiencing nearly five times higher growth in productivity but slower hiring growth. They also note a 25% higher net change in skills required in AI-exposed occupations between 2019 and 2023 and a three times higher growth in hiring for jobs requiring specialized AI skills.

The ongoing Fourth Industrial Revolution, or Industry 4.0, is significantly propelled by the advancements and integration of artificial intelligence and automation. The fusion of intelligent machines with the Internet of Things (IoT) is revolutionizing factory operations, allowing for enhanced adaptability and quicker responses to evolving market demands. By deploying robots and other automated systems, businesses can achieve substantial reductions in labor expenses, leading to increased overall productivity and a significant decrease in errors typically associated with human involvement. This technological shift enables routine production processes to be executed with exceptional precision and consistency, thereby freeing up human capital within organizations to concentrate on more strategic, complex, and creative endeavors that require higher-level cognitive skills and decision-making.

5. Objectives of the study

- To analyze the evolving landscape of job roles.
- To investigate the shifting skill and educational requirements.
- To evaluate the potential economic consequences.
- To explore the perceived impact of AI on individual industries/fields.

6. Hypothesis

H_{o1}: Increased perceived impact of Artificial Intelligence (AI) on job roles is not associated with increased concern about job displacement and the perceived importance of continuous learning.

H_{a1}: Increased perceived impact of Artificial Intelligence (AI) on job roles is associated with increased concern about job displacement and the perceived importance of continuous learning.

7. Research methodology

i. Data collection

- **Primary data:** Primary data would be collected from the Bilaspur district in Chhattisgarh with Questionnaire surveys and semi structured informal interviews also taken from selected individuals.
- **Secondary data:** The secondary data would be collected from web sites, official records, published reports of similar projects, journals and literature from various disciplines.

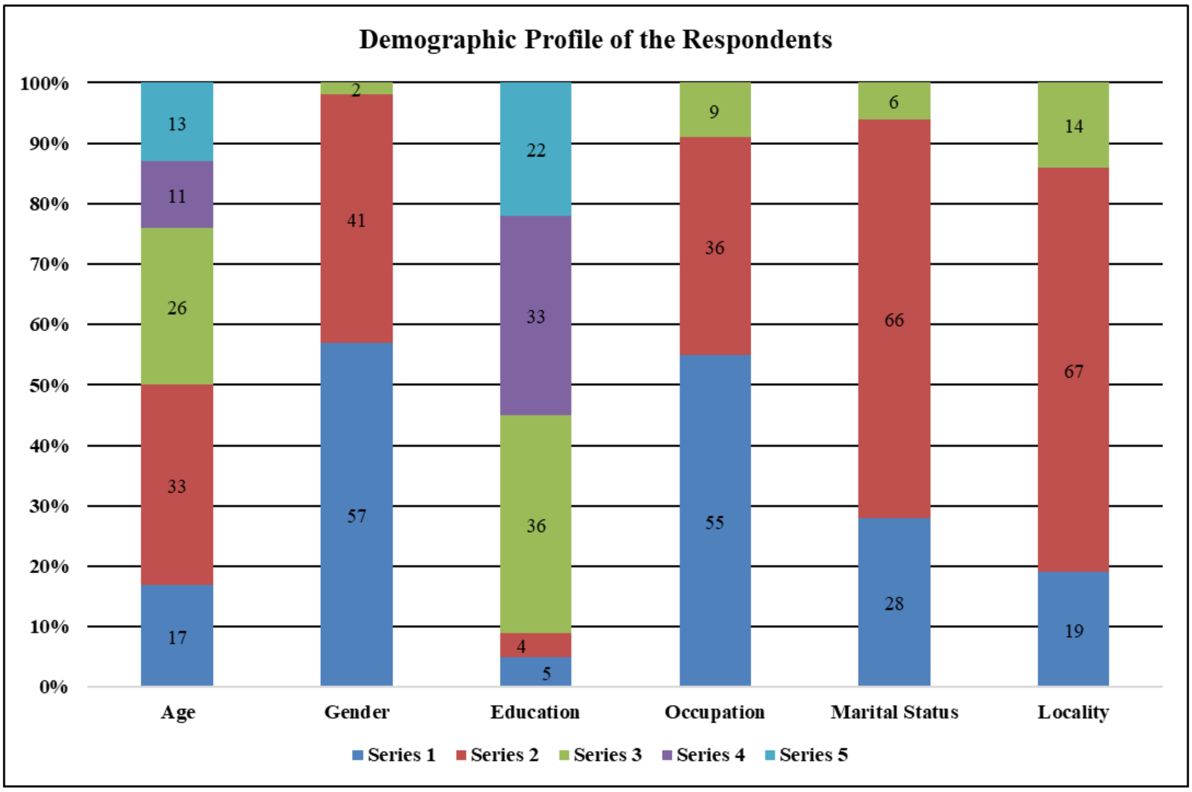
ii. Population: Target population for the study was different types of employees (Government employee, Semi-government employee, Private employee) of Bilaspur district.

iii. Sample: The research will adopt stratified random sampling method to collect the required data.

iv. Tools used for analysis: The researcher adopts the tool for analysis is Multiple regression through SPSS 26.

8. Data interpretation and analysis

- **Demographic analysis**



Source: Researchers observation

Graph 1: Demographic Profile of the respondents

Table 1: Demographic Profile of the respondents

Demographic Profile of the Respondents					
S. No.	**Factors**	**Response**	**Series**	**Frequency**	**Percentage**
1	Age	Below 25	1	17	17%
		25 to 35	2	33	33%
		35 to 45	3	26	26%
		45 to 55	4	11	11%
		Above 55	5	13	13%
2	Gender	Male	1	57	57%
		Female	2	41	41%
		Third Gender	3	2	2%
3	Education	Matriculation	1	5	5%
		Higher Secondary	2	4	4%
		Graduation	3	36	36%
		Post Graduation	4	33	33%
		Professional	5	22	22%
4	Occupation	Private Employee	1	55	55%
		Government Employee	2	36	36%
		Semi-Government Employee	3	9	9%
5	Marital Status	Unmarried	1	28	28%
		Married	2	66	66%
		Divorced	3	6	6%
6	Locality	Rural	1	19	19%
		Urban	2	67	67%
		Semi-Urban	3	14	14%

Source: Researchers observation

The provided table & graph represents the demographic profile of 100 respondents that were surveyed. Regarding age distribution, the largest proportion of respondents falls within the 25 to 35 years age group (33%), followed by the 35 to 45 years category (26%). Respondents below 25 years constitute 17%, while those aged 45 to 55 and above 55 represent 11% and 13% respectively. In terms of gender, the majority of respondents are male (57%), with females comprising 41% and third-gender individuals accounting for 2%. Examining educational attainment, the highest percentages are observed in graduation (36%) and post-graduation (33%), followed by professional qualifications (22%). Matriculation and higher secondary education levels represent smaller proportions at 5% and 4% respectively. Concerning occupation, over half of the respondents are private employees (55%), with government employees constituting 36% and semi-government employees 9%. Regarding marital status, a significant majority are married (66%), while 28% are unmarried and 6% are divorced. Finally, concerning locality, the majority of respondents reside in urban areas (67%), followed by rural areas (19%) and semi-urban areas (14%).

- **Descriptive analysis**

H_{01}: Increased perceived impact of Artificial Intelligence (AI) on job roles is not associated with increased concern about job displacement and the perceived importance of continuous learning.

H_{a1}: Increased perceived impact of Artificial Intelligence (AI) on job roles is associated with increased concern about job displacement and the perceived importance of continuous learning.

Table 2: Description of variables

Variable	Label	Indicator
Dependent	D1	I am concerned about the potential for AI to displace human workers in the future.
Independent	ID1	AI technologies are significantly altering the types of jobs available in the current labor market.
	ID2	My industry/field is experiencing a substantial transformation due to the integration of AI.
	ID3	AI is primarily automating routine and repetitive tasks, freeing up human workers for more complex roles.
	ID4	AI is creating new job roles that did not exist previously.

Source: *Through questionnaire prepared by the researcher*

On the basis of the above table, the analysis investigates the relationship between perceptions of Artificial Intelligence's (AI) impact on the labor market and concern about future job displacement caused by AI. The dependent variable (D1) measures the level of concern regarding the potential for AI to displace human workers in the future. This concern is modeled as a function of four independent variables: the perception that AI technologies are significantly altering the types of jobs available (ID1), the belief that one's industry or field is undergoing substantial transformation due to AI integration (ID2), the view that AI is primarily automating routine and repetitive tasks (ID3), and the perception that AI is creating new job roles that did not previously exist (ID4).

Table 3: Regression Model Summary

Regression Model Summary			
R	R-square	Adjusted R Square	Std. Error of the Estimate
.286	.082	.043	.96004

Source: *Data analyzed by the researcher through SPSS 26*

Table-3, showing Regression Model Summary, provides insights into the overall fit and explanatory power of the model. The multiple correlation coefficient (R) is 0.286, indicating a relatively weak positive linear association between the combined independent variables and the dependent variable. The R-square value is 0.082, which suggests that approximately 8.2% of the variance in the concern about AI job displacement can be accounted for by the linear combination of the four specified independent variables. The Adjusted R-square, which penalizes the inclusion of predictors that do not significantly improve the model, is lower at 0.043 (or 4.3%), further highlighting the limited explanatory power of this particular set of predictors. The Standard Error of the Estimate is 0.96004, representing the typical deviation.

Table 4: ANOVA table

ANOVA Table					
	Sum of Squares	Df	Mean Square	f-statistic	p-value
Regression	7.801	4	1.950	2.116	.085
Residual	87.559	55	.922	---	---
Total	95.360	99	---	---	---

Source: *Data analyzed by the researcher through SPSS 26*

The ANOVA table assesses the overall statistical significance of the regression model, testing whether the independent variables, taken together, significantly predict the dependent variable. The F-statistic, which compares the variance explained by the model to the residual (unexplained) variance, is calculated as 2.116. This test is based on 4 degrees of freedom for the regression (corresponding to the number of independent variables) and 55 degrees of freedom for the residual. The associated p-value is 0.085. Using the conventional alpha level of 0.05 for statistical significance, this *p*-value (0.085>0.05) indicates that the result is not statistically significant. Therefore, we fail to reject the null hypothesis, suggesting that there is insufficient evidence to conclude that this specific combination of independent variables reliably predicts the level of concern about future AI-driven job displacement within the population from which the sample was drawn.

Table 5: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t-value	p-value
	B	Std. Error			
ID1	.254	.109	.246	2.335	.022
ID2	.113	.154	.077	.732	.466
ID3	-.067	.110	-.062	-.609	.544
ID4	.022	.111	.020	.196	.845

Source: *Data analyzed by the researcher through SPSS 26*

Analyzing the individual predictors, as shown in Table-5, reveals that only ID1, representing the perception that AI technologies are significantly altering the types of jobs available, emerges as a statistically significant predictor in this model. Its positive unstandardized coefficient (B=0.254, Std.Error=0.109) suggests that a stronger perception of AI altering job types is associated with a higher level of concern about future job displacement. This relationship is statistically significant at the conventional 0.05 alpha level, as indicated by its t-value of 2.335 and p-value of 0.022. The standardized coefficient (Beta=0.246) confirms this positive association and provides a measure of its relative effect size compared to other predictors.

Conversely, the remaining independent variables did not demonstrate a statistically significant relationship with the concern about AI job displacement within this model. The perception that one's industry is transforming due to AI (ID2) showed a positive but non-significant association (B=0.113, p=0.466). The belief that AI primarily automates routine tasks (ID3) exhibited a negative, non-significant relationship (B=−0.067, p=0.544), weakly suggesting that this belief might slightly reduce concern, but the evidence is not statistically reliable. Finally, the perception that AI is creating new job roles (ID4) also had a very small, positive, and non-significant coefficient (B=0.022, p=0.845).

9. Conclusion

This research explored the complex effects of artificial intelligence (AI) and automation on the modern labor market, acknowledging both job displacement and creation, alongside a growing need for workforce adaptability and digital literacy. The study also considered significant economic and ethical factors like productivity increases, income inequality, algorithmic bias, and privacy issues. A key quantitative finding revealed a significant link between the *perception* that AI is altering the *types* of jobs available and individual anxiety about future job loss. Interestingly, in the specific model used, this factor overshadowed concerns about broader industry changes, task automation, or new job creation as a driver of displacement worries, despite the overall model showing only borderline statistical significance. These results highlight the intricate nature of transitioning to an automated future, emphasizing that strategies must go beyond simply counting job gains or losses. Addressing the qualitative shifts in work and associated employee perceptions is crucial. Therefore, developing robust policies, reforming education to focus on continuous learning and critical skills, and fostering collaboration between policymakers, industry, and educational institutions are essential.

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Redefining growth: how shared prosperity frameworks challenge traditional economic models

Vikas Kumar Joshiya[1*] and Chandra Shekar Joshiya[2]
[1] Professor, Sri Aurobindo College (Evening), Delhi, India
[2] Research Scholar, Guru Ghasidas University, Chhattisgarh, India
*Corresponding Author: Vikas Kumar Joshiya
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Abstract
The concept of shared prosperity has emerged as a critical framework for achieving inclusive development, ensuring that economic growth benefits all segments of society, particularly marginalized and vulnerable groups. This research paper examines the interplay between shared prosperity and inclusive development, analyzing key policy mechanisms, institutional frameworks, and socio-economic factors that contribute to equitable progress.
Using a mixed-methods approach, the study evaluates global case studies to identify best practices in wealth redistribution, social protection, and human capital investment. Findings suggest that progressive taxation, inclusive labor policies, and targeted social programs are essential in reducing inequality and fostering sustainable development. Additionally, the paper highlights the role of digital transformation, gender equity, and participatory governance in enhancing economic inclusivity.
The study concludes that shared prosperity is not merely an outcome but a dynamic process requiring multi-stakeholder collaboration. Policymakers must prioritize pro-poor growth strategies, financial inclusion, and environmental sustainability to ensure long-term, inclusive development. By bridging theoretical insights with empirical evidence, this research contributes to the discourse on equitable growth and offers actionable recommendations for fostering a more inclusive global economy.

Keywords: Shared prosperity, Inclusive development, Economic inequality, Social protection, Sustainable growth, Participatory governance

1. Introduction

For decades, the dominant paradigm of economic development has prioritized aggregate growth metrics, most notably Gross Domestic Product (GDP). The underlying assumption has been that the benefits of a growing economy will eventually "trickle down" to all segments of the population. However, the persistent and often rising levels of inequality within and between nations have starkly revealed the limitations of this model. Economic growth, while necessary, is not sufficient for societal well-being if its gains are concentrated in the hands of a few.

In response to this challenge, the concept of shared prosperity has gained significant traction among international institutions, governments, and civil society. The World Bank defines shared prosperity as increasing the income of the bottom 40% of a population. However, this paper adopts a broader, more holistic definition: it is a framework for development that ensures the fruits of economic progress are distributed equitably, expanding opportunities for all citizens, reducing systemic inequalities, and protecting the most vulnerable.

This paper argues that shared prosperity fundamentally challenges traditional economic models by repositioning equity from a secondary social concern to a primary driver of sustainable and resilient economic growth. The research aims to:

- Analyze the theoretical underpinnings of shared prosperity and its link to inclusive development.
- Identify and evaluate key policy mechanisms and institutional frameworks that successfully promote equitable growth.
- Examine the role of modern catalysts like digital technology and participatory governance in this process.
- Provide actionable policy recommendations for fostering inclusive economies.

2. Theoretical framework: from trickle-down to built-in inclusion

Traditional neoclassical growth models (e.g., Solow-Swan model) focus on capital accumulation, labor growth, and technological progress as drivers of GDP growth. Distribution is often treated as a separate, secondary issue. The "Kuznets curve" hypothesis—which suggests that inequality first increases and then decreases as an economy develops—has been largely debunked by recent empirical evidence, showing that inequality is a choice, not an inevitable economic law.

Shared prosperity, conversely, is rooted in alternative economic theories:

- **Capabilities Approach (Amartya Sen):** Development should be about expanding the "capabilities" of people—their real freedoms to lead the lives they value. This shifts the focus from income alone to health, education, and opportunity.
- **Pro-Poor Growth Theory:** This framework explicitly focuses on policies that enable the poor to actively participate in and significantly benefit from growth.
- **Stakeholder Capitalism:** Challenges the shareholder primacy model, arguing that companies must serve the interests of all their stakeholders—employees, customers, communities, and the environment—to ensure long-term value creation.

In this reconceptualized model, inclusion is built into the growth process, not hoped for as an afterthought.

3. Methodology: a mixed-methods approach

This study employs a mixed-methods approach to triangulate data and enhance the validity of its findings.

- **Qualitative analysis:** A comprehensive review of academic literature on development economics, inequality, and social policy. This includes analysis of policy documents from international organizations (World Bank, IMF, UNDP) and national governments.
- **Quantitative analysis:** Examination of secondary data from World Development Indicators (WDI), OECD databases, and national statistics on Gini coefficients, income growth of the bottom 40%, human development indices (HDI), and public expenditure on social sectors.
- **Case study analysis:** In-depth evaluation of select country cases that demonstrate both successes and challenges in pursuing shared prosperity:
  - **Brazil (2000s-early 2010s) [7]:** Analyzed for its successful *Bolsa Familia* conditional cash transfer program and policies that led to a significant reduction in inequality.
  - **Scandinavian model (Denmark, Norway, Sweden):** Examined for their comprehensive welfare states, active labor market policies, and high levels of social mobility.
  - **Rwanda (Post-1994):** Studied for its rapid economic growth and focused policies on gender equity and digital inclusion, while noting ongoing challenges with political freedoms.
  - **United states (1980s-Present):** Used as a case study of robust GDP growth coupled with rising income and wealth inequality, highlighting the consequences of weaker redistribution mechanisms.

4. Pillars of shared prosperity: key findings

The analysis of literature and case studies reveals that shared prosperity rests on several interconnected pillars.

4.1 Progressive fiscal and redistributive policies

- **Progressive taxation:** Tax systems where effective tax rates increase with income are fundamental for funding public goods and redistribution. Case studies show that countries with more progressive tax systems (e.g., in Scandinavia) achieve lower post-tax inequality.
- **Targeted social programs:** Conditional and unconditional cash transfers (e.g., Brazil's *Bolsa Família*, Mexico's *Progresa*) have proven highly effective in reducing immediate poverty, improving health and educational outcomes, and empowering women. They are a direct investment in human capital.

4.2 Inclusive labor markets and human capital investment

- **Inclusive labor policies:** Minimum wages, collective bargaining rights, and protections for informal workers ensure that productivity gains are shared with employees. Germany's co-determination model (*Mitbestimmung*), which includes workers in company management, is a standout example.
- **Education and healthcare access:** Universal, high-quality education and healthcare are the great equalizers. They create a level playing field, allowing talent to flourish regardless of birth circumstances, and are critical for building a productive workforce for the modern economy.

4.3 Enabling institutional frameworks

- **Participatory governance:** Institutions that are transparent, accountable, and allow for citizen participation foster trust and ensure that policies reflect the needs of the many, not the few. This includes combating corruption and strengthening the rule of law.
- **Financial inclusion:** Access to formal credit, savings, and insurance products (e.g., through mobile banking in Kenya via M-Pesa) empowers low-income individuals to invest, manage risks, and seize economic opportunities.

4.4 Modern catalysts for inclusivity

- **Digital transformation:** Technology can be a powerful tool for inclusion (e.g., digital ID systems like India's Aadhaar for efficient benefit delivery, e-learning platforms) or a driver of inequality (through job displacement and digital divides). proactive policies are needed to harness its potential for good.
- **Gender equity:** Empowering women economically is not just a moral imperative but an economic one. Closing gender gaps in labor force participation, entrepreneurship, and wages could add trillions to global GDP. Policies must address unpaid care work, promote equal pay, and ensure access to capital.

5. Challenges and counterarguments

Pursuing shared prosperity is not without its challenges and critiques.

- **Efficiency vs. equity trade-off:** A common argument is that redistribution discourages investment and innovation. However, evidence suggests that extreme inequality can actually hamper growth by limiting aggregate demand and depriving large segments of the population of the ability to invest in their skills.

- **Fiscal constraints:** Developing countries often face significant budget limitations. This necessitates smart, well-targeted policies and efforts to improve tax collection efficiency rather than abandoning the goal.
- **Political economy hurdles:** Powerful elites often resist redistributive policies. Building broad-based political coalitions in favor of inclusion is a persistent challenge.
- **Globalization and tax avoidance:** The mobility of capital and the complex strategies of multinational corporations to avoid taxes erode the tax base of nations, making progressive taxation more difficult to implement.

6. Conclusion and Recommendations

This research concludes that shared prosperity is not a passive outcome of growth but a dynamic process that must be intentionally designed and pursued through deliberate policy choices. It represents a necessary evolution beyond traditional GDP-centric models towards a more sustainable and just form of development.

To operationalize this framework, the following actionable recommendations are proposed for policymakers:

- **Implement Smart Fiscal Policies:** Broaden the tax base, strengthen progressive income and wealth taxes, and combat illicit financial flows and tax evasion to fund essential public services.
- **Prioritize Human Capital:** Invest universally in quality education, healthcare, and nutrition from early childhood onward. This is the foundation of long-term equity and competitiveness.
- **Strengthen Social Protection Floors:** Build comprehensive social safety nets that include unemployment insurance, pensions, and targeted cash transfers to protect citizens from shocks and poverty.
- **Harness Technology for Inclusion:** Develop digital public infrastructure that promotes financial inclusion, efficient service delivery, and access to information, while simultaneously investing in digital literacy and skills training to mitigate job displacement.
- **Foster Multi-Stakeholder Collaboration:** Governments, the private sector, and civil society must collaborate. Businesses should adopt stakeholder-oriented models, and governments should create incentives for inclusive practices like paying living wages.
- **Mainstream Gender and Sustainability:** Integrate gender budgeting and environmental sustainability into all economic planning. Pro-poor growth strategies must be inherently green to be truly sustainable and resilient.

By adopting a shared prosperity framework, societies can build economies that are not only wealthier but also healthier, more stable, and more equitable for future generations.

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Driving sustainability through diversity, equity, and inclusion: A strategic business imperative

Jyoti Sindhu[1], Palak Bansal[2*] and Sneha Verma[2]

[1] Assistant Professor, Department of Commerce, Indraprastha College for Women, University of Delhi, Delhi, India

[2] Department of Commerce, Indraprastha College for Women, University of Delhi, Delhi, India

*Corresponding Author: Palak Bansal

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Abstract

This research paper examines how Diversity, Equity and Inclusion play a critical role in promoting sustainable business practices by ensuring equitable treatment, encouraging different perspectives, and eliminating obstacles to success. DEI improves decision making, innovation, employee commitment and builds resilience. This study examines the challenges of implementing the DEI controlled sustainability framework and highlighting successful case studies. Although sustainability and DEI have been extensively studied as distinct fields in existing literature, limited research has been done to examine how they intersect as a framework for long-term growth. This study seeks to close that gap by assessing how incorporating DEI into corporate strategy might improve social responsibility and business performance. By integrating DEI into corporate strategy, companies can achieve social responsibility and long-term growth. This descriptive study, using secondary data from journals, websites and publications, demonstrates that DEI is not merely a moral obligation but a strategic requisite for business sustainability.

Keywords: Diversity, Equity, Inclusion, Sustainable business practices, Social sustainability, Employee engagement

1. Introduction

Diversity, Equity, and Inclusion (DEI) are framework conditions for organizations that want to promote fair treatment and full participation of all people, and certain groups that are subject to historically undervalued or discrimination based on identity or disability. These three ideas (Diversity, Equity, and Inclusion) represent three closely connected values that companies want to institutionalize through these frameworks. DEI guidelines are often used by managers to increase employee well-being, productivity, cooperation and enhance active communication. (Gill *et al*., 2018) [1].

Green or sustainable enterprises can employ business strategies to achieve these goals and may have little to no negative influence on the local or global environment. Therefore, to ensure that all of their manufacturing activities, processes, and products make up for the current environmental problems while still making a profit, sustainable businesses engage in eco-friendly or environmentally friendly activities. In other words, it is a business that "meets the needs of the present generation without affecting future generations ability to meet theirs'. It is evaluated on the basis of how well products use renewable resources and how product designs impact the state of the environment today. Sustainable businesses within their supply chains aim to make up for all three via three-line principles by influencing sustainable development and sustainable distribution based on the environment, company growth and society. (Fowler and Hope, 2007) [2]

Companies known for their commitment to DEI are often considered to have more desirable jobs. If employees have a sense of being treated fairly, then they progress and if they are part of an integrated culture, the organization remains healthy. Sustainable companies thrive through effective decision-making. This leads to more robust and effective decisions that contribute to the sustainability of the business work. In today's interconnected world, corporate reputation and brand value play an important role in its sustainability. Organizations that prioritize diversity, equity and inclusion usually build a stronger reputation and become more attractive to customers, investors and partners. (Ayyoob and Sajeev, 2024) [14]. Consumers are increasingly attracted to companies that represent Social, Equity and ethical practices. Companies that demonstrate a true commitment to these principles often see an increase in consumer trust and support.

Business sustainability involves adapting to formal landscapes and changes in society as a whole. DEI is an important aspect of adaptability. A diverse and integrated workplace is better equipped to deal with further developing market trends, regulatory changes and public opinion changes. Consider the Covid 19 pandemic that accelerated the need for long distance work and digital solutions. Companies with different teams have access to different perspectives and problem-solving approaches, making them even more agile to adapt to this new reality. Their adaptability contributed to her long-term sustainability.

2. Objectives of the study

- Analysis of the role of Diversity, Equity, and Inclusion (DEI) in shaping sustainable business practices across industries
- Examining how an integrated workplace culture affects worker productivity and engagement as well as how it contributes to long-term sustainability
- To identify challenges and obstacles in implementing DEI controlled sustainability practices in businesses
- To propose strategies for integrating DEI into sustainability frameworks.

3. Research methodology

A descriptive research design was envisaged that included research and case studies to evaluate implementation in all industries. Secondary data sources including academic journals, industry reports and company guidelines were analyzed to conclude the results. This study is a review-based research paper that relies exclusively on secondary data sources. The aim is to analyze, integrate and interpret existing literature on Driving Sustainability Through Diversity, Equity, and Inclusion: A Strategic Business Imperative to derive comprehensive knowledge and identify knowledge gaps. Secondary sources include magazines, conference processes, books, websites, and more.

4. Importance of the study

The importance of this research lies in investigating how Diversity, Equity and Inclusion (DEI) contribute to a sustainable business environment by improving corporate culture, resilience and value creation. A well-managed, diverse workforce not only promotes social sustainability through inclusion, but also promotes economic and ecological sustainability by improving innovation, decision-making and adaptability. By examining the role of DEI in workplace recruitment strategies, team dynamics, and designing fair guidelines, this study highlights internal equity, employee well-being, and impact on long-term business success. Understanding this dynamic is crucial for organizations that strive to balance profitability with ethical responsibility and promote a corporate culture that aligns with the Sustainable Development Goals. (Chukwudi and Eusebius, 2023) [9].

5. Literature review

i. Diversity, Equity and Inclusion (DEI)-

Diversity Equity and Inclusion (DEI) is crucial to the success of an organization as it increases creativity, improves decision-making and encourages innovation. Diversity includes a variety of aspects, including caste, ethnic belonging, age, gender, sexual orientation, thinking style, working style, personality, and skills. Implementing DEI faces challenges such as managers' lack of understanding and systematic obstacles, such as systematic discrimination and unconscious bias that can lead to underestimation of historically excluded groups. Organizations can use diversity training programs to improve awareness, acceptance, management, and communication through diversity dynamics and establish metrics and accountability systems. Recruitment and retention strategies help create a culture of inclusion, allowing employee resource groups (ERGs) to support and distribute valuable information about workplace diversity. (Annet, 2025) [5]. Diversity includes visible differences such as gender, breed, and nationality, as well as invisible aspects such as style of thinking, socioeconomic class, and personal beliefs. Each of these dimensions can make someone a minority in their work or social environment. Fairness includes fair treatment and access to the same opportunities for all. This eliminates obstacles that prevent participation. It allows individuals to move out of different positions and allocate resources accordingly to achieve the same outcome. On the other hand, inclusion fosters a positive and welcoming workplace that values and incorporates individual differences. (April, 2021) [17].

The significance of DEI in organizational management was widely acknowledged, especially within the global workforce. The initiative aims to create an integrated environment in which a wide range of people are valued and respected to promote cooperation and innovation. The effectiveness of the DEI initiative to improve organizational performance is inconsistent. DEIs are often associated with higher commitments of employees, but the mechanism driving this connection has been lowered. DEI, employee commitment, and team innovation have evolved as key factors that influence organizational performance. This initiative promotes respect and cooperation, and increases employee satisfaction and creativity. (Azizah and Hidayah, 2025) [6] Multiculturalism is a complex topic attributed to the increased diversity through migration and coexistence of various religious and ethnocultural groups. Diversity promotes freedom and self-determination, but also presents economic and political agendas and requires a legal framework to ensure social harmony. Integration and adaptation play an important role in the inclusion of immigrants. This involves cultural, social and institutional unity. Structural integration even ensures access to services, while cultural integration promotes mutual respect for norms and values. Multiculturalism supports cultural diversity, bridges between the private and public sectors, protecting civil rights and promoting social acceptance. It promotes equality, democracy, and the inclusion of minorities, ensuring that cultural identity is preserved in a unified society. (Alaverdov, 2023) [19]

Workplace diversity management encompasses strategies, policies, and practices organizations use to capitalize on a diverse workforce. Equity ensures impartiality by addressing disparities while inclusion provides all employees a feeling of belonging. Managing diversity means promoting community and recognizing differences as valuable, preventing discrimination and promoting inclusiveness. Effective diversity management improves innovation, creativity, and the ability to reach more customers, leading to competitive advantages and increased profitability. Research indicates that diversity has a positive impact on job satisfaction and organizational productivity, especially in relation to creativity. Organizations should manage workplace diversity, equity, and inclusion to attract, retain, and empower diverse talent for long-term success. They must, however, overcome obstacles like prejudices, providing inclusive leadership, encouraging collaboration, and developing fair policies. Many carry out diversity programs without clear guidelines, which can have unforeseen repercussions. Research aims to determine the variables that affect diversity management programs' success or failure and generate actionable recommendations for establishing inclusive workplaces. The primary objectives include assessing current practices, understanding the impact of diversity, identifying challenges, and examining employee perceptions. Qualitative and quantitative methods are applied to understand these challenges and best practices. (Woldeyesus, 2025) [7]. It is important to establish an integrated culture that recognizes and evaluates individual differences, promotes equity and respect, and provides the same opportunity for all employees. Organizations that prioritize DEIs can have significant benefits, such as increased employee engagement, increased organizational performance, and increased innovation and creativity. A diverse workforce contributes to a variety of perspectives and experiences, leading to innovative ideas and new approaches to solving complex problems. Promotion of fairness and equity creates a more integrated atmosphere that everyone feels valuable and supported. (Kiradoo, 2023) [18].

Diversity, Equity and Inclusion (DEI) are becoming increasingly important to businesses. This is due to strong positive relationships between increased diversity and business performance. Not only is DEI correct, it also provides a strong business foundation for gender, ethnic and cultural diversity, leading to outperformance related to profitability, innovation, talent, brand recognition. Embedding DEIs in corporate operations requires regular measurement of progress with management, attitude practice, education and training, commitment to integration guidelines and procedures, and accountability. The most important steps include forming a DEI working group, assessing current guidelines and practices, implementing anti-discrimination guidelines, and providing racial equity training. Quantitative and qualitative DEI metrics are important to guide, support, assess progress and ensure obligations of accountability. Furthermore, transparency in DEI strategies and disclosures are extremely important for stakeholder trust and continuous improvement. (Gutterman, 2023) [8]

As organizations operate in an increasingly globalized, dynamic market, DEI is no longer a moral obligation, but another strategic advantage. A diverse and integrated workforce will increase creativity, expand market coverage, enhance adaptability, ensuring long-term resilience and competitiveness. By addressing fairness and unconscious bias, companies can create fairer jobs that attract and retain top talent, increasing employee satisfaction and increasing sales. Companies that work actively to eliminate unconscious bias and cultivate an integrated culture are looking to greater satisfaction, retention and cooperation among employees who contribute to long-term sustainability. Furthermore, DEI integration in business strategy strengthens brand appeal and increases market relevance. Companies that prioritize inclusiveness and equity not only improve internal cooperation, but also form stronger relationships with customers, investors and other interest groups. (Stephens, 2022) [16] As sustainability is a key driver of business success, it is extremely important for companies to understand the impact of DEI on organizational performance.

ii. Sustainable business practices

The foundation of sustainability in human resource management (HRM) is the alignment of organizational activities with economic, social, and environmental sustainability principles. Sustainability, which is broadly defined as the ability to meet present requirements without compromising the ability of future generations to fulfill theirs, is based on the Triple Bottom Line idea, which emphasizes three interrelated aspects: economic, social, and environmental. Economic sustainability ensures resource efficiency and long-term profitability, social sustainability promotes inclusion and employee well-being, and environmental sustainability lessens ecological footprints through green initiatives like waste reduction and energy efficiency. Human resource management (HRM) and other contemporary organizational techniques now place a high emphasis on sustainability. Businesses that use sustainability-based HRM practices have shown improvement in their reputation, employee satisfaction, and global competitiveness. (Soekotjo *et al.*, 2025) [20] For example, Microsoft promotes inclusiveness into its CSR strategy by investing in different areas through scholarships and mentorship programs and building a pathway for underrepresented groups to access meaningful employment. This project serves as an example of how inclusivity in HRM may be used practically.

The growing awareness of sustainable development has led to the expansion of literature in this field of research. Since the introduction of the Sustainable Development Goals (SDGs), businesses have been focused on the environment, humans and planets, and are confident that this will lead to better financial performance. Therefore, the relationship between sustainability practices and corporate financial performance has attracted a great deal of attention from researchers. Approximately 96% of publications reported a positive relationship between sustainability practices and corporate financial performance. The adoption of SDGs highlights the urgency of global companies to ensure sustainability by caring more about the environment, people and planets. (Muhmad and Muhamad, 2021)

A key challenge in HR management is the lack of qualified and motivated employees, as traditional incentives such as competitive salaries are no longer sufficient. This study examines how corporate sustainable business (CSB) practices affect the appeal of an organization from the perspective of potential employees. It focuses on key CSB attributes such as environmental performance, community relations and duties, and market behavior.

Individuals are attracted to organizations that suit their values and communicate strong sustainability operations. Social identity theory emphasizes the role of group membership in the design of self-concepts, while signal theory shows that sustainable practices send positive information to job seekers. Previous research has shown that socially responsible companies are more attractive to potential applicants, especially to younger generations who prioritize corporate social responsibility. (Magbool *et al*, 2016)

6. About the companies that successfully incorporated DEI in their business model

Diversity, Equity and Inclusion (DEI) have become essential components of sustainable business practices, fostering innovation, employee loyalty, and overall organizational performance. Several companies have successfully integrated DEI principles into their business models and demonstrated the specific benefits of such a workplace. For example, Johnson & Johnson has invested considerable resources to cultivate an inclusive work environment in which employees' diverse backgrounds contribute to innovative health solutions. The company hopes to achieve 50% female representation worldwide by 2025 and has received several awards for its commitment to DEI, including recognition from the US Veterans magazines and a consistent placement on the *Working Mother 100 Best Companies* list.

Similarly, MasterCard has made great strides in promoting inclusivity within its workforce. The company ensures that women and people of color earn the same wages as their colleagues. Additionally, MasterCard has established nine Business Resource Groups (BRGs) in 47 countries to support a wide range of communities. Their investment in diversity ranges from external initiatives such as Girls4Tech, a STEM program aimed at young girls, fostering early interest in technology and innovation. (Bonaparte and Grant, 2020) Accenture also demonstrates its unwavering commitment to DEI by investing $1.1 billion in learning and development programs for all its employees. The company actively supports the LGBTQ+ community with an extensive network of 120,000 Pride Allies and provides tools and resources to disabled employees at 32 global centres. (Amla, 2008) [4].

Technology Giant Microsoft has also put considerable efforts into improving gender diversity and supporting underrepresented groups in the tech industry. The company has implemented shadow programs for internships to increase access to opportunities for individuals from diverse backgrounds and has reported a consistent growth in female representation. Microsoft also prioritizes accessibility and ensures that all its products and services are inclusive and usable for people with disabilities. (Chukwudi and Eusebius, 2023) [9]. Similarly, Ernst & Young (EY) advocated diversity in the workplace by increasing the number of female top management representatives by over 20%. Additionally, EY introduced leadership training programs, releasing its first DEI Transparency Report in 2021, reinforcing its long-term commitment to fostering an equitable workplace. (Sharma *et al*, 2023) [10].

These companies demonstrate how integration of DEI principles in corporate strategy leads to inclusive work environments, improved employee engagement and sustainable corporate growth. These businesses demonstrate the impact of prioritizing Diversity, Equity, and Inclusion as key drivers for innovation and corporate success.

7. Challenges and barriers in incorporating DEI at business

Incorporating Diversity, Equity and Inclusion (DEI) in businesses presents several challenges and obstacles that companies must navigate through to drive meaningful and sustainable change. One of the main challenges is leadership participation and commitment. Organizational change starts at the top, and without strong support from top management, initiatives may lack the resources and accountability they need. While HR departments and individual managers play an important role in promoting an integrated work culture, top management must actively engage by providing resources, setting clear goals and promoting transparency. Without visible and consistent support from leaders, employees may perceive DEI efforts as superficial, reducing overall effectiveness. (Nwoga, 2023) [11].

Resistance to change is another significant barrier organizations face. Some employees can view the initiative as unnecessary or as a preference for a particular group, which leads to skepticism and reluctance to engage. This resistance is often based on deep-rooted prejudice, fear of change or concerns regarding losing power and privilege. Overcoming this challenge requires strategic communication, education and initiatives that foster awareness and empathy.

Additionally, systematic barriers and deeply ingrained bias within recruitment, promotion and corporate culture further complicate the implementation of the DEI initiatives. Many organizations unconsciously perpetuate inequality through biased hiring practices or promotion criteria that disadvantage certain underrepresented groups. Addressing these challenges requires an in-depth review of internal guidelines, the introduction of inclusive hiring and talent development practices, and a targeted outreach programme to attract diverse candidates. (Kraus, Torrez and Hollie, 2021) [12] Limited access to diverse talent, especially in certain industries and regions, can also hinder progress. Organizations need to actively collaborate with educational institutions, community organizations and professional networks to expand their reach and create a pipeline for a wide range of talent.

Finally, the lack of a data-driven approach can impede the successful implementation and evaluation of DEI initiatives. Measuring the effectiveness of a DEI program is important for identifying disparities, setting realistic goals, and tracking progress. However, collecting and analyzing relevant data on sensitive topics, particularly race, genders, and disabilities can be complicated. Without specific data, it can be difficult for businesses to identify key areas of improvement and ultimately limit the impact of their DEI strategies. Addressing these challenges requires comprehensive and long-term commitment from all levels of the organization to ensure that DEI is not only a temporary initiative, but also a fundamental part of the company culture and operations. (Hassan, 2025) [13].

8. Result & Findings

The Research reveals the increasing significance of DEI in organizations that incorporate sustainable practices, highlighting how these principles affect workplace innovation, employee commitment, and corporate sustainability. Companies that fully incorporate the DEI guidelines report high employee satisfaction and strong workplace morale. Furthermore, this study highlights the role of DEI in promoting an active and productive work environment. Inclusion goes beyond mere expression. Organizations need to maintain a culture that values, respects and allows all employees to contribute. Psychological safety, which allows individuals to express themselves without fear of discrimination, and retaliation measures are a key factor in successful DEI initiatives. (Ayyoob and Sajeev, 2024) [14].

Despite the perceived benefits, many organizations are troubled with implementing DEI due to deeply rooted distortion, resistance to change, and lack of measurable frameworks for advancement. The study highlights that the effectiveness of diversity needs to involve fairness in order to ensure that all employees have equal access to opportunities and resources regardless of their background. The gaps and differences in occupational progress continue to be a major challenge, increasing the need for organizations to use transparent guidelines that address systemic inequality. One of the main obstacles to inclusion is unconscious bias that often affects workplace interactions and career growth opportunities. (Mahajan *et al*., 2024) [15]. Even many employees and managers can unconsciously maintain the bias that hinders DEI's progress. To tackle this problem, organizations have to actively educate and train the organization’s members and establish accountability measures.

Despite positive progress, this initiative often faces resistance within the organization. Some employees recognize these programs as a preferred treatment for a particular group, leading to skepticism. This resistance is usually escalated by undervalued groups' loss of power or concerns about opportunities. This makes leadership essential to convey the true purpose and create a fair environment for all. Research suggests that manager participation is extremely important to overcome these challenges.

Managers should be trained to integrate DEI principles into the decision-making process to ensure that the guidelines produce tangible results. Companies that successfully implement DEI often prioritize education, open dialogue and mentoring programs to support employees from a wide range of backgrounds. By promoting an integrated culture, organizations can minimize resistance and create an environment in which DEI initiatives are more embraced than opposed. (Groenewald, 2024)

This study also provides recommendations to improve the DEI initiative and ensure its long-term sustainability. Implementing structured DEI guidelines with clear and measurable goals is essentially important for the pursuit of progress and necessary adjustments. Managers' commitment is a key factor in success, as managers play a fundamental role in sound decisions regarding promoting inclusiveness within an organization. Additionally, companies should use a data-oriented approach to assess the DEI effect. The results show that companies that are actively engaged in Diversity, Equity and Inclusion not only have an improved internal work culture, but also receive a competitive advantage in the market.

9. Conclusion

Diversity, Equity and Inclusion are not options when pursuing business sustainability. They are essential. Diversity brings new ideas and innovation, and Equity ensures that everyone has the same opportunity. Inclusion promotes a sense of belonging and allows employees to do their best. Together, these factors improve decision-making, attract talent, and strengthen the reputation of the company. Financial performance isn't the only way to sustain your business. It's about resilience, adaptability and long-term success. By implementing diversity, equity and inclusion, businesses can position themselves as superiors in their industry. Further development makes it evident that DEI is not just a strategic advantage that can support sustainability for a company's future, but also a moral requirement. Diversity, Equity, and Inclusion (DEI) have emerged as transformative forces in shaping sustainable business practices, and turning into central pillars of strategic and operational excellence. According to this study, DEI is essential for encouraging creativity, enhancing judgment, and developing a resilient workforce that can handle the challenges of modern corporate settings. DEI enhances an organisation's adaptability to rising challenges - be it technological disruption, regulatory shifts, or social change - with the aid of empowering a diverse team of workers to reply with agility and creativity.

But, the course in the direction of effective DEI implementation is not without boundaries. Challenges along with subconscious bias, lack of leadership commitment, inadequate facts, and resistance to change hinder progress. Addressing these problems requires a multifaceted technique, one that includes strong leadership, targeted education applications, inclusive hiring practices, and the establishment of measurable goals and responsibility systems.

To sum up, the mixing of DEI is vital for organizations aiming to create lasting effect both within and beyond their organizational boundaries. DEI fuels sustainability by cultivating equitable possibilities, nurturing inclusive cultures, and reinforcing ethical responsibility. For businesses looking to thrive in the 21st century, prioritizing DEI is far from a desire - it's a need.

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EI as an emergent technique for healthcare workers: A comprehensive literature review and future research agenda

Priya Rani[1*] and Dr. Sherry[2]

[1] Research Scholar, Institute of Management Studies, and Research, Maharshi Dayanand University, Rohtak, Haryana, India

[2] Assistant Professor, Institute of Management Studies and Research, Maharshi Dayanand University, Rohtak, Haryana, India

*Corresponding Author: Priya Rani

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Abstract

Purpose – The study aims to systematically review the role and significance of emotional intelligence (EI) among healthcare professionals (HCPs), with a focus on its impact on stress management, resilience, empathy, and professional performance in both pandemic and general healthcare settings.

Design/methodology/approach – A systematic literature review and scientometric analysis were conducted using the SCOPUS database. A total of 146 articles were initially retrieved, and after applying inclusion–exclusion criteria, 42 relevant publications from 2015 to 2024 were analysed. Manual screening and analysis were performed using R-Studio and MS Excel.

Findings – The results indicate a growing trend of research on EI among HCPs, particularly after the COVID-19 pandemic. Frequently used keywords included "emotional," "intelligence," "healthcare," and "workers," alongside emerging terms such as "resilience" and "emotional distancing." The most prominent journals in this field are *Frontiers in Psychology* and *Healthcare (Switzerland)*. The review highlights EI as a predictor of organizational adaptability and identifies its critical role in mitigating burnout, enhancing empathy, and improving patient–provider relationships.

Research limitations/implications – The study is limited to the SCOPUS database and English-language publications, which may affect the comprehensiveness of coverage. Future research should incorporate broader databases, multilingual sources, and cross-cultural perspectives to capture a wider scope of EI studies.

Practical implications – The findings suggest the integration of EI-based training and assessment in healthcare systems to strengthen stress tolerance, resilience, and professional well-being. EI should also be considered in recruitment and professional development processes.

Social implications – By addressing burnout and promoting empathy, EI contributes to improved patient care, enhanced patient satisfaction, and stronger healthcare outcomes, while also highlighting the need for greater societal recognition of emotional competence.

Originality/value – This study provides one of the few systematic and scientometric reviews of EI among healthcare workers, offering a comprehensive overview of research trends, knowledge gaps, and practical strategies. It contributes to theory-building while providing actionable insights for healthcare practitioners, policymakers, and future researchers.

Keywords: Systematic Literature Review, SCOPUS, Emotional Intelligence (EI), Healthcare Workers (HCWs), R-Studio

1. Introduction

Healthcare professionals (HCPs) are a vulnerable group because they are more likely to suffer from a variety of stress-related conditions at work (Selič-Zupančič *et al*., 2023) [61]. Healthcare workers are prone to a variety of work-related stressors, which frequently result in burnout. This was made very clear during the Covid-19 epidemic. The first sign that an emotional trauma is present is stress reactivity. To cope with the stressors, these reactions are characterized as a collection of conscious and unconscious actions, thoughts, and feelings (Figley CR, 2013) [22]. This is where emotional intelligence (EI), a crucial concept, enters the picture. There are different definitions of emotional intelligence, nonetheless, it is widely acknowledged that emotional intelligence (EI) is the capacity to recognize, communicate, and control one's own and other people's feelings (Mayer *et al*., 2008; Rezvani *et al*., 2016; Hajncl, 2020) [42, 60, 27]. The Mayer-Salovey Emotional Intelligence Test (MSCEIT) is part of the first model, known as the ability model (Mayer and Salovey, 1993; Mayer *et al*., 2002) [41, 43]. The second paradigm (Goleman, 1995; Bar-On, 1997; Ornstein, 1997; Epstein, 1998) [25, 11, 52, 21] is centered on an individual's trait or self-perception of their personality. Compassion, drive, and empathy are all part of this model. The third model values independence, assertiveness, and self-worth (Nelson and Low 2003) [49]. Better project performance is attributed to positive emotions, particularly in situations with a high degree of ambiguity and uncertainty (Ashkanasy and Daus, 2005; Colman, 2009) [6, 18]. Tensions, frustrations, rage, and impediments resulting in subpar performance are also caused by negative emotions (Hammett, 2007; Hammett, 2008) [29, 30]. Therefore, it is inevitable to work with people, and developing strong interpersonal skills is necessary to promote positive working relationships (Dainty *et al*., 2004; Barczak *et al*., 2010; Jiang *et al*., 2016; Kim and Kim, 2017) [19, 10, 34, 36].

However, there is a dearth of review research based on systematic literature review and study of the impact & role of emotional intelligence among HCPs. How they benefit and enhance their work performance as well as it also helps to reduce the stress. So, the current study aims to identify to what extent EI is significant for HCWs not only in emergent or pandemic situations in general settings also? how does EI grace their work? The authors analyse the whole perspective based on four questions and the present research is divided into 5 sections 1st The authors introduce the present study then after the research questions and research methodology described by the authors, the analysis part is performed, and last the core of this study conclusion with future research avenues discussed which will be impactful for future researchers as well as HCWs.

2. Research questions

RQ1. How is the year-wise publication trend of documents going?

RQ2. What are the most prominent and frequently used keywords?

RQ3. What are the most relevant and popular journals based on no. of publications?

RQ4. What are the findings, keywords, and future research avenues of the top five highly cited documents?

3. Methodology

The current systematic literature review searched for publications on emotional intelligence among healthcare workers (HCWs) across numerous publishers and repositories. By using the search string (("EMOTIONAL INTELLIGENCE" OR "EMOTIONAL REGULATION" OR "EMOTIONAL QUOTIENT" AND "HEALTHCARE WORKERS" OR "HEALTHCARE PROFESSIONALS" OR "HEALTHCARE PERSONNEL")). Initially, 146 articles were found on the SCOPUS database and the study covers the period from 1995 to 19.01.2024, but with further criteria, articles were found only between the period 2015 to 2024 and after applying all the relevant filters and manual reading of titles, abstracts, and full-text reading of papers as depicted in Figure No 1., we have 42 articles at last. So, after a careful screening process,104 research articles were discarded and authors performed all the relevant work by manually using R-studio and MS-Excel.

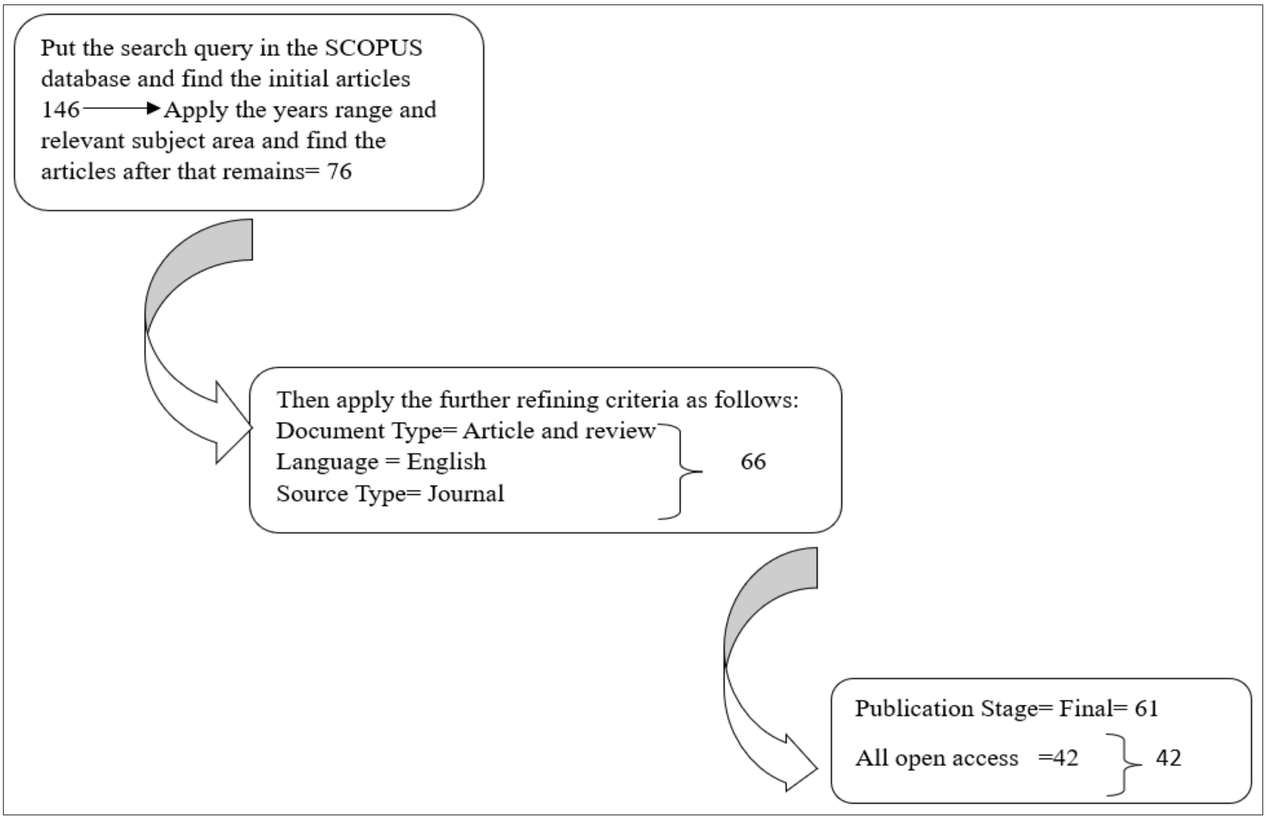
3.1 Inclusion-Exclusion criteria

Table 1: Inclusion-Exclusion criteria- Database – SCOPUS-Date 19-01-2024 ("Emotional Intelligence" or "Emotional Regulation" or "Emotional Quotient" and "Healthcare Workers" or "Healthcare Professionals" or "Healthcare Personnel")

Inclusion	Exclusion
Year-1995 to 2024	In SCOPUS not a single article published before 1995
Subject Area- Healthcare Professions, Psychology, Nursing, Social Science.	Other subject areas like art and humanities, decision science, etc.
Document type Article and Review Paper	Articles excluded conference papers, book chapters, editorials, etc.
Source type= Journal	Excluded conference proceedings, book series books, etc.
Language=English	Non-English language
Publication stage= Final	Articles which are in the proceeding stage or not lying in the final stage
Final articles for study=42	146 initial - 42= 104 exclude not fit in inclusion criteria or relevant to the study.
All open access for full-text reading	Exclude non open access articles

Source: Authors' development

3.2 A Story of document search for analysis in the SCOPUS database with the search query



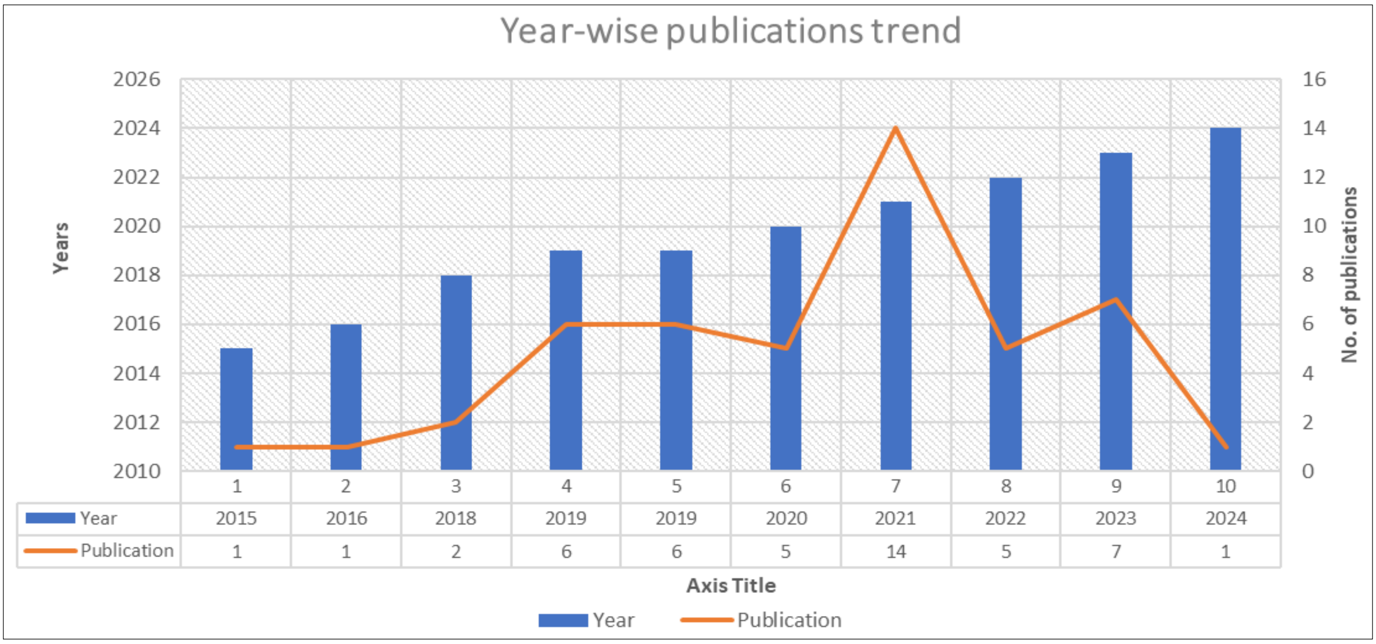
Source: Authors' development

Fig 1: A Story of document search for analysis in the SCOPUS database with the search query

4. Analysis- The systematic analysis of 42 documents is as follows. (According to research questions)

4.1 Year-wise publications trend

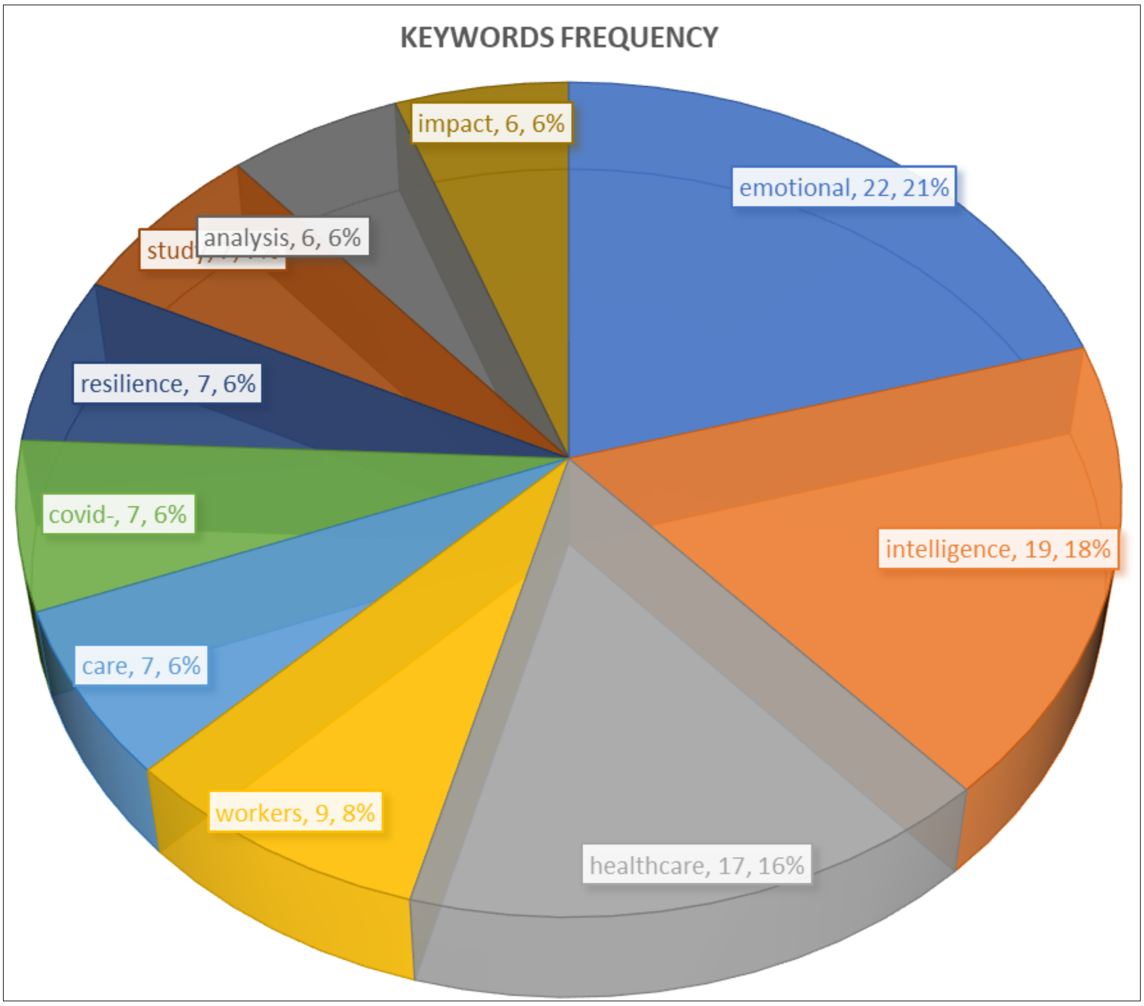
As depicted in the below figure in the year 2021 highest no. of papers in the pertinent field was published and the 2024 publication has not had any significant effect on publication trends because now the year has just started. So, above analysis, we can conclude that yes, COVID-19 sparked the research related to emotional intelligence among healthcare workers (HCWs). But if we compare the trend before COVID-19, no. of publications in 2018 was 2, in 2019 was 6, in 2020 was 5, and after COVID-19 in 2023 no of publications were 7. That means now the need for emotional intelligence is highly realized among HCWs.



Source: Authors' development

Fig 2: Year-wise publications trend

4.2 Most relevant keywords



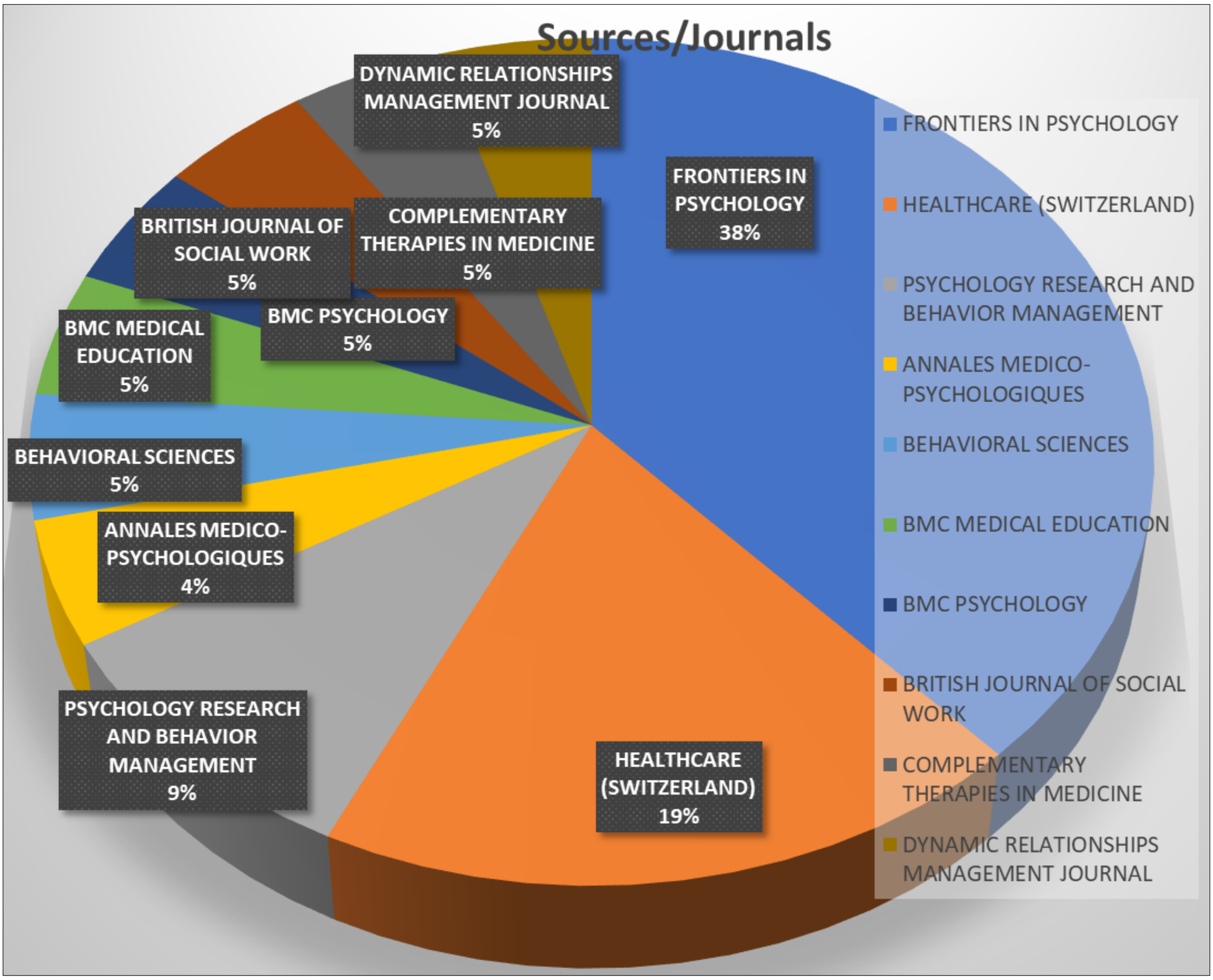
Source: Author's own development

Fig 3: Most frequently used keywords

In the above figure, the analysis of 42 documents shows emotional words repeated at 21%, frequency of intelligence is 18%, healthcare used 17 times with 16% in the title of documents. These three are the most repetitive keywords in the title of documents. Following the above three workers used 8%, the study used 7%, impact, care analysis, and COVID are 6%. It was found that the relevancy of the study is excellent because all four highest-used keywords (emotional, intelligence, healthcare, workers) are directly related to the pertinent topic of the current research. In addition to this, a new keyword resilience is closely associated with emotional intelligence.

4.3 Most relevant and popular journals based on no. of publications

In the below figure after analysis of 42 documents authors find three journals are the most prolific in this field. These are frontiers in psychology, healthcare (Switzerland), and psychology research and behavior management with 38%,19%, and 9% publication rates. The rest are the Annales Medico-Psychologiques, Behavioral Sciences, BMC Medical Education Psychology, British Journal of Social Work, complementary therapies in medicine, and dynamics relationship management journals, which contain 5% and 4% stake in the total publications in the concerned area.



Source: Authors' development

Fig 4: Most relevant source or journals

4.4 Table 2 - Findings, keywords, and future research avenues of the top five highly cited document

The below table is about findings, future research avenues, and mostly used keywords that were explored by authors based on five highly cited papers:

Author's Name	Title	Citation TC	Source/Journal	Keywords	Findings	Future research avenues
Lamothe et.al., (2016)	Outcomes of MBSR or MBSR-based interventions in health care providers: A systematic review with a focus on empathy and emotional competencies	160	Complementary Therapies in Medicine	Emotional intelligence; International comparison; Radiographers; Students	There is strong evidence about how MBSR affects the mental health of professionals. Even though it has been determined that a few emotional competencies are crucial for providing high-quality care.	Future research on empathy should specifically assess its cognitive as well as affective components.
Nightingale et.al., (2018)	The impact of emotional intelligence in health care professionals on caring behavior towards patients in clinical and long-term care settings: Findings	74	International Journal of Nursing Studies	Caring; Emotional intelligence; Integrative review; Nurse leaders; Nurses; Physicians	This review offers proof that improving a nurse's emotional intelligence may have a favourable effect on specific acts of kindness.	A more extensive study examining the association between EI among health professionals and validated measures of both emotional and physical care separately would be helpful.

	from an integrative review					
Lomas et.al., (2019	A Systematic Review and Meta-analysis of the Impact of Mindfulness-Based Interventions on the Well-Being of Healthcare Professionals	72	Mindfulness	Healthcare professionals; Meditation; Meta-analysis; Mindfulness	MBIs were typically linked to favourable results on the majority of measures, and it does seem that mindfulness enhances the well-being and emotional intelligence of medical professionals.	More research is required, especially in the form of excellent randomized controlled trials.
Alonazi W.B. (2020)	The Impact of Emotional Intelligence on Job Performance During COVID-19 Crisis: A Cross-Sectional Analysis	49	Psychology Research and Behavior Management	COVID-19; Emotional intelligence; Job performance; Nurses	The nurses with the highest EI scores were those in critical care units, then intensive care, neonatal intensive care, and general nursing. The nurses who worked in respiratory therapy had the lowest scores. During the crisis, nurses stated that EI had a substantial impact on JP across all demographics.	A large sample size should be taken in future studies.
Zeb et.al., (2021)	Controlling emotions—nurses' lived experiences caring for patients in forensic psychiatry	21	Psychology Research and Behavior Management	Emotional fatigue; Medical professionals; Purposive sampling; Work–life balance	By applying compassion-based techniques like self-analysis, emotional control, and emotional detachment when required, nurses may be able to attend to patients' needs more skillfully.	This article can provide insight into nurses' firsthand accounts of their interactions with patients suffering from mental illnesses while receiving forensic inpatient care, but it does not offer definitive information or clear evidence. So, clear evidence and proper strategies for this should be given in future studies.

Source: Authors' development

5. Implications of the study

5.1 Theoretical implications

By including newly developing categories, such as emotional distancing and resilience, and reaffirming traditional models in healthcare, the study expands on existing frameworks of emotional intelligence (EI). Additionally, it underscores the part that emotional intelligence plays in forecasting how well someone will be able to adjust to the culture of an organisation, thereby making contributions to the fields of psychology, organisational behaviour, and healthcare theory.

5.2 Social implications

Burnout is a worldwide problem that is connected to inadequate patient care, stressed relationships, and mental health problems among healthcare personnel, according to the research. It also emphasises the importance of empathy in improving the connections between patients and providers, increasing the effectiveness of treatment, and promoting a greater level of society awareness of emotional competence.

5.3 Practical implications

The findings indicate that it is necessary to implement training programs that are based on EI in order to improve stress tolerance, resilience, and empathy among healthcare professionals. In addition, EI should be incorporated into the processes of recruiting and professional growth. They also offer suggestions to policymakers and researchers in order to encourage worker well-being and to expand studies of EI in the future across a variety of situations and databases.

6. Conclusion

After a comprehensive review of all 42 documents, it was found that nowadays the requirement of emotional competence and intelligence is realized in HCWs. The relativity of keywords is very high in addition to these new keywords like resilience, and emotional distancing have been found, future researchers can perform their research in EI with these variables. Apart from that authors found two prominent journals in this area frontiers in Psychology and Healthcare (Switzerland) which are very closely associated with the pertinent domain. If we talk about the TCM framework major theories or models have traditionally been used for a very long time because these are the essence or basics of the EI concept and the major situation-based contexts are patient care, clinical settings, stress, and burnout. The methodology used in 42 documents is both type quantitative and qualitative (review-based). The findings of the current study depict that healthcare workers' emotional tiredness is an important global concern. Burnout in HCPs has been connected to subpar patient treatment, marital issues, drug misuse, depression, and suicide.

Professionals in fields like haematology-oncology are regularly faced with emotionally taxing circumstances including pain and death. Harmonious connections between healthcare professionals and patients require empathy. Better treatment outcomes, increased patient empowerment, and increased patient satisfaction and adherence have all been associated with clinical empathy. It has been defined as a quality that entails comprehending patients' inner experiences and reacting emotionally to their feelings. HCPs can read patients more effectively when they possess empathy, but this skill is also associated with a higher risk of burnout.

Additionally, two important roles of emotional intelligence (EI) in stress management are that it increases stress tolerance and fosters resilience against stress. This study offers a thorough scientometric evaluation, a systematic literature analysis of EI research, and recommendations for additional investigations based on the gaps in the literature that were found. Therefore, the findings would be very beneficial to academia. A person's ability to adapt to the culture of an organization can be predicted using their EI. It is assumed that the current organizational environment and culture are understood, and that appropriate analysis has been done to ascertain the "right" emotions for the role that is being filled. This study's main drawback is that, unlike if additional databases had been included, the analysis of the data set, which was taken from Scopus search, may have been influenced by Scopus's coverage. Nonetheless, the technique provides evidence supporting the use of Scopus, therefore selecting this data set had no bearing on the outcomes. An additional constraint of this research is that it solely included publications that were published in English.

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Enhancing the effectiveness of policies in human resources regarding recruitment and selection using a strategy

Nidhi Sharma[1*], Ankit Saxena[1], Ritik Rastogi[2] and Anshika Singh[2]

[1] Assistant Professor, Inmantec Institutions, Ghaziabad, Uttar Pradesh, India

[2] Inmantec Institutions, Ghaziabad, Uttar Pradesh, India

*Corresponding Author: Nidhi Sharma

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Abstract

Having developed a recruitment and selection policy that draws the top talents, every organization has to find a way to keep them in the organization. This paper highlights progress in human resource management practices regarding recruitment and selection. Effective ways like employment branding, skills-based methodologies, and data-informed decision-making could enhance the equity and efficiency of hiring processes. This study is about how technological advancements would affect recruitment, as well as diversity and inclusion programs, and how strategic human resource management influences the results of recruitment. An organization will now be able to devise a strategic recruitment plan by which the human resource practices have been proven against business goals, ensuring that competitive advantage will accrue in securing the necessary talent. The derived findings present the best methods and approaches that shall be followed by human resource managers to have a successful recruitment plan and implementation, thus leading organizations toward realizing their strategic objectives.

Keywords: Talent acquisition, Picking the right candidate, People management, Logo advertising, Competence based recruitment, Choosing, Progress in technology, Inclusion, Advanced HR management, Business edge

Introduction

Recruitment and selection procedures fall within the process of human resource management and significantly affect an organization's capacity to recruit and retain talented employees. Modern companies, unlike those in the past, invest resources and time into recruitment or talent acquisition for the following reasons: as the competition is ever changing, today, new technologies, diversity, and inclusion initiatives, as well as data-driven decision-making improved the efficiency of this work. There is a growing trend in skills and employer branding, which gives efficient outcomes while ensuring a fair hiring process. This paper analyzes recruitment in terms of strategic human resource management, focusing on an organization's competitiveness through having specific plans for human resource planning. In terms of advanced technologies and comprehensive information systems, organizations can enhance or retain their quality of workforce. These findings promise practical suggestions to HR managers when creating or implementing an effective recruitment strategy, ultimately improving the overall efficiency of the organization.

- **Recruitment and its strategic human resource management role:** SHRM-eighteen enhances workforce efficiency by aligning HR policies with the general business strategy. The recruitment has a major role in SHRM in ensuring that the organizations attract and retain employees who can help them achieve their objectives.
- **Long-term objectives:** Organizations devise their recruitment strategy to maintain competitiveness in attracting top talent while minimizing costs and turnover losses.
- **Enhancing hiring and selection practices:** Midway Innovations in recruitment and selection processes have improved hiring in several ways.

Employment branding encompasses an organization's image as an employer and its attraction to candidates.

- An organization with a strong employer brand will attract high-caliber talent by marketing its good working environment, career advancement opportunities, and benefits packages.
- The emphasis of skills-based recruitment is on a candidate's practical skills and abilities rather than traditional qualifications. This helps organizations curb hiring mismatches and improve employee productivity by hiring individuals with the right set of skills for a particular position.
- Data-driven Decision Making: Advanced data analytics and technology empower HR managers to make intelligent hiring decisions. AI solutions for recruitment, applicant tracking systems, and predictive analytics improve the candidate selection process.

Strategic HRM changes and initiatives concerning diversity and inclusion and technology as an impact on recruitment:

- **Technology:** AI-powered screening tools, automated applicant tracking systems, and virtual interview platforms have given birth to a new way of doing recruitment. These technologies act as catalysts in streamlining hiring processes while also reducing bias in recruitment, with an overall enhancement of efficiency.
- **Diversity and Inclusion (D&I) Initiatives:** The D&I initiatives act as a source of equality in hiring, thus developing a more inclusive workforce.

Effective recruitment strategies for effective planning and execution of recruitment. These 5 not-so-easy best practices will help an HR manager in adopting an optimized process in hiring and selection:

- Funding your employer brand to draw top-quality job applicants.
- Implement a capabilities-based hiring model in such a way that the discussion becomes a competency-focused selection event.
- Using AI and data analytics to improve your decision-making.
- Improving diversity and inclusion for innovation and fair outcomes in the workplace.
- Integrate Recruitment Strategy with Business Objectives for Sustained Success.

Positive Strategies for Effective Recruitment Planning and Execution;

By following these best practices, HR managers can make their work easier in recruiting and selecting:

- Invest in your employer brand to attract the best career candidates.
- Make it a capabilities-based recruitment model so that the discussion becomes a competency-focused selection event.
- Use AI and data analytics to improve your decision-making.
- Promote diversity and inclusion in the workplace for innovation and equitable outcomes.
- Integrate the recruitment strategy with business objectives for sustained success:.00

Literature review

Conceptual background

Recruitment is defined as a process through which organizations generate interest in a job opportunity and thereby build a pool of eligible candidates. Selection, on the other hand, refers to the identification and choosing of suitable candidates from among those who have applied based on established criteria (Bah et al. 2022). Again, it can be noted that recruitment includes several activities: just that a particular organization would use to draw in the applicant who, in its estimation, would have the required skills, pertinent knowledge, and values as well as attitudes for that particular job. Recruitment and selection processes are very necessary for the effectiveness of any organization, its competitiveness, performance, and overall success. An effective recruitment and selection process can shortlist and determine candidates who have the requisite qualifications, skills, and professional competence crucial in executing public and civil service roles (Sigma, 2018). Recruitment for human resources in civil service is the imperative modern-day venture of government and forms a core of personnel administration issues (Ayanda and Sani, 2010). It is the genesis of human capital development in an organization. According to Gberevbie (2010), recruitment and selection are the most expensive processes involved in human resource management and are most relevant to any organization. Such organizations recruit such individuals, train those individuals, and have incentives for such employees so that they deliver and continue being productive for a long period. Thus, the goal of recruitment and selection is mainly to ensure availability and quality personnel to achieve strategic objectives while minimizing cost (Ofori & Aryeetey, 2011).

Theoretical outlook

Resource-based view model

The Resource Based View (RBV) holds that internal resources and capabilities of an organization offer maximum significance instead of its analysing or interpreting strengths to obtain strategic planning for creating a sustainable competitive advantage (Barney, 1991). Resources are the inputs needed by an organization to conduct its activities. Therefore, internal resources and capabilities influence the strategic choices organizations make in an attempt to navigate their external operating environment. They also enable certain firms to enhance customers' value chains, innovate new products, and penetrate new markets. According to Peretomode and Peretomode, performance differences among companies are contingent upon the uniqueness, owing to which a company possesses special inputs and capabilities. Such an element underlines that the success of the company mostly depends on the level of talent it has within its organization. It will also help analyze empirical data and allow researchers to become engaged in induction and deduction.

Harvard model

The Hard-Human Resource Model makes policy pronouncements regarding employees as the instruments through which organizational goals are accomplished. It is derived from Alfred Chandler's strategy of structural equality-penalty developed by Fombrun et al. (1984) and is often referred to as the Michigan School model. It concerns the formulation of human resource management policies and their outcomes as well. This would include such processes as: selection, evaluation, development, and reward, drawn to articulate with the performance of the organization. Therefore is applicable for the organization of strategy in directing managers towards their employees, focusing on, in that sense, the "human" or softer aspects of HRM. It promotes employee involvement rather than control with an understanding that staff will have consistency, competence, and cost-effectiveness. The model captures various dimensions, including stakeholder interests.

Methodology

To have a research design

This study was an exploratory case study: soliciting data through interviews and surveys that act as qualitative information, thereby surfacing the insights, and establishing the extent to which the Civil Service Commission is carrying out its recruitment and selection processes.

Source: https://scmtalent.com/retained-search

Research method

Research on Survey Method: Look at the whereby the method sheets were used in the data collection and analysis (Saunders, 2009). This informs the processes of the collection and interpretation of data and the types of generalizations and representations involved. A qualitative approach was the base research method that was employed for the survey, from which data were obtained from different sources, both primary and secondary. The qualitative research has a narrative format of the case problems of the group in their natural form. The qualitative design of this research intends that researchers should understand the phenomenon by observation or interaction with participants (Denzin & Lincoln, 2008). The qualitative aspects of the survey are characterized by the conduct of in-depth interviews with key top executives to address the survey questions.

Source: https://mcconnellhrc.com/hr-services/hr-strategy/

Objectives

- To ascertain the personnel structure in place at the Local Council of Gura Ocniţei;
- To establish the gender ratio of employees;
- To devise strategies aimed at ameliorating identified weaknesses within this public institution, together with determining the most efficient of such strategies;
- To elaborate upon possible solutions to assist in the recruitment of top-tier qualified personnel.

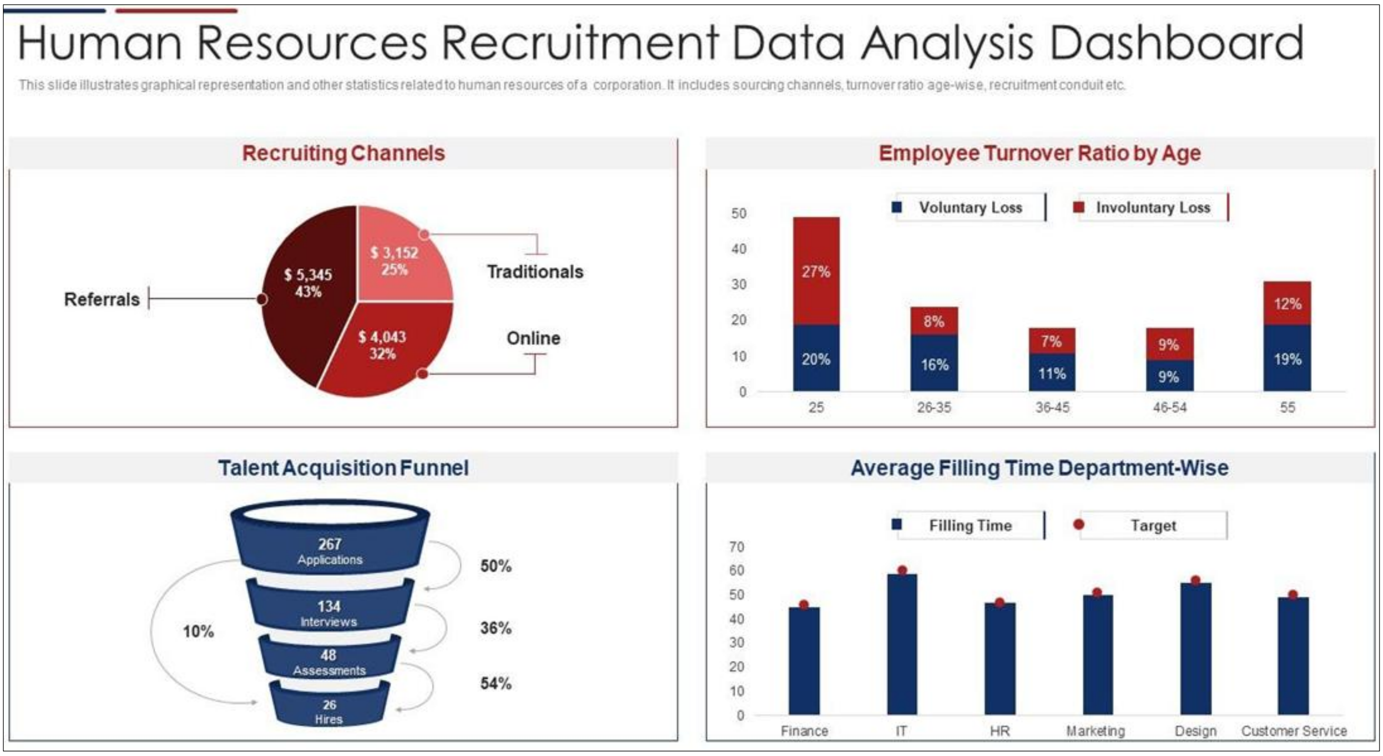
Assumptions regarding the subject were

- Mostly male employees dominate the Local Council administration;
- A large number of inhabitants working in the Ocniţa Local Council are graduates;
- A very effective and high-impact team manifests improving the processes of performance, selection, and recruitment suitable for addressing the shortcomings existing in the respective institution.

Data Presentation, Analysis, and Discussion

Data analysis

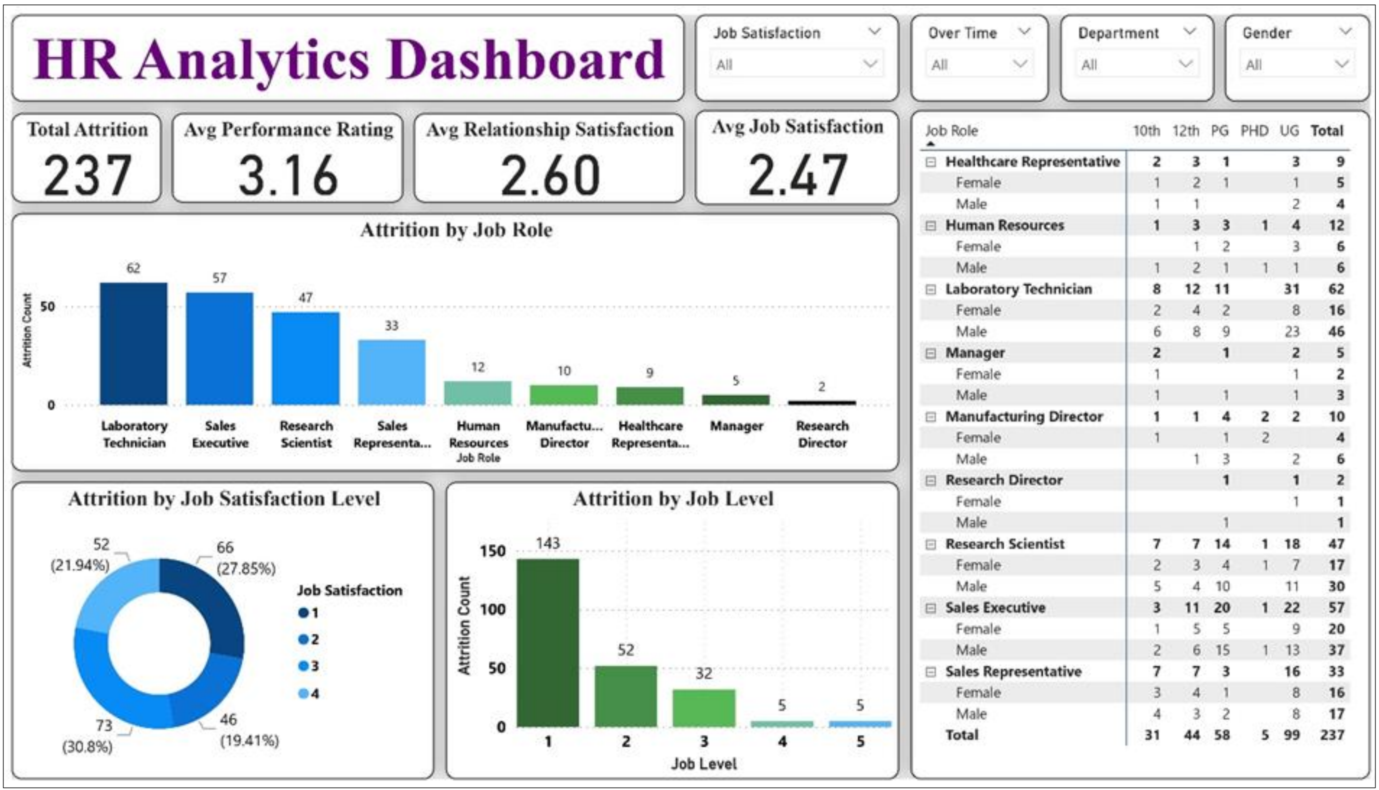
Recruitment and selection, under the ambit of the Human Resources Team or Human Resources Department, is a specific mandate for the Civil Service Commission, aimed at meeting its employment goals as intended by the government. The present study stresses the effectiveness of personnel practices and strategies of recruitment and selection intended for the delivery of any public services. A questionnaire was disseminated in a survey among the participants associated with the Public Services Commission (PSC). A total sample size of thirty individuals was completed, and the result of the total of thirty responses was analyzed thereafter. The finding is presented below in various forms of graphs, figures, and tables.



Source: https://www.slideteam.net/media/catalog/product/cache/1280x720/h/u/human_resources_recruitment_data_analysis_dashboard_slide01.jpg

Background information

The defining background information on respondents included such things as gender, age, years of schooling, and work experience. This background data is essential for researchers to assess whether the participants knew at least something about the research issue to improve the reliability of the analysis and outcomes. Among the 30 completed questionnaires, 53% of the respondents indicate that they are male and 47% female, thus yielding almost an equal representation in public services, according to the findings. Effective recruitment practices, indeed, would be of the highest interest to both men and women alike. Respondents were classified according to age brackets, showing that 32% are aged between 21 and 30, 58% between 31 and 40 years, and 10% aged between 41 and 50 years. This distribution indicates a predominance of respondents in the 31-40 years age bracket, with few members above 50 years being represented in the sample. This data indicates that the Commission boasts a youthful workforce that can realize the core mission of the Commission itself. Furthermore, out of the respondents, 33% were found to be college graduates, while 20% were master's degree holders, and only 7% had diplomas.



Source: https://jha-rajnish.github.io/employee_attrition_analysis/

Research Question One (RQ1)

What recruitment and selection practices, strategies, and frameworks do Public Sector Institutions use? Improving the recruitment framework and practices for civil servants is crucial to effective governance and serves as the foundation for human capital development across all ministries. Better recruitment and selection strategies enhance the organizational outcome. Civil service in Sierra Leone consists mainly of senior and junior staff and administrative and technical executives, distinguished chiefly by educational qualifications, training, skills, ranks, and responsibilities they undertake.

Some of the tactics put into action to boost recruitment and staffing quality include the following:

1. Improving recruitment team efficiency. To ensure that an adequate committee composition is obtained, there has to be an increase in the recruitment and selection efficiency of team members by ensuring a more diverse committee. This committee should include practitioners in diverse fields, for instance, in psychology etc., economics, and even law. To this end, we are guaranteed a more effective placement process through the:
   - Structured job advertisement process,
   - Grammatical correctness of the job advertisement,
   - Clarity regarding the company, position, and qualification information.
2. Improving the effectiveness of the institution's human resources specialist. The actions of this specialist must comply with rules and ethical standards. This specialist must also conduct themself well toward all potential employees to ensure that the actions taken on behalf of the institution are transparent. This transparency means that all relevant information should be displayed on the institution's website and made accessible to the public.
3. The organization should adapt to environmental changes in the course of implementing and sustaining current recruitment and selection policies:
   - A careful selection process designed to retain in the organization only the highest quality employees;
   - Payroll systems should be consistent with employee performance results.

Models through which this adaptation can occur include:

1. The "matching model" propounded by scholars at Michigan Business School speaks to the congruence of human resource policies with strategic goals of the business; this particular paradigm outlines some critical considerations regarding the effective formulation of human resource policies and systems, namely:
   - Attraction and selection of the most suitable candidates in terms of the needs of the organization;
   - Assessment and monitoring of performance with the provision of feedback to the organization and the employees;
   - Recognition and reward for the contribution of employees;
   - Developing the skills and knowledge required for an organization to fulfill its objectives.
2. The "map of human resource management" model, launched in 1984 at Harvard University, recognizes various interest groups in the organization: shareholders, government, and the community. This model argues that human resource management strategies should reflect the legitimate interests of these groups and be integrated with the overall business strategy.

3. Cost reductions in the selection and recruitment process can be formulated through:
   - Appointments of members from MAI who are specialists in various fields in the analysis committee;
   - Interviews and practical tests are carried out internally instead of outsourced.
4. The risks of selecting candidates who do not meet the institution's performance standards can be minimized through:
   - Harshly increasing the stages at an interview,
   - Tightening the physical and psychological tests,
   - Introducing a period of training lasting for about one month.
5. Employee performance may be enhanced by:
   - A clear line of communication and motivation for the use of different recruitment and selection methods.

Conclusion

These findings point out that an improper selection and recruitment process, which is not backed by the necessary rules, will put a public institution in serious trouble, concerning its service credibility among the users. Decreasing reputation usually means a worse time for individual employees; they feel out of place in their roles and often find it difficult to deal with their colleagues. There were three initial hypotheses: of the three, the second one is corroborated. The first hypothesis, which states that more males are present within this public institution, is refuted since there are more female employees, with no significant numerical difference. The second one is proved correct because representatives from the Gura Ocniţei Local Council reported that most employees hold university degrees. The last one is not proven true as the effectiveness of the recruitment and selection team is only one factor for process improvement; other factors also include alignment of human resources department objectives with organizational strategy, cost-benefit analysis, and evaluation of the overall effectiveness of the selection team hired.

The primary findings of this study showed that there is considerable cost to public institutions from the selection and recruitment process when it does not meet the required protocols and has been invalidated in the eyes of the service user. Lower reputation is not an unhealthy sign for the employees; misalignment in the use of their skills likely disappoints them and may pose difficult times interacting with coworkers. Out of the initial three hypotheses, only the second one stands proven by the evidence. The first hypothesis, which states that a public institution probably consists of 90% males, is refuted as to is no weighty difference; it proves that females are greater in number than males. This second hypothesis was proved correct, as representatives from the Gura Ocniţei Local Council stated that the majority of employees hold university degrees. The last hypothesis does not stand tested since the effectiveness of the recruitment and selection team is only one in a plethora of factors affecting the improvement of this process, but also with alignment of human resources department objectives with organizational strategy, assessment of all costs and consequences, and overall efficacy of the selection team.

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Creating a future ready workforce for industry 4.0

Dr. Gurmeet Singh
Assistant Professor, Shyam Lal College, Delhi University, Delhi, India
*Corresponding Author: Dr. Gurmeet Singh
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Abstract
India is the world's fourth largest economy and is on track to become the third largest by 2028. To speed up its growth rate towards this end, we have, inter-alia, create a future ready workforce for Industry 4.0, because it provides the tools and technologies that enables it to become more efficient, data-driven, and responsive to changing needs. It extends well beyond manufacturing, actively transforming speciality hospital services, e-Commerce, online retail, retail malls, and infrastructure through digital integration and smart technologies. It requires vertical, horizontal, and end-to-end integration across people, technology, processes, and infrastructure, impacting both technical and human aspects of organizations. Creating a future-ready workforce needs strengthening of specialised skills in tools and technologies of the "Fourth Industrial Revolution framework" in India, corresponding to its adoption level in the advanced economies.

Keywords: Industry 4.0, Great benefits, Technologies, Tools, Strategies

1. Introduction

Industry 4.0 also known as the fourth Industrial Revolution is a comprehensive concept. It requires vertical, horizontal, and end-to-end integration across people, technology, processes and infrastructure, impacting both technical and human aspects of organizations. Advanced digital technologies are integrated to transform operations and customer experience. The integration is into physical processes and systems across a wide spectrum and systems of industries in various sectors. Thus, in essence, Industry 4.0 provides the tools and technologies that enables to become more efficient, data-driven and responsive to changing needs. Service industries, not just manufacturing, are recognised as key beneficiaries of industry advancements.

2. Coverage of Industry 4.0 across sectors

Industry 4.0 extends well beyond manufacturing, actively transforming hospital services, e-Commerce, online retail, retail malls, and infrastructure through digital integration and technologies.

Speciality hospital services: Industry 4.0 technologies (like loT, AI, and data analytics) are increasingly applied in healthcare to improve operational efficiency, supply-chain management, and patient care, which were especially highlighted during challenges like the Covid-19 pandemic.

E-commerce and online retail: These sectors are at the forefront of adopting industry 4.0, using technology to analyze customer behaviour, personalize experiences, and optimize logistics and inventory management.

Retail malls: Physical retail spaces are integrating digital tools for customer relations management, inventory tracking, and enhanced shopping experiences, aligning with the Industry 4.0 principle.

Infrastructure: Industry 4.0 includes the digital transformation of infrastructure, focusing on smart systems automation, and data-driven management for improved efficiency and sustainability.

Sector	Industry 4.0 Application Examples
Speciality Hospital Services	Smart supply chains, digital patient management
eCommerce/online Retail	AI-driven personalisation, automated logistics
Retail Malls	Digital CRM, real-time inventory, smart kiosks
Infrastructure	Smart buildings, IoT enabled monitoring

3. Foundational types of disruptive technologies

In fact, Industry 4.0 has focused on four foundational types of disruptive technologies that can be applied all along the values chain:

- Connectivity, data, and computational power: cloud technology, the internet block chain, sensors.
- Analytics and intelligence: advanced analytics, machine learning, artificial intelligence.
- Human-machine interaction: virtual reality (VR) and augmented reality (AR), robotics and automation, autonomous guided vehicles.
- Advanced engineering additive manufacturing (such as, 3-D printing), renewable energy, nano particles.

4. Key technologies of the Industry 4.0 framework

- System Integration
- Cyber- Physical System
- Internet of Things and Service

- Big Data
- Additive Manufacturing
- Cloud Computing
- Augmented Reality
- Autonomous Robot
- Simulation

5. What industries are being transformed by Industry 4.0?

Every single industry will be transformed during the Fourth Industrial Revolution, but some to a greater degree than others. The nature of the Industry 4.0 transition will differ according to the specific types of technology being adopted, as well as the existing infrastructure and skills of organizations.

Operationally intensive sectors, such as manufacturing transportation, and retailing, will experience the greatest change because many companies in these sectors employ large numbers of people for tasks particularly suited for automation or digitization. Operations-intensive sectors have 1.3 times more automation potential than others do.

In these operations-intensive sectors, McKinsey analysis indicates that up to 58 per cent of work activities could be automated with current technology. Education, by contrast, is projected to undergo the least degree of change during Industry 4.0; only 25 percent of the sector's work is automatable.

6. Creating a future-ready work-force for Industry 4.0

Valuable suggestions have been made by CEO Ravi Kumar of COGNIZANT:

- "Cross-functional skills are needed by mid – level managers. Inter-disciplinary skills are very important. Managers will need to develop expertise in new functional areas, knowing the operations of the (client) enterprise"
- "Vibe Coding helps individuals from non-STEM fields build software using natural language." The company is also currently running a GenAI hackathon as part of its Vibe Coding initiative, where more than 2,50,000 employees from verticals like HR, sales, engineering, and marketing will register to develop ideas using AI programming.

Challenges in skills development-National Skills Policy:

"Key challenges include aligning training with market needs, expanding short-term courses and apprenticeships, ensuring placements, standardising content, and improving course quality," opines Dr. Uma & Suneha Sharma, Associate Prof. Dept of Economics (D.U).

7. Key AI/ML career paths

A) Technical roles

- **Machine learning engineers:** Designs, bulks, and deploys AI and ML models and systems.
- **AI engineer:** Develops tools, software, and processes to implement AI in real-world applications.
- **Data scientist:** Uses data, AI, and ML to extract insights and solve problems.
- **Data engineer:** Builds and maintains infrastructure for data collection, storage, and processing.
- **Natural Language Processing (NLP) engineer:** Enables AI to understand and process human language.
- **Computer vision engineer:** Develops AI systems to interpret visual data.
- **Robotics engineer:** Designs and develops robotic systems, integrating AI and ML.
- **Deep learning engineer:** Specialises in developing and optimising neutral networks.

B) Research and development

- **AI research scientist:** Conducts research to create new AI and ML algorithms and techniques.

C) Product and business roles

- **AI product manager:** Oversees development and delivery of AI products.
- **AI/ML consultant:** Provides expert advice on AI and ML projects.
- **AI ethics specialist:** Addresses the ethical implications of AI technologies.
- **AI/ML educator:** Trains others in AI and ML.

D) Other roles

- **Business intelligence developer:** Applies data and AI/ML insights to improve decision-making.
- **Consultant:** Offers strategic guidance on AI/ML applications.
- **Data analyst:** Identifies trends and insights from data.
- **Software engineer:** Develops software incorporating AI/ML capabilities.

8. Popular AI libraries and their use cases

- **TensorFlow (python, C++):** Deep learning, image recognition, NLP.
- **PyTorch (Python):** Neural networks, computer vision, reinforcement learning.
- **Scikit-learn (Python):** TraditionalML, data pre-processing, clustering.
- **Keras (Python):** Rapid prototyping and research in deep learning.
- **OpenCV (C++, Python):** Image processing, object detection
- **NLTK (Python):** Text analysis and NLP basics.
- **spaCy (Python):** Industrial NLP tasks like tagging and parsing.
- **Apache MxNet (Python, Scala):** Scalabie model training and deployment.
- **Caffe (C++, Python):** CNNs for image classification.
- **Gensim (Python):** Topic modelling, word embeddings.
- **H20, ai (Java, R, Python):** Enterprise-scale machine learning.
- **Theano (Python):** Enterprise-scale machine learning.
- **Apache Mahout** (Java, Scale)**:** Scalable ML for clustering, filtering.

9. New/Next frontiers of artificial intelligence

"Agentic AI combines the flexibility and generality of AI foundation models with the ability to act in the world by creating "virtual co-workers" that can autonomously plan and execute multi-step workflows. Although quantitative measures of interest and equity investment levels are as yet relatively low compared with more established trends, agentic AI is among the fastest growing of this year's trends, signalling its potentially revolutionary possibilities." opines experts Lareina yee & others, in their recent report titled McKinsey technology trends, Outlook (2025).

10. Old gen AI vs new agents

Early chatbots

- Content generation, summarization
- Static, pre-trained knowledge, often outdated.
- Single-step, direct commands
- Hallucinations, lack of verifiability

Reasoning AI

- Complex problem-solving, planning, automation
- Live real-time access to external and proprietary data
- Multi-step, autonomous tasks requiring planning
- Computational cost, ethical oversight complexity.

11. Global I. A leaders

To lead the AI arms race. Meta is aggressively recruiting top talent from across the industry from Open AI, Anthropic, Microsoft, and cutting-edge start-ups. But among all those experts, Deitke stood out. He co-founded Verecept – a prestigious, bold IA which could thin and explore, and adapt to complex digital environments. He is 24 years old and has been offered $250 million over four years – doubling the offer he received from Meta during 2022. It has launched during June 2025, a Super Intelligence lab where IA is expected to surpass human intelligence, reports Special correspondant, The Millennium Post.

12. Suggestions

In the context of the above noted background, following suggestions are offered:

- Success stories in 'Industry 4.0" should be published to encourages other industry leaders to follow them suitably. These should include tools and methodologies adopted by the top achieving organizations.
- A mission-mode nodal organization for 'Industry 4.0's progress should be set-up in the context of India's aspirations for becoming the Third Economic Power.
- The autonomous Non-Govt organizations conducting advanced courses/practicals on emerging technologies should either be completely exempted from GST or be charged a lower rate.

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Bhagavad Gita–based ethical frameworks for carbon market sustainability

Daksh Puri
School of Humanities, Indira Gandhi National Open University (IGNOU), Delhi, India
*Corresponding Author: Daksh Puri

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Abstract
This study examines how the moral and spiritual guidance offered in the Bhagavad Gita—particularly the principles of *Karma Yoga* (selfless action) and *Nishkama Karma* (acting without attachment to results)—can shape ethically responsible carbon trading mechanisms. Against the backdrop of escalating environmental harm and the growing reliance on market-driven climate strategies, the research underscores the necessity for an inner shift in the mindset of leaders, policymakers, and businesses. Adopting a qualitative and cross-disciplinary approach, it links Gita-inspired values with real-world Indian examples, including the Tata Group, the Sikkim Organic Mission, and Amul, to illustrate how dharmic approaches are already advancing sustainable progress. Ultimately, it proposes an ethical, dharma-oriented model for carbon governance that aligns with the aspirations of India's *Viksit Bharat 2047* vision.

Keywords: Bhagavad Gita, Nishkama Karma, Viksit Bharat 2047 vision, IGNOU

Introduction
With the rapid intensification of climate change and the growing adoption of carbon markets as policy instruments, issues of morality and underlying intent have gained prominence. Although carbon trading can deliver market efficiency, it often suffers from a weak ethical foundation, resulting in practices such as greenwashing and profit-driven motives. The *Bhagavad Gita*, an enduring treasure of Indian philosophy, provides deep guidance on selfless service (*Karma Yoga*), mastery over emotions, and duty-centered ethics. This research seeks to bridge the ancient wisdom of the Gita with present-day environmental challenges, focusing on how its principles can be embedded into carbon trading models to promote authentic, long-term sustainability.

Shloka
"कर्मण्येवाधिकारस्ते मा फलेषु कदाचन ।

मा कर्मफलहेतुर्भूर्मा ते संगोऽस्त्वकर्मणि ॥"

(Bhagavad Gita, 2.47)

Your entitlement extends only to the performance of your assigned actions; the results of those actions are never within your claim. Do not see yourself as the sole cause of those outcomes, and avoid attachment either to results or to idleness.

Literature Review
Bhatia and Madabushi (2013) [1] investigate how philosophical insights from the Gita can be applied in mental health practices, comparing the guru–disciple tradition to the modern therapeutic alliance. They emphasize that mutual trust, meaningful dialogue, and self-examination are key to personal growth. These same qualities can guide environmentally responsible governance by fostering honest negotiations, open stakeholder communication, and ethical conduct in carbon market systems.

Ghimire (2013) [2] explains the Gita's concept of "Vidya," or true knowledge, which places greater importance on inner discipline and self-awareness than on collecting academic titles. He draws a parallel between the Kurukshetra battlefield and the internal struggles of individuals, where conflicting duties are resolved through adherence to dharma. This analogy applies to carbon markets, where the temptation for immediate profit often clashes with the need for lasting ecological stewardship. His work suggests that moral vision should guide decision-making in climate-related trade mechanisms.

Shunmugam and Sukdaven (2014) [3] study ethical dimensions within Hindu thought as described in the Gita, distinguishing between niti—universal moral codes—and niyama—context-dependent rules. They argue that dharma evolves with circumstances, a notion that aligns with the flexible standards required in carbon trading as markets adapt to new technologies, shifting emission targets, and changing socio-economic realities.

Gurjar (2015) [4] positions the Gita as a model for educational innovation, advocating for experiential learning rather than repetitive memorization. For carbon market professionals, this would mean hands-on training and scenario-based exercises that cultivate ethical reasoning, much like Krishna's tailored counsel to Arjuna in the epic.

Sharma and Ramachandran (2015) [5] present the Gita as an all-encompassing educational framework that integrates Karma Yoga (selfless work), Jnana Yoga (knowledge), and Bhakti Yoga (devotion). They contend that real education develops moral integrity, emotional resilience, and intellectual sharpness alongside practical abilities. Applied to environmental governance, this suggests that effective carbon trading must blend practical action with ethical understanding and dedication to the collective good.

Mukherjee (2017) [6] explores how Karma Yoga principles benefit corporate talent management, showing that detachment from end results fosters commitment, honesty, and creative problem-solving. Within carbon trading systems, this philosophy implies that true success is measured by ecological and social impact rather than just market profitability.

Kalita (2018) [7] critiques the emphasis of modern education on economic productivity while overlooking value-based growth. He recommends integrating Gita values into curricula to nurture socially conscious citizens. For climate policy, this would mean creating regulatory structures that inspire market actors to value environmental protection above short-term financial rewards.

Lolla (2020) [8] examines the psychological strengths gained from learning the Bhagavad Gita during youth, such as resilience, empathy, and ethical awareness. He suggests that early exposure to these teachings prepares individuals to navigate complex moral challenges later in life. In the carbon trading sphere, such preparation would benefit policymakers, corporate leaders, and traders who must balance commercial goals with environmental ethics.

Subedi (2024) [9] provides evidence from Nepalese institutions showing that moral education rooted in the Gita fosters accountability, emotional balance, and social unity. This indicates that value-based training could be equally impactful in corporate sustainability programs and in shaping fair, transparent carbon trading practices.

Jana and Adhikary (2025) [10] explore digital tools as vehicles for delivering Gita teachings, noting that technology can expand access to moral and philosophical learning. Applied to carbon governance, AI-powered compliance and monitoring systems could embed dharma-inspired ethical standards into market operations, ensuring consistency and broad engagement.

Research objectives

- To examine how the ethical values embedded in the *Bhagavad Gita*—with a focus on Karma Yoga (selfless action) and Nishkama Karma (detachment from results)—can shape and strengthen moral responsibility within contemporary carbon trading practices.
- To study Indian examples such as the Tata Group, the Sikkim Organic Mission, and Amul as living models of dharma-driven sustainability, offering guidance for creating ethical carbon governance in alignment with the vision of *Viksit Bharat 2047*.
- To develop a proposed framework for carbon trading policies in India that is grounded in dharma, inspired by the teachings of the *Bhagavad Gita*, and informed by both philosophical insights and real-world case studies.

Research methodology

This research follows a qualitative and interpretive approach, structured around three key components:

- **Textual analysis:** Selected verses from the *Bhagavad Gita* were examined alongside traditional commentaries and contemporary interpretations, with particular attention to concepts such as *Karma Yoga*, duty, and environmental stewardship.
- **Literature review:** Scholarly articles, policy documents, and credible reports were analyzed thematically, drawing from the fields of environmental science, Indic philosophical thought, and economics to frame the ethical considerations of carbon trading.
- **Case study approach:** Three Indian examples—the Tata Group's ESG initiatives, Sikkim's statewide organic agriculture program, and Amul's cooperative sustainability practices—were explored to illustrate how dharma-based principles are applied in practical sustainability contexts.

Key findings

Objective I: Ethical foundations from the Gita in carbon trading

The concept of *Nishkama Karma*—performing one's duty without fixation on outcomes—offers a strong ethical compass for governing carbon markets. In the current landscape, many carbon trading systems lean heavily toward profit-driven objectives, often compromising fairness and openness. The Gita's counsel to act without greed provides a timeless philosophical basis for guiding stakeholders toward practices that are environmentally sound and socially just.

Objective II: Dharma-inspired case studies in governance

Indian examples such as the Tata Group, Sikkim's transition to organic farming, and Amul's cooperative model demonstrate how dharmic values—like ecological responsibility, equity, and integrity—can be effectively realized in practical contexts. Tata's enduring dedication to CSR and ESG embodies Nishkama Karma in corporate practice. Sikkim's complete shift to organic agriculture showcases leadership rooted in environmental ethics, while Amul's cooperative system highlights the strength of shared growth and collective responsibility. Together, these cases offer valuable models for embedding ethical principles within carbon market governance.

Objective III: Dharma-centric framework for policy this study proposes a three-level ethical approach to carbon policy:

- **Individual level:** Offer structured training for professionals in carbon markets, rooted in Gita-based ethical principles.

- **Corporate level:** Integrate ESG assessment tools that prioritize moral intention as well as compliance.
- **Policy level:** Craft carbon trading mechanisms that reward long-term environmental protection and discourage purely profit-oriented strategies.

Challenges of the study

While this study underscores the profound ethical and philosophical guidance that the Bhagavad Gita can provide for sustainable carbon trading, several obstacles hinder the seamless application of these teachings in practice:

- **Philosophy-to-practice gap** – The Gita's wisdom is expansive and interpretive, which makes it challenging to translate into precise, quantifiable compliance criteria for carbon markets.
- **Cultural specificity** – Rooted in a distinct cultural and spiritual tradition, the Gita's principles may require careful adaptation to be effectively applied in diverse, multi-faith, and global market settings without losing their core meaning.
- **Resistance from stakeholders** – Participants driven by short-term profit goals may be reluctant to embrace dharma-based ethics, particularly if they view such frameworks as potentially limiting competitiveness.
- **Interpretive diversity** – Multiple interpretations and commentaries on the Gita create the possibility of varied or even conflicting applications of its guidance in environmental governance.
- **Complex policy integration** – Embedding Gita-inspired ethics into current global carbon trading regulations demands reconciling philosophical ideals with legal frameworks and market-driven economic structures.
- **Technology dependence concerns** – Although AI and digital platforms can aid ethical compliance, excessive reliance on technology without strong human oversight may result in symbolic adherence rather than genuine ethical engagement.
- **Scarcity of empirical validation** – Current discourse is largely conceptual, with a lack of concrete case studies or pilot programs directly linking Gita-based ethics to measurable improvements in carbon trading systems.

Overcoming these challenges will require collaborative, interdisciplinary efforts, real-world pilot initiatives for dharma-based compliance, and active engagement with all stakeholders to preserve the depth of the Gita's philosophy while ensuring practical, scalable solutions.

Conclusion

The research establishes that the teachings of the Bhagavad Gita—particularly the concept of *Nishkama Karma*—can act as a guiding framework for embedding ethics into carbon trading. Viewing carbon markets as a dharmic duty rather than merely an avenue for financial gain positions India to become a global leader in sustainability that balances efficiency with fairness. The examples of Tata Group, Sikkim's organic initiative, and Amul's cooperative model demonstrate that these values are not confined to philosophy but can be successfully implemented in real-world contexts. As the nation advances toward its Viksit Bharat 2047 aspirations, weaving ancient moral insights into modern environmental governance can help ensure that sustainability initiatives remain rooted in honesty, inclusivity, and long-term accountability.

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Heuristics of sustainable decision making: psychographic predictors of green purchase intention in the electric vehicle market

Priyal Jain[1*] and Meha Joshi[2]

[1] Research Scholar, Department of Management, Indira Gandhi Delhi Technical University for Women, New Delhi, India

[2] Associate Professor, Department of Management, Indira Gandhi Delhi Technical University for Women, New Delhi, India

*Corresponding Author: Priyal Jain

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Abstract

Purpose: Transportation has now become one of the major contributors to greenhouse gas emissions, thereby exacerbating global warming. In response to this escalating peril of climate change, consumer behavior is undergoing a transformation aimed at environmental conservation. This evolution in consumer decision-making necessitates an examination of the green purchase intentions exhibited by consumers. The purpose of this research is to study various psychological factors that may influence the consumer's intention towards electric vehicles.

Methodology: This qualitative research study involves a comprehensive review of the existing literature to gather pertinent information.

Findings: The study reveals that the theory of planned behavior and the technology acceptance model are central to this enquiry, which states that intention is the result of subjective norms, perceived behavioral control, attitude, perceived ease of use, and perceived usefulness.

Originality: Only a few studies in the domain of sustainable consumer behavior have focused on the emerging industry of electric vehicles. Therefore, this study originally synthesizes the extant corpus of literature and highlights the role of psychological factors of consumer behavior towards electric vehicles.

Limitation: This investigation is restricted to the exploration of psychological factors; however, various other dimensions, such as infrastructural, political, and product-related factors, may also significantly affect the purchase intention towards electric vehicles.

Practical implication: Research findings will not only add to the existing corpus of literature but will furnish essential insights for policymakers and marketers in their initiatives to foster the adoption of electric vehicles.

Keywords: Electric vehicles, Green purchase intention, Innovation, Sustainability

1. Introduction

Today, increasing environmental degradation has become a major global concern due to the overconsumption of resources (Joshi & Rahman, 2015) [18]. Exhaustion of natural resources & adverse impacts of environmental degradation exacerbate the challenges that the world is facing (Hameed *et al*., 2022) [15]. One of the major reasons for environmental degradation is carbon dioxide (CO_2) emission (Salim *et al*., 2024; Monge *et al*., 2020) [29, 8]. In response to this exacerbating global threat, the Government, business sector & individuals should contribute to changing unsustainable consumption and production patterns. In various government conferences and agreements like the UNESCO conference in Belgrade in 1975, the Kyoto protocol in 1997, the Paris agreement in 2015, the idea to save the environment has been enforced (Chen & Kim, 2024) [11].

Facing the revenge of nature, consumers have also begun to change their thinking and behavior to live in harmony with nature (Esty, 2021) [14]. This paradigm shift in consumer behavior has made it important to study green purchase behavior (Sharma *et al*., 2023) [35]. Sustainable consumption is a concept that requires people, businesses, and countries to reduce the incorrect application of resources (Sharma *et al*., 2023) [35]. According to the survey, which was conducted in 2013, named Green Gap Trend Tracker found that around 70 percent or more of US consumers consider environmental problems while purchasing goods (Miller and Washington, 2014). Although the demand for sustainable products is rising but there is still an exigency to bolster green purchase intention (GPI). So, this investigation aims to assess the psychological constructs that can influence the green purchase intention of consumers towards electric vehicles. The study specifically focuses on the industry of electric vehicles because transportation has now become the major contributor to CO_2 emissions, and electric vehicles (EVs) are considered a good alternative to internal combustion engine vehicles (ICEVs) (Asadi *et al*., 2021; Borthakur, 2023; Virmani *et al*., 2023) [3, 7, 38].

Being a qualitative descriptive study, the secondary source of data will be used, necessitating the examination and analysis of existing literature in order to draw informed conclusions that will effectively guide the investigation. The research outcomes suggest that a range of elements, including green purchase attitude, subjective norms, perceived behavioral control, perceived ease of use, and perceived usefulness, positively influence their intention to participate in sustainable behaviors. In light of these findings, marketers possess the opportunity to strategically leverage this research to develop marketing strategies, increasing the market share of electric vehicles. The overall structure of this comprehensive study is organized into several distinct sections, which include Section 2: Methodology, Section 3: Literature review, and Section 4: Conclusion and Future Directions.

2. Methodology

The present research uses a qualitative approach rooted primarily in the well-established Theory of Planned Behavior (TPB), which provides a solid framework for explaining the complexity of consumer behavior. In this conceptual model, the study identifies and defines four key variables that significantly influence consumer choices: green purchase attitude, subjective norms, perceived behavioral control, and green purchase intention. To ensure the relevance and academic value of this research, it relies heavily on secondary data, carefully collected from a selection of peer-reviewed scholarly articles accessed through reputable databases like Scopus and Google Scholar. Additionally, the study focuses specifically on publications from 2017 to 2023, ensuring that the analysis reflects the most recent developments and scholarly perspectives in this rapidly evolving field. This methodological approach enhances the depth of analysis and allows for a comprehensive understanding of the factors that significantly impact consumers' intentions to make environmentally friendly purchases within the specified period. Through this rigorous approach, the study aims to contribute valuable insights to the body of knowledge on sustainable consumer behavior toward electric vehicles and their determinants. In conclusion, this research is positioned to offer important lessons that can influence both academic discussions and practical efforts to promote consumer acceptance of electric vehicles.

3. Literature review

Our planet is running out of resources, but populations are continuing to grow. According to census data, the global population reached 7.95 billion in 2022 (World Bank, 2023), which is represented by Figure 3. If the world population reaches 9.8 billion by 2050, then natural resources of almost three planets will be required to maintain the present lifestyle (United Nations, 2023). Therefore, to avoid this jeopardizing situation, consumption patterns and energy supplies should be diverted to green and sustainable ones to bring down the level of consumption (United Nations, 2023). As per the literature reviewed, green products are linked with the protection of the environment as they lead to reduced wastage during production, low energy consumption, fewer emissions, etc. (Barbu *et al*., 2022) [4]. In response to the exacerbating environmental issues, the businesses that have traditionally been involved in the aggravation of ecological degradation (Chawla *et al*., 2018) [10] are today increasingly being pushed, in the face of escalating consumer pressures for sustainability and environmental responsibility (Sharma *et al*., 2023) [35], towards more sustainable, conscious operational strategies, especially in the transportation sector. This industry not only acts as a pillar of international commerce but also as a major contributor to greenhouse gas emissions (Castillo *et al*., 2023) [16]. The internal combustion engine vehicles (ICEVs) are major polluters within this sector (Virmani *et al*., 2023) [38] and thus provoked a growing call for the immediate requirement of decarbonisation, a critical process with great potential through embracing and merging EVs as a conceivable option (Secinaro *et al*., 2022; Umar *et al*., 2021) [31].

The current research provides a review of the literature on sustainable consumer intention and outlines the variables of the Theory of Planned Behavior to guide researchers and practitioners in fostering sustainable intention and developing strategies to increase the penetration of EVs in the global economy.

a) Green purchase attitude

GPA refers to favourable or unfavourable belief which bolster up an intention towards GPB (Sharma and Aswal, 2017; Patwary *et al*., 2022, Ajzen and Fishbein, 1988) [33]. It is difficult to change attitude which are developed over certain period of time but can be affected with psychological motivation (Lien and Cao, 2014, Peña-García, 2020) [25]. When attitudes changes, people learn new concepts (Shaouf *et al*., 2016, Peña-García, 2020) [25]. Usually, if attitude of a person is positive towards buying online then, intention to make online purchase will increase Peña-García, 2020) [25]. According to most of literature reviewed, positive GPA leads to positive GPI (Sharma, Aswal and Paul, 2023, Sharma and Aswal, 2017; Jaiswal and Singh, 2018; Patel, Trivedi and Yagnik, 2020; Taufique and Islam, 2021; Bong and Jin, 2017; Patwary *et al*., 2022; Peña-García, 2020) [35, 33, 17, 24, 36, 6, 25]. In support, Klöckner *et al*. (2013) identified pro-environmental attitudes as increasing the willingness to adopt green cars. Therefore, attitude of consumer can be a significant factor in predicting their intention towards electric vehicle.

b) Subjective norms

Subjective norms are the motivation from family, friends, and other social groups that a consumer receives, to make purchase (Peña-García, 2020) [25]. For Consumers their peers are trustworthy helpers than biased celebrities of brand. Consumer trust the information shared by their known ones therefore interpersonal communication is considered to be more influencing than advertising campaigns, as they perceive less risk while purchasing goods (Goldsmith & Horowitz, 2006, White *et al*., 2019) [39]. Possibility of interpersonal influence increases through social networks as they act as behavioral cues which further impact intention of consumer to purchase (Bedard and Tolmie, 2018) [5]. Only limited research is there on factors which can influence online green purchase. According to the literature, if peers of consumer have positive attitude towards green products then green purchase intention of consumer will also increase (Barbu *et al*., 2022; Patwary *et al*., 2022; Bong and Jin, 2017; Zhang and Dong, 2020; Patel, Trivedi and Yagnik, 2020; Bedard and Tolmie, 2018; White *et al*., 2019) [4, 6, 41, 24, 5, 39]. Numerous studies emphasize the relevance of social influence in the adoption of alternative fuel vehicles (AFV) and highlight its significance in promoting electric vehicles (Zhao *et al*., 2024) [42].

c) Perceived Behavioral Control (PBC)

PBC is the amount of control perceived by a person during the process of buying goods and services. People usually prefer situations that they have control over to those in which they do not have control or situations that are under the control of external forces (Peña-García, 2020) [25]. The more consumer feel that their effort can protect nature, the more of their purchase decision will be for green products. Perceived behavioral control is positively related to green purchase intention, which means if one believes that they can protect the environment with their purchase and they will have more positive purchase intention towards green products (Sharma *et al*., 2023; Sharma and Lulandala, 2021; Patel, Trivedi and Yagnik, 2020; Pisitsankkhakarn and Vassanadumrongdee, 2020; Taufique and Islam, 2021; Bong and Jin, 2017; Zhang and Dong, 2020; White *et al*., 2019; Patwary *et al*., 2022) [35, 34, 24, 27, 36, 6, 41, 39]. In modern contexts, perceived behavioural control includes the perception of the individual towards technology, expense, availability, and mastery in the use of PHEVs, with López-Mosquera and Sánchez (2012) positing that higher consumer control over them is associated with increased behavioural intention (Adnan *et al*., 2018) [1].

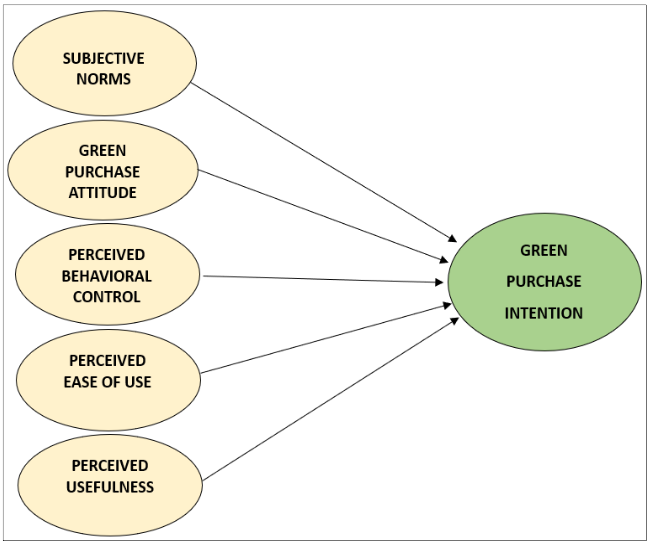
d) Perceived ease of use

The idea generally described as perceived ease of use can also be explained by the term low complexity. The idea of low complexity is actually closely entangled with that of ease of use, including factors like easy operation and simple charging procedures, and it has important relevance to people who are contemplating the use of new technologies like electric vehicles. In light of the academic work provided by Peters and Dutschke (2014), it is significant to note that in the given context of electric vehicles (EVs), the term "perceived ease of use" can well be used as an alternative to "complexity." Subsequently, within the scope of this research study, perceived ease of use is considered a decisive factor, as reported by Xu *et al*. (2020).

e) Perceived usefulness

Perceived usefulness can be stated as the extent to which the implementation and use of technological innovations act to enhance and expand the performance capacities of those involved in executing different tasks (Karahanna & Straub, 1999) [19]. The electric car, described as an eco-friendly mode of transport, is a key factor in reducing the negative impacts that accompany greenhouse gas emissions, while at the same time providing a traveling experience that is not only comfortable, convenient, and easy on the environment but one that also greatly accelerates travel and boosts the overall efficiency of travel (Anagnostopoulou *et al*., 2018) [2]. Since the electric vehicle conforms to existing eco-friendly standards and promises a driving experience characterized by ease, speed, safety, and comfort, its existence in the transportation industry plays a pivotal role in promoting perceived trust among stakeholders and users (Lakshmanan *et al*., 2024). Therefore, it can be seen that the placement of electric vehicles into day-to-day transportation is not just a fad but a huge step towards larger environmental objectives and personal performance increase (Wu & Zhang, 2017) [40].

Proposed research model



Source: The author

Fig 2: Model based on TPB and TAM

4. Findings

The literature confirms that the Theory of Planned Behavior (TPB) is a good theory in explaining green purchase intention for electric vehicles (EVs). A positive green purchase attitude, where customers consider EVs as environmentally friendly, economically beneficial, and forward-looking, positively affects their intentions to buy them. This attitudinal tendency gains even greater strength when amplified by subjective norms, given that people have a propensity to do what their social groups do. If influencers and peers show support for green technology such as EVs, consumers will feel more approved and are likely to emulate them; social disapproval, on the other hand, can suppress their willingness to adapt. Extending this, perceived behavioral control introduces yet another key dimension: those consumers who feel that they possess adequate resources, access to infrastructure, or self-efficacy to buy and utilize EVs are likely to follow through with plans. But when there are perceived barriers like excessive cost or poor charging infrastructure, even positive attitude and favourable norms cannot lead to action.

Though TPB considers psychological and social variables, the Technology Acceptance Model (TAM) supports this knowledge by laying stress on technology-specific perceptions. Perceived usefulness, like operational costs, environmental benefits, or incentives from the government, cements the consumer's perception that it is not only ethical but also sensible to adopt EVs. Likewise, perceived ease of use, manifesting in intuitive user interfaces, quick charging, and digital functions, increases the consumer's feeling of comfort with the product. The combination of TPB and TAM thus offers an overarching framework to explain green purchase intention towards electric vehicles, showing how attitude, social influence, perceived control, and technological perceptions collectively influence consumer decision-making related to sustainable mobility.

5. Practical implications & limitations

Implications for managers: The implications of this research provide useful insights to managers and marketers who seek to market electric vehicles. Knowing the psychological factors influencing green purchase intention, marketers are in a position to design their strategies to create positive consumer attitudes. This can be done through product placement advertising, peer recommendation, and communication strategies that emphasize the environmental and economic advantages of EVs. Designing spaces for consumer engagement, both with others and the brand, is an effective way to enhance social influence and adoption. In addition, improving perceived behavioral control is important; streamlining the purchasing process, providing monetary incentives, and increasing charging facilities can enable consumers to feel more competent and self-assured when purchasing EVs.

Implications for policymakers: For policymakers, this study provides evidence for policy interventions that promote the adoption of EVs through behavioral considerations. Policy interventions like public campaigns, subsidy programs, and investment in infrastructure can augment consumer intention as well as integrate with other sustainable development objectives and facilitate a circular economy.

Limitations and directions for future research: Although the study supports the applicability of the Theory of Planned Behavior in the context of EV, it is restricted to a limited number of psychological variables. Future studies can investigate other factors, including ethical values, product attributes, demographics, and online influence. Additionally, the present study examines generic offline consumer behavior without controlling for geographic or demographic segments. Online purchase channels and segment-specific behavior can be studied by further research to understand in-depth EV promotion.

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A study on circular economy adoption in Indian MSMEs: exploring the circular economy practices in large industry

Anamika Garg[1*], Dr. Renuka Sharma[2] and Dr. Chand P Saini[3]
[1] Research Scholar, Amity College of Commerce, Amity University, Haryana, India
[2] Assistant Professor, Amity College of Commerce, Amity University, Haryana, India
[3] Associate Dean and Professor, SGT University, Haryana, India
*Corresponding Author: Anamika Garg
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Abstract
The existing linear economics system has been unsustainable whereby a lot of waste is produced and the natural resources are not utilized efficiently. To combat that, the Circular Economy (CE) has been presented as a universal option that will be regenerative and restorative, plus sustainable. To the Indian industrial environment and specifically the Micro, Small and Medium Enterprises (MSMEs), circular economy offers a new transformative paradigm in the realization of long term sustainability. To gain better insight in successful strategies and implementation techniques, this study also comprises an analysis of the case of the Reliance Industries, which is one of the largest conglomerates in India and has implemented such strategies related to CE approaches as efficient use of resources and reduction of waste. Findings suggest that Enablers and Barriers to CE adoption are the most frequently mentioned topics in the literature. Though there is a growing interest in adoption of CE practices by MSMEs in India, there are still various challenges which bedevil broad adoption of the practice. These are; low awareness, lack of finances and poor policy and regulation support. Considering both general trends and the micro-level of business operations, this paper will be implemented into the existing discussion on sustainable development and will highlight the crucial place of MSMEs in the shift toward the states of circular economy in India.

Keywords: Circular economy, Sustainability, Adoption, Indian MSMEs, Reliance industry

1. Introduction
The concept of circular economy (CE) being the revolutionary approach to sustainable economic development has become popular, however, in times of the increased awareness regarding environmental issues and restrictions that resources might face. Circular economy focuses heavily on concepts of recycling the resources, minimizing the wastes, along with using particles again to develop a stronger and more defined economic model as opposed to the traditional linear economy model that largely relies on a so-called take-make-dispose structure.

The concept of circular economy is gaining increasingly more interest among businesses and policymakers (Geissdoerfer *et al*. 2017). Borrowing CE techniques provides the developing economies such as India that has large Micro, Small, and Medium Enterprises (MSMEs) industry sector with the opportunity to enhance the effectiveness of their operations, promote long-term sustainability, and mitigate the impact on the environment. Being one of the key industries driving economic growth in India, MSMEs contribute significantly to the industrial output, innovation, and work creation. The following challenges that these businesses experience, like limited information access, technology, and funding, may limit their ability to pursue sustainable practices.

India largest conglomerate Reliance Industries Limited (RIL) has achieved a lot towards adoption of the circular economy concept in each of its business units. RIL also comprise several industries like consumer products, textiles, and manufacturing and is pivotal in shaping the course of the Indian circular economy. In exploring the CE practices in RIL, we can possibly find out a lot concerning how the MSMEs can enhance their competitiveness and how MSMEs can deal with the transition to sustainability. This paper aims at investigating circular economy adoption by Indian MSMEs through the case of circular economy practice at Reliance Industries Limited. By closely examining CE practices, including its waste management, resource efficiency and sustainable product design, we will identify best practice, impediments, and the role of legislative systems in facilitating this transition. It is the wish of this study to uncover more viable information about the circular economy potential and offer viable recommendations to the stakeholders on what can be done to ensure a more robust and sustainable Indian economy.

1.1. Research objectives
- To analyze the current state of the art in the existing research on the Circular Economy adoption in Indian Micro, Small and Medium Enterprises.

- To analyze and document the current circular economy practices implemented by Reliance Industries in its operations.
- To develop strategic recommendations for Reliance Industries and Indian MSMEs on scaling circular economy practices while enhancing sustainability and competitiveness.

Identify the potential areas of research and practice. The systematic literature review is a valuable technique to be used to reach our goal due to the transparency, and traceability. The findings can serve as an effective reference of interested scholars investigating the implementation of circular economy practices.

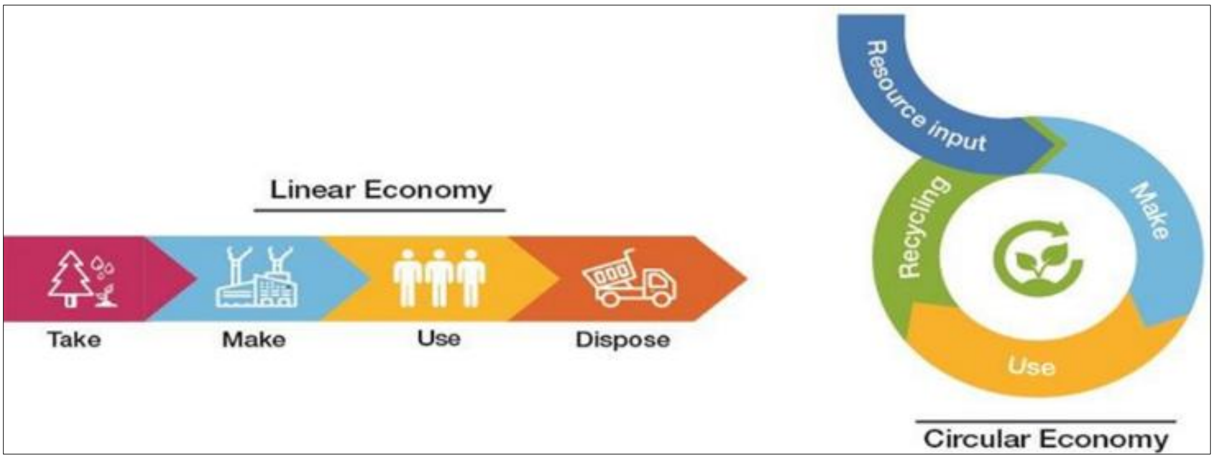
1.2. Background and significance

Circular Economy (CE) is a more sustainable development concept, which tries to make maximum use of resources and minimize waste. It is centered on the closed-loop systems wherein the resources, materials and the products are recycled, remanufactured and reused. The Indian economy largely depends on Micro, Small, and Medium-Sized Enterprises (MSMEs) with abounding challenges such as funding, knowledge gap, shortages of technology accessibility and regulatory roadblocks. This paper examines the CE practice of Reliance Industries that can be of versatile help to the MSMEs in India. The solutions can inform the business activities and make economic growth sustainable to social responsibility and the idea of a green environment.

2. Understanding circular economy

One of the most popular concepts in the field of environmental economics is the circular economy that constitutes a key feature of the Horizon in 2020 program developed by the EU (Sylvie Geissdoerfer & Felicitas Pietrulla, 2017). A circular economy is an industrial system that is designed to be restorative or regenerative and aims at decoupling growth with the use of finite resources. The paradigm of the circular economy is attracting the increasing interest of businesses and policymakers (Geissdoerfer *et al*. 2017). It aims at ensuring that components and products are designed to be reusable, repairable, and durable at desire, and that the production and disposal of products are programmed to recirculate technical and biological nutrients in a faster or more extensive fashion. Finally, it aims to be resource- smart. Through this process, the environmental degradation effect that a product causes in the lifecycle will be minimized (such environmental degradation impact of the chemicals, energy required during marketing of a product, resource consumption during production and waste volumes being recycled or used as a resource). According to studies, the circular economy could address the increasing complications related to resources by 2030, generate employment, stimulate innovation, and produce significant environmental benefits, and this would lead to the net positive impact of EUR 1.8 trillion (Ellen MacArthur Foundation, 2019). These are the basic concepts, which the transition between a linear and a circular manufacturing system is based on. To begin with, in the case of products, products themselves may become temporary sinks. The closed-loop systems are created under which the garbage is sold to another production system and the waste by-product becomes a source of raw material to come back to production system.

In the present-day world, the food system is producing enough food to meet the food needs of everyone on the planet, yet, about the entire third of food is lost during the consumption and supply chain activities (Ellen MacArthur Foundation and Google 2019). A circular economy is an economy in which the outputs of the products and services are shared and commonly traded in a system of lifecycles wherein the waste materials are perceived as resources to the succeeding activities. Regarding product life cycles, compared to the traditional linear ones, the circular economy looks very different and implies that we do not extract materials aimlessly on the face of the Earth, manufacture something out of them to get rid of them as waste at some point.



The model of linear economy and circular economy (Source: Author's Synthesis, 2021)

The volume of the extraction of natural values worldwide has been tripled since the turn of the century (Oberle *et al*. 2019). The circular economy aims to establish a sustainable world by preserving the environment and reversing the destruction by ensuring a sustainable globe as per the concept of corporate social responsibility. The primary goal of the circular economy is preservation and creation of the goods and materials, which utilize resources and energy to make them. To minimize greenhouse gases, it intends to extend the life cycle of materials and goods concerning energy and resource-efficient in processing technologies. The circular economy also tries to increase the value of services and the duration of goods as well as the infrastructure sustaining them and lower the consumption of non-renewable resources. The concepts of the circular economy rely on three guiding principals, design led (Ellen MacArthur Foundation 2019):

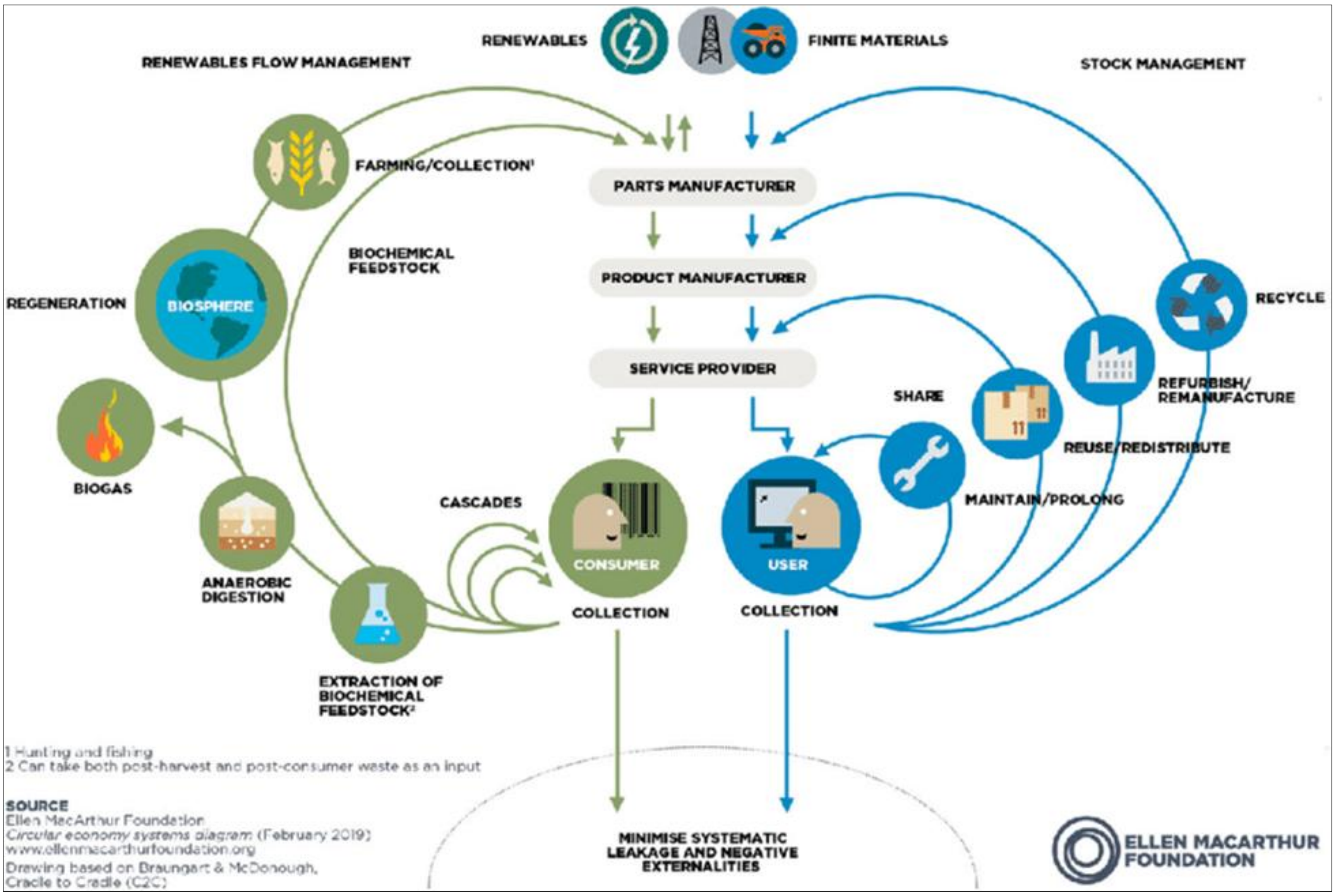
- Eliminate waste and pollution
- Circulate products and materials (at their highest value)
- Regenerate nature

3 R's of Circular Economy:

Reduce - Reduction in the consumption of non- renewable raw materials, resources, and emissions in the process of business as a viewer of a producer. A reduction in the rate of purchase and the longer service of the product as seen by the consumer point of view.

Reuse - Prolonging the life cycle of the products by reintroducing back to the economy after the given usage of these products and either via the existing or new channel.

Recycle - Recycling or reprocessing (shredding/melting) of the end of use materials or section of it to recover pure products that constitute similar or different productions.



Ellen MacArthur Foundation, Circular economy systems diagram (February 2019) www.ellenmacarthurfoundation.org.

The circular economy is gaining interest in the existing environment since the increasing trends such as the rise in energy prices and environment considerations are expected to cause further transformation of the way the global economy is run into a more sustainable and efficient use of resources based model. It is global awareness in the private sector of the necessity to integrate the concepts of the circular economy in the business strategies of companies. Circular economy is worth $1 trillion USD in total and probably will add up to another one trillion USD in future. The circular economy has created a serious paradigm shift in the policy, industry, and the society in the global front by way of good implementation of optimization of resources base value and minimization of waste at the end of a product lifespan.

3. Indian Micro, Small and Medium Enterprises (MSMEs)

Micro, Small and Medium Enterprise are the driving force behind the economic growth of any nation. Indian manufacturing sector comprises all the essential elements of transforming into the global industrial hub, large internal market with ample labour source and government policies such as make in India and skill India. Recent trends show the capacity of India to maintain its strong growth line.

The Indian manufacturing sector in India is dominated in major part by small, medium and micro industries which contribute about 45 percent of the manufacturing output and around 40 percent of the total exports. In addition to the notable contribution, they also develop entrepreneurship and innovation in the Indian environment, it is essential to understand the role Micro, Small and Medium Enterprises (MSMEs) could play in order to achieve growth in the manufacturing industry.

The enterprises are divided into categories as elaborated under the Micro, Small and Medium Enterprises Development (MSMED) Act, 2006 which is dependent upon the level of investment made in the form of plant and machinery. The following definitions are given to the categories:

- **Micro enterprises:** Those enterprises whose investment in plant and machinery does not go beyond 2.5 million rupees (25 lakhs).
- **Small enterprises:** The enterprises whose investment amounts to over Rs. 2.5 million to a limit of Rs. 50 million (5 crores).
- **Medium business enterprises:** Enterprises whose investment is greater than 50 million India rupees (more than 10 crores) however, these enterprises fall below an investment of 100 million rupees (10 crores).

MSME definition has been revised on 13 May, 2020 through Aatmanirbhar Bharat Abhiyan (ABA) package to ramp up MSME sector and also increase the number of units which come under this definition and was further revised on June 1, 2020. The US innovation uses the turnover factor along with the investment in plant and machinery. Additional separation of service and manufacturing has been eliminated. Another significant provision is also that exports are not to be included in the turnover. The new categorization of the MSMEs took effect on July 1, 2020.

4. Circular economy and Indian MSMEs

The micro, small and medium enterprises (MSMEs) play an essential role in the economy of India since MSMEs are agents of employment generation, innovation in the economy, export and inclusive growth in the economy. The Micro, Small and Medium Enterprises (MSME) are regarded to be the backbone of Indian society developing in terms of economical growth. Indian MSMEs are responsible in generating nearly 30 percent of India GDP. Major products that the Indian MSME sector is exporting include textile, garments, various forms of shoes, rice and castor oil.

Even though the circular economy is very new material in India, already in the last five years the country has received over 1.8B in investments in subsectors. Estimates show that approximately 60 percent of the total deal activity and approximately 80 percent of the deal value concentrate on innovations of energy and sustainable mobility that are mitigation-oriented (Kaalari, 2021).

As predicted by the Ministry of External Affairs of the Government of India, the country will be the third largest economy in the world taking a share of 8.5 in the world GDP by 2030. With this regard, in the instance that the global circular economy might reach 4.5 trillion US dollars as it is projected, the circular economy in India can only approach 1 percent of that market, which is a US 45 billion opportunity in India (Ministry of External Affairs, 2022).

Micro, Small & Medium Enterprises (MSME) segment is among the most important players in shift towards sustainable development in India. Therefore, this segmental development is highly vital. Mechanisms of mentoring and supporting should be put in place to foster culture of innovation and entrepreneurship as well as enhancing understanding and knowledge regarding businesses and policy-makers to build so as to create circular business model and experts on the subject matter. To do this, India will require a profound ecosystem with players that promote and facilitate circular economy projects so that it can survive the financial, skills, market, knowledge and technological barriers.

5. Literature review

Table 1

Title	Objectives	Methodology	Research gaps
Building the circular economy into the SMEs: A behavioral perspective in modeling review (2023)	1. To investigate the factors influencing SMEs' adoption of Circular Economy practices. 2. To assess the attitudes, perceived behavior control, social pressure, and readiness of SME actors towards Circular Economy practices. 3. To analyze the impact of positive attitudes, social pressure, and facilitation on SMEs' commitment to circular economy practices.	1. The research analysed SMEs within Malang region in East Jakat, whereby a sample size of 75 companies was used to conduct the study. 2. Secondary and primary data were taken. 3. The assessment of aspects of the research entailed the measurement of research variables on the Likert Scale, which was on a five-point agreement scale. The collected variables were Attitude, Perceived Behavior Control, Social Pressure, Environmental Commitment and SME Readiness.	1. The researchers concentrated on SMEs within one or another geographic unit, and this can qualify the results of the study to unknown generality as regards SMEs elsewhere or in a different nation. 2. More substantial results could be implemented in a bigger sample size. 3. The role of judgment sampling can allow biasness into the list of respondents.
Practice-based view of antecedents of circular manufacturing and how it affects both the environment	1. To examine the impact of circular manufacturing (CM) practices on environmental and financial performance.	1. This research involves the sequential mixed-methods research design.	1. Take into consideration the environmental and financial performance but not the social sustainability performance.

and financial performance. (2023)	2. To investigate the influence of Industry 4.0 (I4.0) production technologies on the relationship between CM and performance.	2. A survey of 255 Chinese manufacturers and 2 explanatory case studies. 3. The creation of a questionnaire that was conducted on intensive literature study.	2. They did not involve longitudinal data but rather cross sectional information. 3. The China context of a study. Other countries comparative study will be of meaning.
The article is, directly and indirectly, a reflection of other organizations across the manufacturing sector in terms of technological innovations in a circular economy. (2023)	To analyze the contributions of technological innovation toward sustainability in manufacturing organizations with a circular economy (CE) Perspective.	A questionnaire has been developed and conducted, also using the Grey VIKOR method and a sensitivity analysis.	1. One depends on the expertise of the already experienced individuals because the panel of experts can be rotated hence altering the outcomes. 2. Grey VIKOR approach has been employed in conducting analysis in determining the influence of technological innovation to sustainability within the manufacturing industry. This may be a methodological constraint that other MCDM tools, (e.g. TISM, TOPSIS, ANP and DEMATEL) can be used.
ICF: Education: Barriers to adopting circular economy practices in MSMEs: Instrument development, measurement and validation (2022)	1. Determine the dimensions of barriers to the adoption of circular economy practices in MSMEs. 2. Systematically and structurally develop a scale to evaluate barriers to circular economy practices from the perspective of MSMEs in the Indian context.	1. building a multi-item latent measure to evaluate hindrances to integration of circular economy practices in MSMEs. 2. Testing of the sub-constructs and measurement scale using PCA and CFA analysis through the scale validation. 3. The measurement scales should be tested and validated on the basis of exploratory factorial analysis and structural equation modeling by means of the products IBM SPSS 26 and AMOS 26.	1. It also employed cross-sectional data in the study, and hence longitudinal studies that will be conducted in the future will be needed to give the study a much deeper insight into the barriers to the uptake of the circular economy. 2. The generalizability could be increased through repeated use of the study in other areas.
Indian firm sustainability performance exploratory research An exploratory research of sustainability and performance of firms in India.new small and medium size enterprises production (2022)	1. To investigate the drivers of sustainability in Indian manufacturing SMEs. 2. To explore the impact of sustainable environmental and social practices on firm performance. 3. To examine the relationships among internal/external drivers of sustainability, sustainable business practices, environmental and social benefits, and firms' financial and non-financial performance.	1. Identification of SMEs within the distinct manufacturing industry (e.g. food and beverages, textile, engineering, leather, chemicals), in Indian states. 2. Design of a questionnaire to collect data. 3. Conducting a survey of SME owners/managers either by conducting a face to face interview, or using on-line surveys. 4. EFA and SEM were employed.	1. Particular geographic areas in India or limited sample size might have been the limitation of the study. 2. The application of a cross-sectional design means that it is difficult to make causal associations between variables as time progresses. 3. It has been possible that the study has not considered such external influences as the market, change in regulation, or technology development that may have a bearing on the relationship, or it is rather the productivity of sustainability practices and performance within a particular firm.
The question mark is how to make the small and medium enterprises circular economy compliant through minimizing the use of single use plastic (2022)	1. To analyze how personal norms of individuals within SMEs influence their behavior and decision-making regarding the reduction of single-use plastics. 2. To analyze how personal norms of individuals within SMEs influence their behavior and decision-making regarding the reduction of single-use plastics. 3. To analyze the behavioral intentions of employees in SMEs and how these intentions correlate with	1. In the study, the hypotheses were tested and the research questions answered using a quantitative research design in the context of behavioral intentions which refer to the intentions of SMEs to reduce their single-use plastic consumption. 2. The study has made use of an organized survey. 3. The SMEs sample that operated in Indian context gave a total of	1. This study was done within a given geographical setting and only the SMEs in India were studied. This hinders the interpretation of results to other geographical locations or nations. 2. The research can be of no use in bigger organizations or other industries. 3. Although this study obtained information about 305 SMEs, it is possible that the sample is not inclusive of the entire representation of SMEs in India.

	the organizational practices aimed at reducing single-use plastics.	305 responses thus forming a good sample to analyze.	4. Such theoretical approaches as theory of planned behavior or corporate social responsibility were not analyzed, which may bring extra insight into the phenomenon.
Analysis of operational behavioural factors and the idea of circular economy within SMEs: A perspective of an emerging economy (2021)	1. To empirically investigate the operational behavioral factor that contributes to the adoption of circular economy practices in SMEs. 2. To understand the cause-effect relationship between these behavioral factors and build an influential network relationship map. 3. To provide recommendations for the effective adoption of circular economy practices in SMEs.	1. Conducted an extensive literature review to identify operational behavioral factors for adopting circular economy practices in SMEs. 2. Developed a factor structure model using Exploratory Factor Analysis (EFA) to confirm the factors. 3. Developed a questionnaire using a 5-point Likert scale to gather responses from SMEs.	1. The research sampled 162 SMEs, and thus can restrict the extendability of the data to bigger sample of SMEs in emerging economies. 2. The responses taken using convenience and snowball sampling approaches might have certain biases in them inherently possibly much to the validity of the results.
Integration determinants of sustainability, and innovation strategies within the Indian manufacturing firms: Empirical evidence among the MSMEs (2020)	To identify and consolidate the determinant that strengthen the integration of sustainability with innovation for Indian manufacturing MSMEs.	1. Literature review 2. Questionnaire and surveys.	1. Critical factors that only some of them were identified to be strengthening the implementation of sustainability innovated practices in enterprise. 2. The current study has looked into manufacturing only. Other factors may as well be looked into.
Evaluating the drivers of intentions and actions of organization inrelation to a circular economy of plastics (2020)	1. To empirically assess the determinants of intentions and behaviors of organizations towards a circular economy for plastics. 2. To identify the intention-behavior gap in organizations' implementation of best practices for plastic recycling. 3. To investigate the impact of attitudes, subjective norms, and perceived behavioral control on organizations' intentions and behaviors.	1. There were 637 organizations that were studied in Belgium. 2. Usage of the Theory of Planned Behavior (TPB) as the factor of comprehending the determinants of intentions and behaviors. 3. A survey using the questions was used to collect data on the attitude of the organizations, subjective norms, perceived control of behavior, pressures, barriers, and enablers in the regard of the plastic recycling. 4. The associations of the variables were analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM).	1. The research coverage was also narrowed to 637 organizations within Belgium and so this could limit the applicability of the findings to other national situations or other countries. 2. This study had objections in gathering information in an increased amount of organizations.

6. Methodology

This section describes the systematic literature review's method adopted for this paper, listing and discussing all search protocols, inclusion and exclusion criteria, article selection process, as well as the structured key wording and search string used to find relevant research. SLR is a method for creating literature review articles that is integrative or systematic. SLR offers the benefit of an organized review procedure and strives for maximum transparency, reproducibility, and comprehensiveness (Torraco, 2005). The document database utilized to acquire relevant literature is Scopus. We selected titles and abstracts of articles published in English and selected articles with publication, i.e., not older than ten years.

6.1. Search strategy

The primary source of studies for this SLR is journal papers and research articles. Prior to executing the searches, a search plan was established that specified key concepts based on the research questions and inclusion and exclusion criteria. These concepts were then identified to generate search language. An extensive and systematic search for relevant literature was conducted. The search terms used to obtain the relevant literature were “circular economy” AND “small medium enterprise” OR “SME” OR “micro small medium enterprise” OR “MSME”.

6.2. Inclusion and exclusion criteria

Inclusive Criteria

- **Main theme of paper:** This SLR includes papers that are solely associated with the circular economy in MSMEs.
- **Type of papers:** This SLR includes research articles, review articles, perspectives, full papers, and short communication papers.
- **Journal rank:** Cumulative rank of each article and the number of citations for each paper has been defined based on the database.

- **Year of publication:** Only literature that is published after 2015 is considered.
- Full English peer-reviewed conference papers were also included**.**

Exclusion Criteria

- Papers that are unrelated to the theme were excluded.
- Articles in mechanisms such as patents or standards were not included.
- Posters, discussion papers, web pages, editorials, abstracts, or conference slides were excluded from the SLR.

The following figure offers insights into the development and distribution of Circular Economy research by examining publication counts. In the Figure1, the upward publication trend suggests that Circular Economy will attract growing interest from researchers, especially in determining the challenge of balancing financial, environmental and social goals in business activities to maximize value.

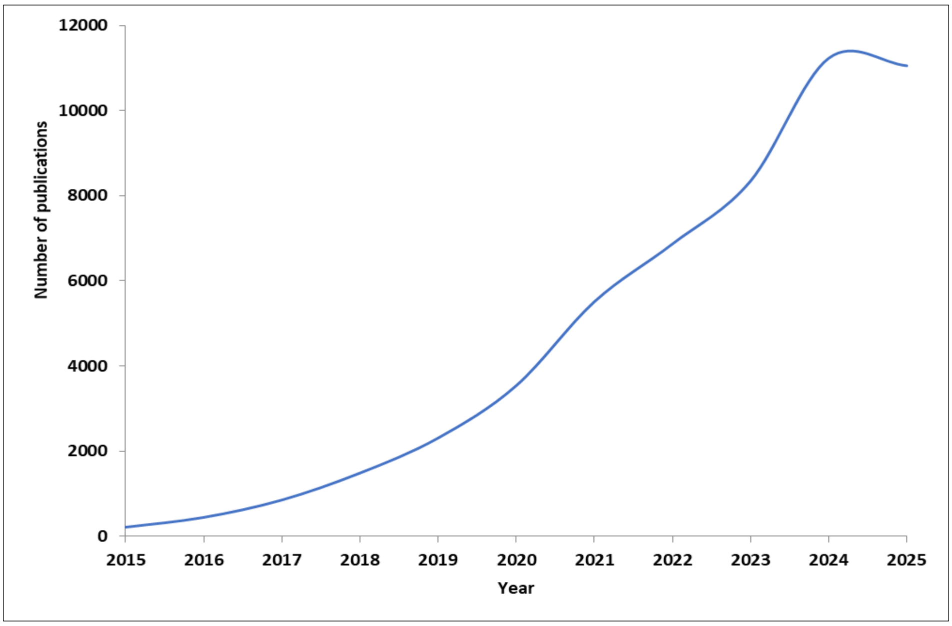


Fig 1: Research articles on "Circular Economy" from 2015 to 2025, as per recent search in Scopus Database

The following figure offers country-wise insights into the development and distribution of Circular Economy research in Small and Medium Enterprise or Micro, Small and Medium Enterprise by examining the publication counts. In Figure 2, it can be seen that Circular Economy concept is attracting interest from researchers in various countries. India has also the growing number of publications on Circular Economy in Small and Medium Enterprise (SMEs) or Micro, Small and Medium Enterprise (MSMEs).

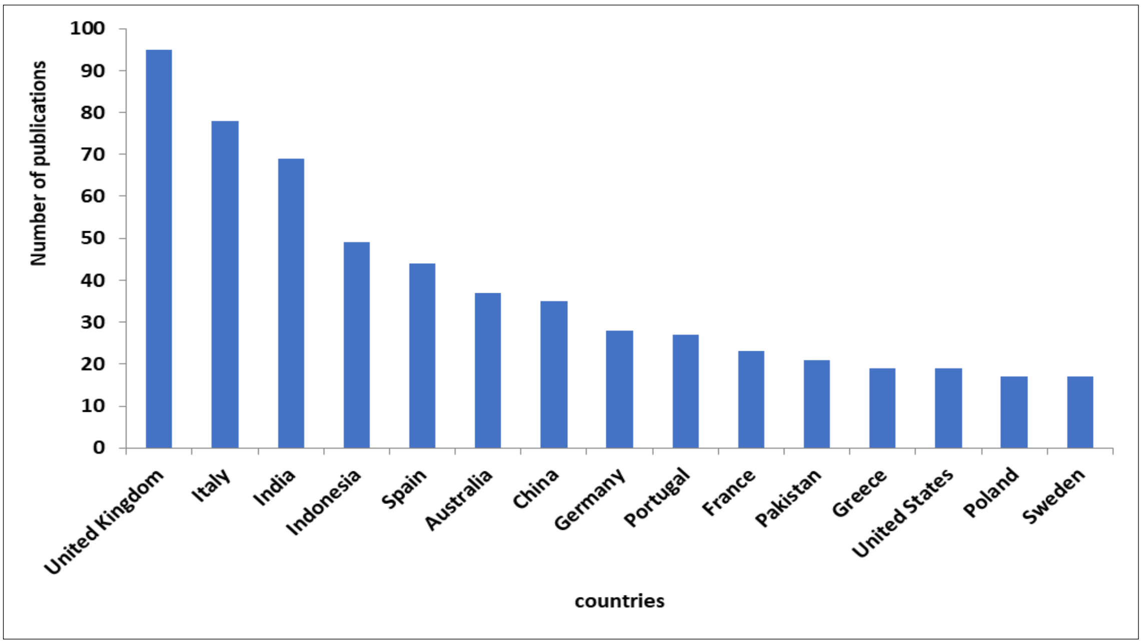


Fig 2: Research articles in countries/territories on "Circular Economy in SMEs or MSMEs" from 2015 to 2025, as per recent search in Scopus Database.

7. Case study of reliance industries

Reliance Industries Limited (RIL), India's largest conglomerate, has made significant strides in implementing the circular economy principles across all its business divisions. The circular economy model emphasizes sustainability, resource efficiency, and waste minimization, aligning with global environmental trends. RIL has invested in infrastructure and technology to recycle plastics, aiming for 100% recyclable or reusable items. The company is also transitioning to using renewable feed stocks in chemical manufacturing, exploring bio-based substitutes and optimizing waste processes. RIL has adopted energy-efficient procedures, integrating renewable energy sources like solar and wind power, improving operational efficiency, and streamlining processes. RIL has programs aimed at managing and reducing trash, focusing on reducing single-use plastics and implementing policies for industrial waste management.

7.1 About Reliance Industries Limited

Reliance Industries Limited (RIL) is the largest company in India, in the private sector, with consolidated revenues of ransom 9,74,864 crore (approximately US118.6 billion), a cash profit of ransom 1,25,951 crore (US15.3 billion), and net profit of ransom 73,670 crore (US9.0 billion) as on the 31 st march 2023, the end of the financial year. The scope of the business operations dealt in by the company has a wide gamut, which covers hydrocarbons exploration and production, petroleum refining and marketing, petrochemicals, advanced materials, renewable energy (such as solar and hydrogen), retail, and digital services.As of 2023, Reliance is the top-ranked Indian privately held business on the Global 500 list of the largest companies of the world ranking 88th on the list. It has also been ranked the highest among Indian corporations at the 45th place in Forbes global 2000 list of the largest companies in the world. Moreover, Reliance has also achieved an honor of being the highest rated Indian Company and the sole Company in the top 100 across the world on Forbes in its list of the World's Best Employers 2023. It is also listed under LinkedIn Top Companies 2023: The 25 Best Places to Grow Your Career in India.

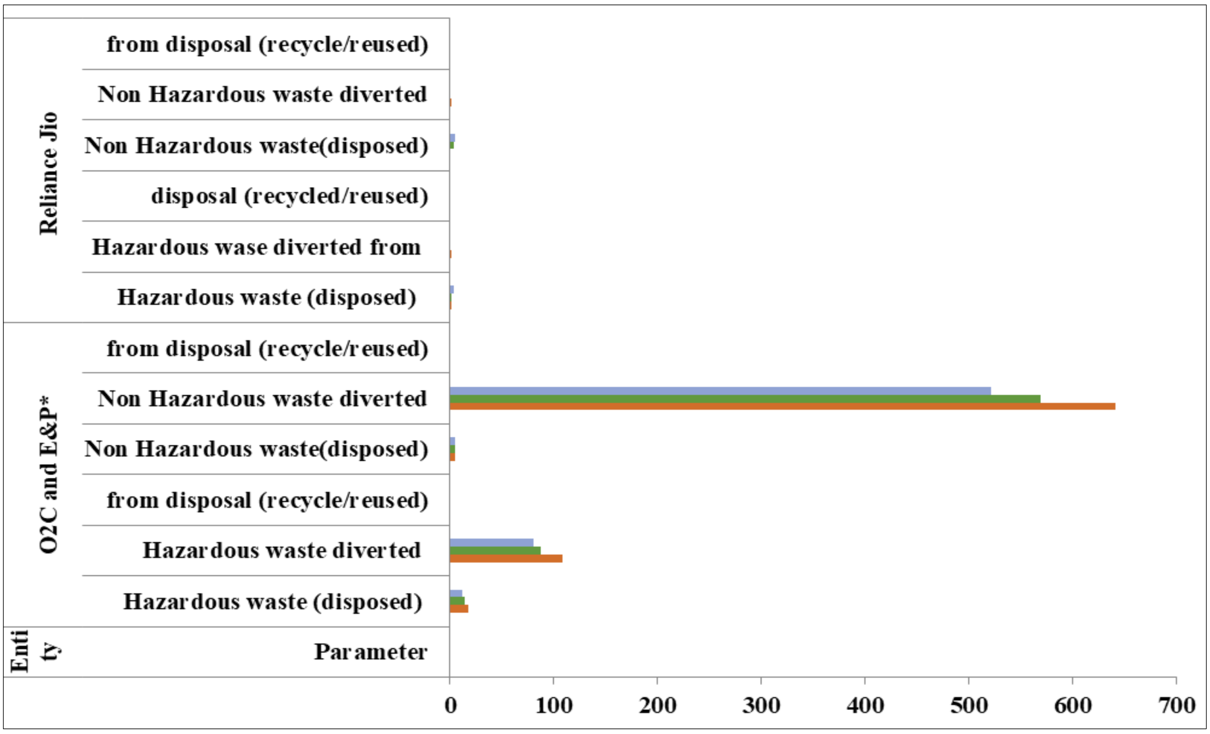
7.2 Waste management and circular economy initiatives

Reliance heavily emphasizes the element of sustainability by maintaining an effective waste management and circular econ practice in many of its business units. The main ones are the recycling of PEt and polyolefins, chemical recycling through pyrolysis oil, reusing of hazardous wastes as alternative fuels/raw materials, and the introduction of zero-waste retail stores.The company is also developing several projects to improve on circularity including the ReRouteTM innovation, sustainable packaging solutions, the RELANTM eco-friendly fabric, the commercialization of the RCAT-HTL technology, and the production of circular polymers. The ISCC Plus certification confirmed its integrated refining and petrochemical plant in Jamnagar where it is able to produce branded circular polymers - CircuRepol (TM) and CircuRelene (TM) - through the chemical recycling process of plastic waste using pyrolysis oil. Reliance also complies with the Extended Producer Responsibility (EPR) Guidelines and Plastic Waste Management Rules implemented in India to make sure that the combination of waste disposal and recycling processes implemented is up to the latest regulatory measures established in the country.

Table 2: Waste generation and management AT reliance in FY 2024-25

Entity	Parameter	Unit	FY 2024-25	FY 2023-24	FY 2022-23
O2C and E&P*	Hazardous waste (disposed)	'000 MT	17.4	14.8	12.32
	Hazardous waste diverted	'000 MT	108.65	87.89	80.68
	From disposal (recycle/reused)				
	Non Hazardous waste(disposed)	'000 MT	4.75	4.8	4.44
	Non Hazardous waste diverted	'000 MT	641	569.27	521.77
	From disposal (recycle/reused)				
Reliance Jio	Hazardous waste (disposed)	'000 MT	0.003	1.93	3.84
	Hazardous waste diverted from	'000 MT	0.54	0	0
	Disposal (recycled/reused)				
	Non Hazardous waste(disposed)	'000 MT	0	3.84	4.47
	Non Hazardous waste diverted	'000 MT	1.36	0	0
	From disposal (recycle/reused)				

Source: Integrated Annual Report 2024-25



Source: Integrated Annual Report 2024-25

8. Results and Discussion

The literature review gave important information about the circular economy (CE) and how it relates to environmental sustainability. The paper has managed to establish some of the main aspects of CE framework and what makes its adoption so necessary especially in the way of environmental safety. Being a new paradigm, the role of the circular economy in realizing a sustainable development and resource efficiency is undermined.

The results also reveal the idea that Micro, Small, and Medium Enterprises (MSMEs) play a tremendous role in economic growth in India. However, adoption of CE practices within the Indian MSMEs is still in nascent state although it has potential. According to the literature, Enablers and Barriers remain the most common mentionable aspects, which suggests their primary role in determining the implementation of CE.

On the whole, the findings indicate that there is increasing awareness about the circular economy but more work should be done to eliminate the structural and systemic issues that MSMEs encounter to spur the mass uptake.

Table 3: Circular Economy Adoption Enablers in Indian MSMEs

Major Categories	Sub-Enablers
Technological Enablers	Adoption of the 3 R's (Reduce, Reuse, Recycle) within organizations Efficient supply chain opportunities Enhanced information management platforms
Financial Enablers	Whole Life Costing Availability of large-scale materials Rising resource prices
Regulatory Enablers	Incentives for CE in manufacturing sectors Regulatory reforms
Policy Enablers	Policy support for skills development and innovation
Cultural Enablers	Strong company environmental culture Client coordination on CE importance Business collaborations to promote CE Environmental awareness among top management
Environmental Enablers	Mitigation of environmental degradation Addressing resource scarcity

Table 4: Circular Economy Adoption Barriers in Indian MSMEs

Major Categories	Sub-Barriers
Production and Operation Related	Lack of advanced manufacturing facilities Lack of R&D facilities Lack of skilled workforce Lack of continuous improvement culture Lack of information technology facilities
Organization Related	Lack of top management support for sustainability Lack of funds Lack of corporate social responsibility Lack of time for transition Lack of initiatives for sustainable manufacturing
Collaboration Related	Lack of supplier integration Lack of integration among stakeholders Lack of customer integration Lack of industrial networks
Government Rules and Regulations	Lack of enforcement for sustainability practices Lack of training and programs organized by governmentdepartments - Lack of financial policies

9. Conclusion and future research direction

The study on the adoption of Circular Economy (CE) practices among Indian Micro, Small, and Medium Enterprises (MSMEs) highlights a significant potential to improve sustainability and operational efficiency. Using Reliance Industries as a case study—one of India's largest conglomerates—this paper illustrates how the transition to CE can lead to multiple benefits, including reduced waste, improved resource utilization, and increased competitive advantage. Reliance serves as a strong example of how large enterprises can successfully implement CE principles and set benchmarks for smaller firms in the MSME sector.

The findings reveal that although a growing number of MSMEs recognize the importance of sustainable practices, several challenges hinder widespread adoption. Key barriers include limited awareness, inadequate financial resources, and restricted access to technology. Nevertheless, initiatives by industry leaders like Reliance can serve as catalysts for transformation by offering platforms for knowledge dissemination, financial assistance, and technological support.

For broader and more inclusive CE adoption, collaboration between large corporations, government bodies, and MSMEs is essential. Such partnerships can help build an ecosystem conducive to circular practices, benefiting enterprises at all levels.

Future research should focus on sector-specific implementation of circular economy principles within the MSME ecosystem, identifying unique barriers and replicable best practices. A deeper investigation into the practical challenges MSMEs face when attempting to adopt CE models will be valuable in framing targeted interventions. This can include real-world applications and solutions tailored to overcome these limitations.

Another promising area for future inquiry is the role of government policy in enabling and accelerating CE adoption in the MSME sector. Research should assess the effectiveness of existing policies and explore the potential of new regulatory frameworks in fostering circularity. Understanding how policy instruments—such as incentives, compliance mechanisms, and capacity-building programs—can support MSMEs will be key to shaping a sustainable and circular industrial future in India.

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Social Science

Green banking as a catalyst for sustainable development for Viksit Bharat 2047

Abhishek Badoni[1*], Dr. R. P. Badoni[2] and Dr. Santosh Kumar Gupta[3]

[1] Research Scholar, Invertis University, Bareilly, Uttar Pradesh, India

[2] Assistant Professor, Department of Commerce, V. S. K. C. Rajkiya Snatkottar Mahavidyalaya, Dehradun, Uttarakhand, India

[3] Assistant Professor, Department of Commerce, P. D. B. H. Govt. P. G. College, Kotdwar, Uttarakhand, India

*Corresponding Author: Abhishek Badoni

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Abstract

Banking sector plays an important role in the growth of an economy. In this regard Green Banking is becoming a common word whose practices are being followed by maximum banks in their working operations. Green Banking refers to promoting sustainable and socially responsible banking practices for the overall banking operations. This exploration paper aims to explore the programs and practices used by different financial institution in relation to green banking to achieve the goal of Viksit Bharat 2047. This paper explores the programs, innovation and environmental & social impact, as well the suggestions for the challenges faced to strengthen eco-conscious financial practices.

Keywords: Banking sector, Economy, Viksit Bharat 2047

Introduction

The Viksit Bharat 2047 initiative is the most embracing idea of Government of India to make India a developed nation by the century of its independence. Embracing diverse facets of development such as economic prosperity, social advancement, environmental sustainability, and effective governance. This vision emphasizes at the critical situation at which India presently stands.

This vision can be completed by the fulfilment of certain ideas and productive activities in the economy. So, in this respect Banking sector is the most prominent and important sector in the Indian economy. In the relation of Banking system "Green Banking" is such an idea which can coordinate with the Viksit Bharat 2047 initiatives.

To fulfil the goals of Viksit Bharat scheme green banking practices can play a major role. In this regard Green Banking is becoming a well-known standard which is being followed for a socially and environmentally acceptable business operations. This banking method is preventing environmental degradation and making the earth more liveable for the human beings. In the last few times, green banking practices has become a common word in the area of sustainable banking. In reality, green banking is recognized as sustainable banking, which plays a vital role in protecting the world from environmental damage with the goal of guaranteeing long term economic prosperity.

So, to protect and make our environment greener by 2047, all the financial institutions should focus at the business level and apply greening efforts at the corporate level. As Industrialisation have deteriorated the overall environment the most so most of the efforts must be done by this sector.

The aim of Viksit Bharat 2047 initiative is not only making India an advanced country by 2047 but achieving it through sustainable means to safeguard environment. Sustainability must be promoted while achieving the future goals by 2047.In a larger sense, Sustainable Development is defined as "long-term cultural, socioeconomic, and environmental wellness," with the focus on "long-term," "together with the necessity of integrating our social, economic, and environmental well-being." Many academics have given different definition and dimensions of Green Banking but the ultimate goal of it is economy growth in a long term without harming the environment.

All the banks in the Indian economy have the eventuality to increase economic growth while keeping sustainability and environment protection in their mind.

Literature review

Theoretical background

Most of the research and theories are about green banking practices and environmental protection but this research goes deep on the relation of Green Banking practices with the Viksit Bharat initiative 2047.

As every country wants to grow briskly and Viksit Bharat initiative is also associated with the idea of India being developed till 2047 but the SDG goals set up by the United Nations must be followed for the environmental protection.

Green Banking Practices (GBP) and Banks Environmental Performance (BEP)

Different prior research initiated by a lot of scholars has mentioned the use and importance relating to Green Banking practices on the firm performance (Environmental performance, social performance, and financial performance). Green banking means the adoption of green innovation methods that leads to energy-saving, pollution reduction, reducing organizational costs, increasing operational efficiency, improving the firm's image and making business more sustainable in the achieving competitive advantages. To understand this Vidyalaya carried out his study in Coimbatore city in India. She uses simple random sampling and the results were found out by correlation and regression analysis. It was the green banking practices adopted through employee training to follow, green policies, providing awareness regarding green products and procedures and general green efforts had a significant effect on Banking Environmental Performance. Content analysis was also done by them to get the desired results.

Importance of green banking

Green banking practices plays an important role for sustainable development. Green Banking is referred as a process which ensures sustainability in which business operations have no worse impact on the environmental conditions and also enhances productivity. Moreover, the environment management is more like risk management. It is extremely important for both banks and banks and the economy since it avoids different hazards in the banking sector. Banks play an important part in the economy because banks have the capability to contribute significantly to sustainable development. Green banking not only safeguards the greening of different sectors, but it also supports banks to improve their asset quality in the future times. Green banking improves the image of the bank by demonstrating and serving its environmental commitment, minimizes operational costs due to low utilization of office stationery, energy and water, improves employee productivity and efficiency through skilled and optimum use of technology; and reduces dangers by installing eco-friendly equipment's. It secures a lot of time and forestry by reducing paper usage; it also reduces greenhouse gas emissions by tele-conferencing and arranging a transportation pool for employees; it also helps in developing customers environmental consciousness by organizing awareness program; and reduces the extent of non-performing assets by investing in less risky projects.

Green banking program mainly includes energy effectiveness, recycling, lift sharing and environmentally responsible lending. This makes green banking practices so much important for any frugality. So, due to many environmental regulations enforced by competent authorities throughout countries, industries would be required to observe definite standards in order to conduct business.

Research gap

- There are numerous studies on green banking practices but not on the enterprise of a marketable bank in India on sustainable development.
- There are lack of study suggesting the effectiveness of green banking on the overall banking practices.

Objectives of the study

- To understand the impact of green banking practices on the operations of banking sector.
- To understand the green banking initiatives used by different commercial bank.

Hypotheses of the study

H_0: Green banking practices does not support sustainable development.

H_1: Green banking practices have a positive impact on sustainable development.

H_2: Green banking practices have positive impact on growth of economy.

Green banking initiative by State Bank of India

1. **Green building instruments**
   - As of FY 2024, SBI attained IGBC ratings for 45 of its buildings and achieved certifications across 13 buildings just in that year.
2. **Solar power adoption**
   - Installed roughly 20 solar rooftop systems (20.09 MWp) on bank buildings and 3534 solar-rooftop ATMs (6.73 MWp) as of March 31,2024.
3. **Waste reduction: PET bottle crushers & rainwater harvesting**
   - Deployed 20 PET bottle crushing machines and installed 538 rainwater harvesting systems across branches in FY2024.
4. **Green power purchasing**
   - Shifted 18 buildings to green power purchasing, offsetting nearly 1.74 crore electrical units annually.
5. **Tree plantation efforts**
   - Planted 1.8 million (18 lakh) trees on open land and within bank premises in FY 2024.
6. **Large ESG loan instrument**
   - Raised a $ 1 billion syndicated social loan with a $ 500 million green shoe, the largest ESG loan by an Asia-Pacific commercial bank.

Green banking initiative by ICICI Bank

1. **Green energy operation**
   - 30% of the bank's total electricity operation came from renewable sources as of FY 2024.
   - Multiple ICICI services are IGBC Platinum-certified.
2. **Net zero waste achievements**
   - BKC office certified as Net Zero Waste to Landfill.
   - Introduced waste isolation, recycling and composting across services.

3. Paper reduction through digitalization

- Saved 27.5 million A4 sheets wastes in a time.
- 59% of paper used is eco-labelled or reclaimed.

4. Water conservation technologies

- Recycled 1180 km per day of water through on-site treatment systems.
- Installed Atmospheric Water Generators (AWG) that extract water from air (500L/day).

5. Sustainable finance portfolio

- Handed over Rs 19000 crore in green loans, half of which supported renewable energy systems.

6. Climate risk management framework

- Developed a frame aligned with global climate standards.
- ESG factors are now embedded in lending decisions for high-emission sectors.

Green banking initiative by Bank of Baroda (BOB)

1. $1 Billion Syndicated Social Loan

- Raised in 2023, including Asia-Pacific's largest ESG loan, to support green and social infrastructure.

2. Green deposit framework (2024)

- Launched new deposit schemes where the proceeds are simply used for green projects.

3. Digital banking push

- Reduced paper and energy usage through promotion of paperless banking, mobile apps, and e-statements.

4. Energy-efficient infrastructure

- Retrofitting old branches with LED lighting, smart HVAC, and energy-efficient equipment.

5. Staff sensitization programs

- Trained employees on green banking, energy savings, and carbon-conscious behaviour.

6. Rainwater harvesting and solar installations

Installed rainwater harvesting systems and solar panels at key branches and zonal offices.

Green banking initiative by HDFC Bank

1. Green banking score

- Introduced a system to reward customers based on their digital banking usage, reducing paper and branch visits.

2. Carbon Disclosure Project (CDP) participant

- Regularly submits climate-related disclosures and ranks among the top Indian Private banks in climate reporting.

3. Electric Vehicle Loan Schemes

- Provides discounted loan rates for electric vehicles and solar installations.

4. Green branch certification

- Several branches have been made compliant with IGBC/LEED standards, using eco-friendly materials.

5. Digitization to reduce carbon footprint

- Transitioned many processes like onboarding, statements, KYC, and communication to completely digital.

6. Afforestation drives

- Conducts tree plantation campaigns across India, including partnerships with NGO's and schools.

Green banking initiative by Punjab National Bank (PNB)

1. PNB Palaash Campaign (2023)

- An 8-month internal program aimed at reducing paper use, electricity, and waste.

2. Concessionary green loans

- Offers lower interest rates for renewable energy projects (solar rooftops, biogas, etc).

3. Paperless branch initiative

- Promoted e-statements, online account opening, and digital KYC.

4. Use of renewable energy

- Installed solar panels in several rural branches and ATMs.

5. Green building construction

- Builds and retrofits branches with eco-friendly materials, smart lighting, and rainwater harvesting.

6. Staff awareness campaigns

- Organized training sessions, webinars and competitions to raise awareness on sustainability among employees.

Table 1: Commercial Banks initiative in relation to Viksit Bharat 2047

SBI Green Banking Initiative	Link to Viksit Bharat 2047 Vision
IGBC- certified green buildings	Promotes energy efficiency in infrastructure, supporting sustainable urbanization.
20.09 MWp rooftop solar systems & 3,534 solar Atm's	Reduces fossil fuel dependency, enabling a clean energy economy.
Green Power Purchase for 18 building	Accelerates adoption of renewable energy sources nationwide.
18 lakh tree plantations	Contributes to carbon sink creation for net-zero goals.
PET bottle crushers & 538 rainwater harvesting units	Encourages circular economy and water security.
Largest $1B ESG-linked loan	Channels large-scale capital towards green infrastructure and renewable projects.

Table 2

ICICI Bank Green Initiative	Link to Viksit Bharat 2047 Vision
30% renewable energy usage in operations	Aligns with India's renewable energy capacity targets.
IGBC Platinum-certified offices	Supports sustainable construction norms and energy-efficienct workspaces.
27.5 M A4 sheets saved	Cuts deforestation and promotes digital governance.
1180 Kl/ day water recycling & AWG systems	Enhances water resource management for climate-resilient India.
19000+ crore green finance portfolio	Mobilizes private capital for clean energy and green projects.
Climate Risk Management Framework	Prepares banking sector for climate-resilient financing decisions.

Table 3

Bank of Baroda Green Initiative	Link to Viksit Bharat 2047 Vision
$1 Billion ESG loan	Funds for renewable, clean transport, and sustainable urban projects.
Green Deposit framework	Channels citizens savings directly to green projects.
Digital banking adoption	Reduces carbon footprints and supports Digital India mission.
LED lighting & energy-efficient retrofits	Enhances energy efficiency in financial infrastructure.
Employee Sustainability training	Builds a green workforce ready for the 2047 economy.

Table 4

HDFC Bank Green Initiative	Link to Viksit Bharat 2047 Vision
Green Banking Score for customers	Incentivizes public participation in eco-friendly banking.
EV Loan schemes	Accelerates adoption of electric mobility for net-zero transport.
Green-certified branches	Encourages low-carbon infrastructure
Digital onboarding & paperless services	Supports e-governance and paperless economy goals.
Tree plantation drives	Aids afforestation targets under national climate action plans.
Climate disclosures (CDP)	Enhances corporate transparency for sustainable growth.

Table 5

PNB Green initiative	Link to Viksit Bharat 2047 Vision
PNB Palaash Campaign	Drives internal resource efficiency, supporting sustainable governance.
Concessional green loans	Expands renewable energy access for households and MSMEs.
Paperless branch operations	Reduces environmental impact and promotes digital literacy.
Solar-powered rural branches	Improves rural clean energy access.
Eco-friendly building construction	Advances green building standards in Tier-2 and Tier-3 cities.
Employee sustainability awareness programs	Spreads climate-conscious behaviour across India's workforce.

Limitations of the study

1. The study does not include all the commercial banks of India, it only includes the major banks in the banking industry.
2. Time constraint was the major issue in this research.
3. Demographic constraint was faced during this research.
4. Lack previous studies on the research topic.

Conclusion

Viksit Bharat 2047 is a dream initiative and project of Government of India. To fulfil this dream all the sectors of the economy will have to come together. Perhaps, Banking sector is the most prominent sector which will have the biggest role towards this development. Banking sector is mainly assumed as the backbone of the overall economy so it will have a greatest part in the overall growth and development of the economy, but driving towards the path of growth and development should not come at the cost of the environment. All the organisms in the environment should be safeguarded for the overall protection of this Mother Earth.

In this regard Green Banking Practices applied by many commercial banks is a good initiative. Green Banking Practices of many banks have reduced waste, made banking activities less harmful for the environment, and is trying to make the whole environment clean. Towards the Green Banking Practices many commercial bank have provided loans which works for environmental projects.

All the commercial banks are promoting and utilizing digitalization in their working operations to avoid paper waste, hence reducing environmental impact and promoting digitalisation. Many banks are also planting trees fulfilling the afforestation targets which also benefitting the environment.

So all of the efforts from the commercial banks are commendable, but more efforts should be done in the coming future to fulfil the goal of Viksit Bharat 2047.

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Redefining financial services for Viksit Bharat: the role of credit cards in inclusive growth and digital banking

Monika[1*] and Dr. Harshdeep[2]
[1] Research Scholar, Department of Management and Commerce, Baba Mastnath University, Rohtak, Haryana, India
[2] Assistant Professor, Department of Management and Commerce, Baba Mastnath University, Rohtak, Haryana, India
*Corresponding Author: Monika
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Abstract
Introduction: Credit cards have emerged as pivotal tools in advancing inclusive financial growth and promoting digital banking in India's journey toward Viksit Bharat 2047. Their growing adoption reflects a broader transformation in consumer financial behavior, enhanced access to credit, and rising digital literacy. This study explores the perceptions of consumers and bankers regarding the role of credit cards in fostering financial inclusion, transactional convenience, and trust in digital platforms.
Methodology: A structured primary survey was administered to a demographically diverse sample to capture variations in credit card usage and perception. The questionnaire assessed factors such as usage frequency, satisfaction, accessibility, and trust. Statistical tools including frequency analysis, t-tests, and ANOVA were applied to examine behavioral patterns and to identify significant differences across demographic variables such as age, gender, income level, and occupation.
Analysis: The results indicate notable disparities in credit card adoption and satisfaction across socio-economic groups. Younger, higher-income, and urban respondents demonstrated greater engagement with credit card usage and higher satisfaction levels. Conversely, certain demographics, particularly lower-income and rural respondents, exhibited limited access and lower satisfaction, primarily due to lack of awareness, digital literacy, and perceived trust issues.
Implications: The findings underscore the necessity for targeted financial literacy initiatives and product innovations tailored to diverse user groups. Enhancing trust, accessibility, and user-centric design in credit card services can significantly contribute to a more inclusive digital financial ecosystem. The study provides strategic recommendations for policymakers, financial institutions, and fintech developers to fortify India's credit-based digital infrastructure and ensure equitable financial participation on the path to Viksit Bharat 2047.Credit cards have become pivotal instruments in fostering inclusive financial growth and accelerating the shift toward digital banking in India's journey toward Viksit Bharat 2047. Their increasing adoption reflects a broader transformation in consumer financial behavior, accessibility to credit, and digital literacy. This research investigates the perceptions of both consumers and bankers regarding the role of credit cards in enhancing financial inclusion, convenience, and trust in digital transactions. A primary survey was conducted using a structured questionnaire targeting a diverse demographic segment. Frequency analysis was applied to understand usage trends and behavioral patterns. Further, ANOVA and t-tests were conducted to assess significant differences in credit card usage and satisfaction across variables such as income level, age, gender, and occupation. The analysis revealed disparities in adoption and satisfaction based on socio-economic backgrounds, highlighting the need for tailored financial education and innovation in credit card services. The study offers strategic insights to strengthen credit-based digital financial infrastructure and ensure equitable access across all sections of society.

Keywords: Financial inclusion, Credit cards, Digital banking, Viksit Bharat, Inclusive growth, Fintech innovation

Introduction

India's ambitious vision of Viksit Bharat by 2047 envisions a developed nation empowered by inclusive growth, technological innovation, and equitable access to financial resources. In this transformative journey, credit cards and digital banking play a pivotal role in reshaping the financial landscape and fostering financial inclusion. These tools, once seen as exclusive to urban elites, are gradually becoming instruments of empowerment for semi-urban and rural populations. This paper explores how credit cards, supported by digital banking infrastructure, are redefining financial services to align with India's inclusive growth agenda.

The need for redefining financial services

Traditional banking in India, despite its expansive network, has often failed to fully serve the financially underserved, particularly in remote or low-income regions. The concept of financial inclusion ensuring access to affordable financial products and services has gained prominence in recent years. Redefining financial services implies making them more accessible, digital, and inclusive, driven by fintech innovations and government policies such as Jan Dhan Yojana, UPI, and Digital India.

India has witnessed rapid strides in digital payments, but the credit card penetration remains comparatively low. As of 2024, there are over 110 million credit cards in circulation, but a vast section of the population still relies on cash or debit cards. Enhancing credit card accessibility, especially through digital means, is essential for achieving the financial inclusion goals of a Viksit Bharat.

Credit cards as tools of empowerment

Traditionally, credit cards have been considered luxury financial products used primarily for convenience, rewards, and emergency credit by affluent urban users. However, in the context of inclusive development, they are gradually transforming into tools that promote credit access, digital literacy, consumer spending, and financial discipline.

a) Access to short-term credit

Credit cards offer an important gateway to short-term credit without the cumbersome processes involved in traditional loans. For salaried individuals, small business owners, and gig economy workers, credit cards provide a safety net for managing cash flow, especially during emergencies.

b) Credit history and financial identity

Using a credit card responsibly helps individuals build a credit history, which can be crucial for accessing future credit lines such as personal loans, home loans, or business loans. In a country where many still lack formal credit profiles, credit cards can help integrate the unbanked and underbanked into the formal financial system.

c) Digital transactions and transparency

With increasing digitization, credit cards support cashless payments and offer transaction records, enhancing financial transparency and budget planning. This is aligned with the government's push towards a less-cash economy and reducing the shadow economy.

Credit cards and digital banking a synergistic relationship

The true power of credit cards in promoting financial inclusion is unlocked when they are integrated with digital banking ecosystems. Mobile apps, internet banking, and real-time alerts have made managing credit card accounts easier for even first-time users.

1. Simplified application and KYC processes

Digital banking platforms enable seamless credit card applications through e-KYC, AI-based eligibility assessments, and paperless verification. This reduces barriers for individuals in Tier II and III cities.

2. Innovative credit products

Fintech partnerships and digital banks are offering low-limit, secured credit cards backed by fixed deposits or alternative credit scoring. Such innovations help in risk mitigation while catering to a previously untapped market.

3. Financial literacy and alerts

Digital banking apps offer educational content, spending trackers, repayment reminders, and credit score updates, thereby promoting responsible usage of credit cards.

4. Integration with UPI and wallets

Modern credit cards are being integrated with platforms like UPI and digital wallets, allowing users to make payments via smartphones, thereby broadening usage beyond traditional swipe machines.

Challenges in credit card penetration for inclusive growth

While the opportunities are vast, several challenges hinder the widespread use of credit cards in promoting inclusive growth:

- **Low financial literacy**: Many potential users in rural and semi-urban areas are not fully aware of how credit cards work, including interest rates, billing cycles, and penalties.
- **Risk of over-indebtedness**: Misuse of credit cards can lead to debt traps, especially for low-income users without financial education.
- **Limited acceptance network**: Despite digital growth, many small merchants still prefer cash or UPI payments, limiting the utility of credit cards in certain regions.
- **Trust and cybersecurity**: Concerns about fraud, phishing, and misuse discourage new users from adopting credit cards and digital banking.

To address these issues, there is a need for robust financial literacy programs, user-friendly card products, grievance redressal mechanisms, and greater merchant acceptance.

Policy and institutional support for digital credit growth

The Government of India and the Reserve Bank of India (RBI) have introduced several initiatives to drive credit and digital inclusion:

- RBI’s Financial Inclusion Index tracks and encourages progress in access, usage, and quality of financial services.
- The Digital Payments Index, launched by RBI, promotes the adoption of cashless payment methods.
- RuPay Credit Cards integrated with UPI promote indigenous and cost-effective credit solutions for all economic segments.
- The Jan Samarth Portal and Credit Guarantee Schemes are also enabling credit linkages for MSMEs and self-employed individuals.

Case studies and innovations

Several Indian banks and fintech companies have launched innovative credit card solutions catering to new-to-credit (NTC) individuals:

- SBI’s SimplySAVE Card offers low annual fees and rewards tailored for everyday expenses.
- Airtel Axis Bank Credit Card offers cashback on utility and mobile recharges, targeting digital-first users.
- One Card by FPL Technologies is a mobile-first credit card with flexible limits and spending control features.

These innovations are designed to align with the consumption patterns of younger, tech-savvy users while also introducing rural and semi-urban users to credit culture.

The road ahead: vision for Viksit Bharat 2047

To fully realize the potential of credit cards in building a developed India (Viksit Bharat), several strategic steps must be taken:

- **Expand access through simplified onboarding**: Use AI and alternative data (like utility payments, rent payments) to offer credit cards to the unbanked or underbanked.
- **Strengthen credit infrastructure**: Enhance credit bureaus' coverage and credit scoring models to include informal income groups.
- **Promote financial literacy**: Government, banks, and NGOs must collaborate to conduct nationwide campaigns on credit card usage, rights, and responsibilities.
- **Boost digital infrastructure**: Ensure high-speed internet and mobile connectivity in rural areas to support digital banking.
- **Encourage MSME credit adoption**: Offer business credit cards with incentives for micro and small enterprises to adopt formal credit.
- **Leverage Jan Dhan and Aadhaar**: Link these platforms with digital credit solutions to build trusted identity-linked financial ecosystems.

As India moves toward the goal of Viksit Bharat by 2047, the democratization of credit access through digital tools will be a critical enabler of inclusive growth. Credit cards, when coupled with robust digital banking platforms, can become more than just spending tools—they can serve as instruments of economic empowerment, credit identity, and financial literacy. The transformation of credit cards from luxury products to inclusive financial tools will not only bridge the urban-rural divide but also foster a more resilient, self-reliant, and financially empowered India.

Review of literature

Jain and Bhatia (2023) [3] explored how credit cards have transitioned from luxury products to essential financial tools in India's evolving economy. They reported a significant increase in credit card adoption among younger users and rural consumers, driven by fintech innovations and relaxed Know Your Customer (KYC) procedures. The study indicated that the use of credit cards correlated with higher engagement in digital banking platforms, promoting a shift toward formal financial ecosystems. Jain and Bhatia also highlighted the role of technology in enabling credit access for previously underserved populations. They concluded that inclusive credit card services, backed by responsible regulation, could reduce reliance on informal lending channels and align with the broader goals of inclusive development under Viksit Bharat.

Sharma and Verma (2022) [6] analyzed the relationship between digital banking services and inclusive growth in India. Their study found that digital banking significantly lowered transaction costs and improved access to financial services in rural areas. They noted that the integration of digital platforms with credit instruments like credit cards encouraged financial engagement and enabled broader financial participation. Additionally, their findings highlighted that government schemes such as Jan Dhan Yojana and UPI played a foundational role in promoting credit card adoption. The authors observed that trust in digital infrastructure, supported by enhanced cybersecurity and financial literacy, was essential for sustaining long-term engagement. They concluded that digital banking and credit cards together created a comprehensive framework for financial empowerment under Viksit Bharat.

Das and Iyer (2022) [1] examined the impact of public policy on expanding credit access in India through credit cards and digital banking. They found that government credit schemes and regulatory incentives encouraged banks to issue credit cards in under-banked areas, including Tier 2 and Tier 3 cities. Their study revealed that linking credit cards with digital platforms improved efficiency and transparency, particularly in subsidy transfers and micro-entrepreneurship support. The authors argued that such integration not only facilitated economic participation but also improved consumption patterns and employment opportunities. They concluded that government-backed credit access, if scaled strategically, could significantly support the Viksit Bharat initiative by enabling financial independence and sustainable economic development.

Gupta and Narayan (2021) [2] studied the influence of fintech innovations, especially digital credit cards, on financial inclusion in India. They discovered that collaboration between traditional banks and fintech firms resulted in low-limit, fee-free credit cards tailored for underserved populations. These credit instruments helped first-time users build credit scores and participate in the formal economy. The study highlighted that AI-driven credit scoring, digital onboarding, and simplified user interfaces made these cards highly accessible. Gupta and Narayan concluded that the proliferation of fintech-based credit cards played a transformative role in democratizing credit access. Their findings aligned with the goals of Viksit Bharat by promoting inclusive growth through financial empowerment and technology integration.

Kumar and Singh (2021) [4] examined the role of credit cards in promoting financial inclusion across semi-urban regions of India. They found that credit cards facilitated access to formal credit and enabled users to develop digital credit histories, thereby increasing trust in formal financial systems. Their research revealed that users who had never interacted with banking institutions before were gradually integrated into the broader digital economy through structured and responsible use of credit cards. The study also emphasized that simplifying interest structures and improving financial education were essential in making credit cards a viable inclusion tool. The authors concluded that the expansion of credit card services could support national objectives such as Digital India and Viksit Bharat by fostering inclusive economic participation.

Mehta and Roy (2020) [5] investigated the barriers to credit card adoption in rural India and emphasized the role of financial literacy. Their study revealed that lack of awareness, fear of debt, and distrust of formal institutions limited the penetration of credit cards in rural areas. However, when supported by targeted awareness campaigns and simplified credit products, adoption rates improved notably. The authors found that credit cards, when introduced alongside financial education, empowered rural consumers to engage with digital financial systems more confidently. Mehta and Roy concluded that successful financial inclusion through credit cards required not only technological access but also education and robust consumer protection mechanisms. Their findings supported the view that credit card usage could contribute to Viksit Bharat by bringing rural populations into the formal financial fold.

Objective

- To examine the role of credit cards in fostering inclusive growth and advancing digital banking within the vision of Viksit Bharat

Methodology

In the study titled *"Redefining Financial Services for Viksit Bharat: The Role of Credit Cards in Inclusive Growth and Digital Banking,"* a sample of 100 respondents from Haryana was selected to understand the key challenges and barriers affecting the adoption and usage of credit cards within the digital banking ecosystem. A mixed-method research design was adopted, combining both quantitative and qualitative approaches to gain a comprehensive view of the factors influencing credit card adoption as part of India's financial inclusion efforts.

Quantitative data were gathered through structured questionnaires, capturing insights into awareness, trust, technological access, usage behavior, and perceived risks associated with credit cards. Frequency analysis was used to identify recurring patterns, while ANOVA and t-tests were applied to assess demographic variations across age, income, education, and digital literacy.

To enrich the analysis, qualitative methods such as literature review and focus group discussions were employed to explore concerns related to digital trust, user experience, regulatory clarity, and consumer preference for traditional payment methods. Thematic and statistical findings together provide a nuanced understanding of how credit cards can support inclusive digital financial services under the Viksit Bharat vision, offering actionable insights for policymakers, banks, and fintech innovators.

Data Analysis

Data analysis involves examining and interpreting collected information to uncover patterns, trends, and insights. Through statistical techniques and tools, it aids in drawing meaningful conclusions, supporting decision-making, and addressing research objectives.

Table 1: Frequency Analysis of Demographic Variable

Demographic variables		Frequency
Age (In years)	18-25	33
	25-30	29
	30-35	21
	Above 35	17
	Total	100
Marital status	Unmarried	38
	Married	62
	Total	100
Educational qualification	Graduation	49
	Post graduation	37
	Others	14
	Total	100

Source: Researcher's compilation

The demographic variables provide valuable insights into the composition of the surveyed population. In terms of age distribution, the majority of respondents fall within the 18-25 and 25-30 age brackets, comprising 33% and 29%, respectively. Notably, a significant portion falls in the 30-35 age groups (21%), and a further 17% are above 35, reflecting a diverse representation across various career stages. Regarding marital status, the data reveals that 62% of respondents are married, while 38% are unmarried. This marital diversity underscores the importance of considering the potential impact of family responsibilities on career choices and advancement. Educational qualifications exhibit a range of academic achievements, with 37% holding postgraduate degrees, 49% completing graduation, and 14% falling into the "Others" category. This educational diversity highlights the varied backgrounds of individuals contributing to the study, emphasizing the need for nuanced approaches in addressing career advancement challenges within this demographic.

Table 2: Frequency analysis of the role of credit cards in fostering inclusive growth and advancing digital banking

Statements	SD	D	N	A	SA
Credit cards enhance financial inclusion by offering access to formal credit for individuals without traditional banking histories.	5	2	3	18	72
They promote digital banking adoption by encouraging users to engage with online platforms and mobile apps.	2	2	6	31	59
Credit cards help build credit histories, enabling underserved populations to qualify for larger loans and financial services.	1	2	7	36	54
They support cashless transactions, contributing to the digital economy and reducing dependence on physical currency.	6	5	9	35	45
Government and fintech collaborations have increased the availability of low-limit and secured credit cards, broadening access.	3	5	2	17	73
Credit cards incentivize digital payments through reward programs, thereby reinforcing the shift toward digital banking.	8	7	3	55	25
They empower micro-entrepreneurs and small businesses by providing flexible short-term credit and online transaction tools.	3	3	5	32	57
Credit cards encourage financial literacy as users become more aware of budgeting, interest rates, and repayment cycles.	3	4	5	53	35
Integration with mobile wallets and UPI systems strengthens the digital infrastructure and ease of use.	7	6	7	33	47
Responsible credit card usage contributes to inclusive economic growth by bridging the gap between the formal financial system and underbanked communities.	11	4	5	33	47

Source: Researcher's compilation

The frequency analysis of respondents' perceptions regarding the role of credit cards in fostering inclusive growth and advancing digital banking reveals a predominantly positive outlook. A significant majority (72 respondents) strongly agreed that credit cards enhance financial inclusion by providing access to formal credit for individuals lacking traditional banking histories. Similarly, 59 strongly agreed and 31 agreed that credit cards promote digital banking adoption by encouraging engagement with online platforms. The ability of credit cards to build credit histories and qualify underserved populations for broader financial services was affirmed by 90 respondents (54 strongly agree, 36 agree). Furthermore, their role in supporting cashless transactions received substantial support, though a small portion remained neutral or disagreed. Notably, 73 respondents strongly agreed that government and fintech collaborations have broadened access to credit cards, indicating trust in institutional efforts. Reward-based incentives for digital payments were recognized, with 55 agreeing and 25 strongly agreeing. The empowerment of micro-entrepreneurs through credit card usage also saw positive responses. Moreover, credit cards were viewed as contributors to financial literacy and infrastructure integration, especially with mobile wallets and UPI. Overall, the data indicates that credit cards are widely perceived as effective instruments in achieving financial inclusion and digital transformation under the Viksit Bharat vision.

H0: There is no significant difference in the role of credit cards in fostering inclusive growth and advancing digital banking within the vision of Viksit Bharat across different age groups.

Table 3

ANOVA: Age					
Age	**Sum of squares**	**df**	**Mean square**	**F**	**Sig.**
Between Groups	33.619	8	1.865	10.677	.000
Within Groups	103.756	92	.176		
Total	137.375	100			

Source: Researcher's compilation

The ANOVA analysis was conducted to examine whether there is a significant difference in perceptions regarding the role of credit cards in fostering inclusive growth and advancing digital banking across different age groups within the framework of the Viksit Bharat vision. The results revealed a statistically significant difference between age groups, as indicated by an F-value of 10.677 and a significance level (p-value) of .000, which is less than the conventional alpha level of 0.05. This suggests that the null hypothesis (H_0), which states that there is no significant difference in perceptions across age groups, should be rejected. The between-groups sum of squares was 33.619 with a mean square of 1.865, while the within-groups sum of squares was 103.756 with a mean square of 0.176. These findings imply that age is a significant factor influencing how individuals perceive the role of credit cards in driving financial inclusion and digital banking in India's journey toward Viksit Bharat.

H0: There is no significant difference in the role of credit cards in fostering inclusive growth and advancing digital banking within the vision of Viksit Bharat across marital status.

Table 4

Levene's test for equality of variances	t-test for equality of means: marital status						
	F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean difference**	**Std. error difference**
Equal variances assumed	7.935	.000	-1.374	98	.159	-.387	.276
Equal variances not assumed			-1.639	56.000	.119	-.396	.253

Source: Researcher's compilation

A t-test was conducted to assess whether there is a significant difference in perceptions of the role of credit cards in fostering inclusive growth and advancing digital banking under the Viksit Bharat vision based on marital status. The Levene's Test for Equality of Variances yielded a significant result (F = 7.935, p = .000), indicating that the assumption of equal variances is violated. Hence, results from the row "Equal variances not assumed" are considered. The t-value was -1.639

with 56 degrees of freedom and a p-value of .119, which is greater than the 0.05 significance level. Therefore, the null hypothesis (H_0), which states that there is no significant difference in perceptions based on marital status, is not rejected. The mean difference between the groups was -.396 with a standard error of .253. This implies that marital status does not significantly influence how individuals perceive the role of credit cards in promoting financial inclusion and digital banking in the context of Viksit Bharat.

H0: There is no significant difference in the role of credit cards in fostering inclusive growth and advancing digital banking within the vision of Viksit Bharat across Educational Qualification.

Table 5

ANOVA: Educational qualification					
Education qualification	**Sum of squares**	**df**	**Mean square**	**F**	**Sig.**
Between groups	184.988	9	9.683	30.195	.000
Within groups	184.985	78	.321		
Total	369.973	100			

Source: Researcher's compilation

An ANOVA test was conducted to examine whether perceptions regarding the role of credit cards in fostering inclusive growth and advancing digital banking under the Viksit Bharat vision vary significantly across different levels of educational qualification. The results indicate a statistically significant difference among educational groups, as shown by an F-value of 30.195 and a significance level (p-value) of .000, which is well below the 0.05 threshold. This leads to the rejection of the null hypothesis (H_0), which stated that there is no significant difference in perceptions across educational qualifications. The between-group sum of squares was 184.988 with a mean square of 9.683, while the within-group sum of squares was 184.985 with a mean square of 0.321. These findings suggest that educational qualification significantly influences how individuals perceive the contribution of credit cards toward inclusive financial growth and the advancement of digital banking. More educated individuals may be more aware and receptive to digital financial tools.

Conclusion

The transformation of financial services in the context of *Viksit Bharat* underscores the significant role of credit cards in promoting inclusive growth and accelerating the adoption of digital banking. As India moves toward a digitally empowered economy, credit cards have emerged as more than just a mode of payment—they are catalysts for financial literacy, access to formal credit, and seamless integration into the digital financial ecosystem. This study highlights that credit cards, when leveraged responsibly and innovatively, can enhance financial inclusion by extending banking services to underserved segments, including rural and semi-urban populations. Furthermore, the collaboration between traditional banks and fintech companies is redefining customer experiences through secure, efficient, and accessible digital platforms. Government initiatives like Digital India and Jan Dhan Yojana have laid a strong foundation, but the continued emphasis on awareness, digital literacy, and infrastructural support is essential. In conclusion, credit cards, as a component of digital financial services, hold transformative potential in realizing the vision of *Viksit Bharat* by empowering citizens, bridging financial divides, and driving sustainable economic development across all strata of society.

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Social Science

Eco-conscious consumers and sustainable packaging: exploring bioplastics adoption in central NCR as a strategic pathway to Viksit Bharat 2047

Ankita[1*] and Dr. Komal Rani[2]

[1] Research Scholar, Department of Management, Baba Mastnath University, Rohtak, Haryana, India

[2] Assistant Professor, Faculty of Management and Commerce, Baba Mastnath University, Rohtak, Haryana, India

*Corresponding Author: Ankita

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Abstract

India generates over 3.5 million tons of plastic waste annually, much of it from single-use plastics, posing severe environmental and health hazards. In response, the Indian government has enforced restrictions and promoted eco-friendly alternatives like bioplastics. This study aims to assess the level of awareness among consumers in Central NCR regarding bioplastics. A sample of 120 respondents was selected using primary data collected through structured questionnaires, supported by secondary sources and qualitative focus group discussions. Statistical tools including frequency analysis, t-test, and ANOVA were used to analyze the data across demographic variables such as gender, age, education, and income. Results revealed moderate awareness overall, with significant gaps in knowledge about disposal practices and product differentiation. Inferential analysis showed no statistically significant differences in awareness across demographic groups. The study concludes with a call for targeted educational initiatives to promote informed adoption of bioplastics, supporting India's broader sustainability goals under Viksit Bharat 2047.

Keywords: Eco-conscious, Consumers, Bioplastics, Strategic, Viksit Bharat

Introduction

The rapid industrialization, economic expansion, and population growth in India have led to a dramatic increase in the consumption of goods, particularly packaged products. While packaging is essential for product safety, storage, and distribution, it has simultaneously contributed to the alarming rise in plastic waste. Traditional petroleum-based plastics, due to their non-biodegradable nature and extensive environmental footprint, have emerged as a critical environmental challenge. In response to this growing concern, there is a global push toward sustainable packaging solutions, among which bioplastics are gaining significant momentum. As India envisions a transformative developmental journey under the vision of Viksit Bharat 2047, promoting sustainable consumption practices, such as the adoption of bioplastics, becomes crucial for achieving environmentally responsible growth.

India generates more than 3.5 million tons of plastic waste annually, with a significant proportion originating from single-use plastics in packaging. This escalating crisis poses severe threats to biodiversity, public health, and natural resources. Recognizing this, the Government of India has imposed restrictions on single-use plastic items and is increasingly supporting research and innovation in eco-friendly alternatives. Among the various sustainable materials, bioplastics—derived from renewable biomass sources such as corn starch, sugarcane, cassava, or vegetable fats—offer the dual advantage of being biodegradable and compostable. Despite their potential, the mainstream adoption of bioplastics in India remains limited due to a combination of factors including high costs, limited availability, technological constraints, and lack of consumer awareness.

In this context, consumer behavior plays a pivotal role in driving the demand and successful integration of bioplastics into the market. The emergence of eco-conscious consumerism, characterized by increased environmental awareness and sustainable lifestyle choices, is reshaping purchasing patterns across demographics. Particularly in urban and semi-urban areas like Central NCR, educated and environmentally aware consumers are demonstrating a growing willingness to pay a premium for sustainable products. However, the gap between attitude and actual behavior—commonly referred to as the "green gap"—remains a significant hurdle. It becomes imperative to study the factors influencing this gap, such as perceived effectiveness, trust in bioplastic claims, price sensitivity, and availability of options.

Furthermore, Viksit Bharat 2047, the government's visionary roadmap for transforming India into a developed nation by the 100th year of independence, places a strong emphasis on sustainable development, green innovation, and responsible consumerism. Encouraging bioplastics adoption aligns with several key pillars of this vision, including environmental sustainability, circular economy, and citizen participation. By nurturing an eco-conscious consumer base and supporting industries that promote green alternatives, India can pave the way for an inclusive and sustainable future. Central NCR, being a microcosm of the broader Indian urban economy, can serve as a pilot region for scalable strategies promoting sustainable packaging through citizen engagement and market-based incentives.

Review of literature

Cao *et al*. (2025) [17] examined Japanese consumers' knowledge and acceptance of bioplastics using an online survey and binary logistic model. Findings revealed limited awareness, with greater acceptance for non-skin-contact products. Key adoption drivers included environmental concern, bioplastics knowledge, policy awareness, and income. The study highlights the importance of addressing consumer misconceptions and preferences to inform effective policy and promote the sustainable adoption of bioplastics in Japan.

Califano *et al*. (2024) [15] explored factors influencing Italian consumers' choices of biodegradable and compostable packaging using a hybrid model combining the theory of planned behaviour and discrete choice experiments. Through latent class analysis, they identified consumer segments based on preferences and psychological traits. The study highlights the role of both economic and psychological drivers, offering valuable insights for promoting sustainable packaging through targeted marketing and policy interventions.

Kumar *et al*. (2024) [16] conducted a systematic review of Life Cycle Assessments (LCAs) to evaluate the environmental impact and mechanical performance of bioplastics. The study found bioplastics to be more sustainable than conventional plastics but highlighted challenges such as high costs, limited biodegradability, and EoL management issues. It emphasizes the need for standardized methodologies, stakeholder collaboration, and further research to enhance bioplastics' environmental and functional viability.

Filho *et al*. (2022) [14] conducted a cross-country study exploring consumer perceptions of bioplastics in 42 nations. Findings revealed generally positive attitudes, particularly regarding their use in packaging and kitchenware. Cost and availability emerged as key adoption factors, though price sensitivity remains a concern. The study highlights a need for better consumer awareness and supportive policies to enhance bioplastics' market penetration and reduce reliance on conventional plastics.

Background of the study

With growing environmental concerns and increasing emphasis on sustainable development, understanding the evolution of packaging practices becomes essential. The background below outlines the historical journey that has led to today's focus on bioplastics.

Pre-industrial era

Before industrialization, packaging was primarily natural and biodegradable—leaves, cloth, jute, and pottery were commonly used. Environmental degradation due to packaging waste was virtually nonexistent, as materials decomposed naturally within ecosystems.

Industrial era (1800s–1950s)

With industrial growth and mass production, packaging needs expanded. The invention of synthetic plastics like Bakelite in the early 20th century revolutionized packaging due to plastic's durability, lightweight nature, and cost-effectiveness. However, environmental concerns were not a priority during this period.

Post-industrial/Consumerism era (1960s–1990s)

The global rise in consumerism led to excessive use of plastic packaging. Plastics became ubiquitous across industries—especially food, retail, and pharmaceuticals. The "throwaway culture" emerged, creating massive non-biodegradable waste and beginning visible environmental harm.

Awareness era (2000s–2010s)

Environmental movements gained momentum. Terms like *climate change*, *carbon footprint*, and *sustainable packaging* entered mainstream discourse. Researchers and activists highlighted the dangers of plastic pollution, marine contamination, and microplastics. Bioplastics began emerging as a viable solution, though adoption remained low.

Sustainability era (2020s–Present)

Governments, including India's, introduced bans on single-use plastics and promoted circular economy models. Consumers, especially in urban areas like Central NCR, became more eco-conscious. Bioplastics are now positioned as strategic alternatives aligned with national goals like Viksit Bharat 2047, aiming for sustainable growth, innovation, and environmental stewardship.

Research objective

- To assess the level of awareness among consumers in Central NCR regarding bioplastics.

Research hypothesis

H_0: There is no significant difference in awareness regarding bioplastics among consumers across different demographic variables.

Concept of bioplastics and eco-conscious consumerism understanding bioplastics

Bioplastics represent a transformative innovation in the global effort to combat the environmental impacts of traditional plastic packaging. Unlike conventional plastics derived from petroleum, bioplastics are made from renewable biological sources such as corn starch, sugarcane, cassava, or cellulose. Depending on their composition, bioplastics may be biodegradable, compostable, or simply bio-based but with similar properties to conventional plastics. They offer a promising alternative to fossil fuel–based plastics by reducing the carbon footprint, encouraging sustainable resource use, and minimizing pollution.

There are two broad categories of bioplastics

- **Bio-based but non-biodegradable bioplastics:** These are derived from renewable resources but do not degrade easily. Examples include bio-based polyethylene (bio-PE) and bio-polyethylene terephthalate (bio-PET).
- **Bio-based and biodegradable bioplastics:** These decompose naturally under specific environmental conditions and include types like polylactic acid (PLA) and polyhydroxyalkanoates (PHA).

The main advantage of biodegradable bioplastics is their ability to break down into natural substances such as water, carbon dioxide, and biomass, given the right composting conditions. However, it is important to note that not all bioplastics are automatically biodegradable, and their end-of-life management must be clearly communicated to consumers to prevent misuse or contamination with traditional waste streams.

Environmental importance of bioplastics

The growing urgency to replace petroleum-based plastics arises from their contribution to greenhouse gas emissions, marine pollution, and long-term environmental degradation. Plastic waste often takes hundreds of years to decompose, clogging landfills, harming wildlife, and releasing toxic microplastics into ecosystems. In contrast, bioplastics support the principles of a circular economy, where products are designed to be reused, recycled, or composted—thereby reducing the burden on the environment.

Moreover, as nations push for carbon neutrality, the adoption of bioplastics is aligned with global and national environmental policies, including the United Nations Sustainable Development Goals (SDGs) and India's climate action plans under the Paris Agreement. With their lower carbon emissions during production and decomposition phases, bioplastics are a sustainable material choice for future-ready packaging systems.

The rise of eco-conscious consumerism

Eco-conscious consumerism refers to a behavioral shift among modern consumers who are increasingly making purchasing decisions based on environmental, ethical, and social considerations. This new breed of consumers evaluates products not just for their quality or price but also for their environmental footprint, source of materials, production methods, waste disposal impact, and corporate social responsibility.

Several trends reflect this shift:

- A rise in demand for sustainable packaging.
- Increased preference for green-certified or eco-labeled products.
- Support for plastic-free packaging, zero-waste lifestyles, and plant-based materials.
- Consumer readiness to pay a premium for eco-friendly products.

This behavior is especially evident among millennials and Gen Z consumers, who are not only digitally informed but also actively engaged with sustainability campaigns and social causes. In India, urban regions such as Central NCR are witnessing a sharp increase in awareness related to environmental issues, leading to the emergence of a consumer class that prefers sustainable and socially responsible brands.

Bioplastics and the eco-conscious consumer: a natural alignment

There exists a strong link between eco-conscious consumerism and the market potential for bioplastics. As consumers become more informed about the environmental harm caused by single-use plastics, they are more inclined to support packaging that is biodegradable, compostable, or sourced from renewable feedstocks. This shift in consumer attitude acts as a market-driven force influencing industries to innovate and adopt eco-friendly packaging alternatives.

However, the actual adoption of bioplastics by consumers is often affected by several factors:

- Lack of awareness about what bioplastics are and how to dispose of them correctly.
- Price sensitivity, as bioplastics are often more expensive than conventional plastic packaging.
- Greenwashing concerns, where companies falsely label or exaggerate the eco-friendliness of their products.
- Limited availability of bioplastic-packaged products in regular markets and retail outlets.

Bridging this gap between consumer intention and action requires not only consumer education and awareness campaigns but also policy interventions, subsidies, and industry engagement.

India's sustainable transition and regional relevance

In India, the government has taken several steps to reduce plastic consumption, including bans on single-use plastics and the promotion of biodegradable alternatives. Cities within Central NCR, such as Delhi, Gurugram, and Noida, are at the forefront of adopting green infrastructure and environmental governance. Consumers in this region are more likely to encounter and engage with sustainable products, thanks to better exposure, higher literacy levels, and access to eco-friendly alternatives.

Given the region's progressive market and informed population, Central NCR serves as a critical test bed for understanding how eco-conscious consumers interact with emerging packaging innovations like bioplastics. This makes the region a valuable focus area for studying consumer perceptions, behavioral intentions, and readiness for change.

The integration of bioplastics into mainstream packaging systems is deeply intertwined with the rise of eco-conscious consumerism. As India aims to achieve its developmental goals under the Viksit Bharat 2047 vision, leveraging the behavior of informed and responsible consumers becomes essential. A shift toward bioplastics not only contributes to reducing environmental harm but also signals a larger transformation toward sustainable consumption and production. Understanding this consumer-packaging dynamic will be vital for policymakers, businesses, and civil society working towards a greener and more resilient India.

Research methodology

For the present study, a sample of 120 consumers from the Central NCR region was selected to represent the target population. Primary data was collected directly from respondents using structured questionnaires designed to capture both demographic information and variables related to awareness, perception, and adoption of bioplastics.

To analyze the quantitative data, statistical tools such as frequency analysis, T-test, and ANOVA were employed to explore significant differences in awareness levels across various demographic segments, including gender, age, education and income. The data collection process included surveys and interviews.

In addition to the quantitative approach, secondary data was utilized to support the conceptual foundation of the study. This included a review of relevant research articles, academic journals, government reports, policy documents, and books focusing on bioplastics, sustainable packaging, and eco-conscious consumer behavior. To further enrich the study with qualitative insights, focus group discussions were conducted to understand consumer attitudes, barriers to adoption, and expectations regarding bioplastics.

This mixed-method approach enabled a comprehensive understanding of the role of eco-conscious consumers in driving bioplastics adoption in Central NCR, aligning with the broader vision of Viksit Bharat 2047.

Data analysis

Data analysis refers to the process of examining and interpreting the collected data to identify patterns, trends, and significant insights. By applying statistical methods and tools, it helps derive meaningful conclusions, supports informed decision-making, and effectively addresses the research objectives.

Table 1: Frequency analysis of demographic variables

Demographic variables		Frequency
Gender	Male	72
	Female	48
	Total	120
Age (In Years)	18-25	64
	25-35	28
	35-45	21
	Above 45	7
	Total	120
Educational Qualification	12th	15
	Graduation	65
	Post graduation	34
	Others	6
	Total	120
Monthly Family Income (In Rs.)	Less than 30,000	16
	30,000-50,000	68
	Above 50,000	36
	Total	120

Source: Researcher's compilation

The demographic profile of the respondents (N = 120) reveals a diverse representation across gender, age, education, and income levels. In terms of gender, the sample comprises 72 males (60%) and 48 females (40%), indicating a male-dominant participation. Regarding age, the majority of respondents (64 or 53.3%) fall in the 18–25 years age group, followed by 28 respondents (23.3%) aged 25–35 years, 21 respondents (17.5%) aged 35–45 years, and only 7 respondents (5.8%) above 45 years, showing that younger individuals were more actively involved. In terms of educational qualification, most respondents were graduates (65 or 54.2%), followed by postgraduates (34 or 28.3%), 12th pass (15 or 12.5%), and others (6 or 5%), indicating a relatively well-educated sample. With respect to monthly family income, a significant portion (68 or 56.7%) belonged to the ₹30,000–50,000 bracket, while 36 (30%) earned above ₹50,000, and 16 (13.3%) earned less than ₹30,000.

Table 2: Frequency analysis of awareness among consumers regarding bioplastics

Statements	HA	A	N	NA	NAA
I am aware that bioplastics are made from renewable biological sources	46	55	9	5	5
I can differentiate between bioplastics and conventional plastics	28	53	6	6	27
I have seen the term "bioplastics" on product packaging or advertisements	26	25	45	19	5
I am aware of the environmental benefits of using bioplastics over traditional plastics	34	49	27	7	3
I know that bioplastics are biodegradable or compostable under certain conditions	22	29	29	21	19
I understand the role of bioplastics in reducing plastic pollution	27	65	17	8	3
I am aware of the availability of bioplastic products in the market	76	20	6	2	16
I have read or heard about government initiatives promoting the use of bioplastics	34	40	30	13	3
I am informed about the disposal and recycling methods for bioplastics	26	33	36	16	9
I know the difference between biodegradable plastics, compostable plastics, and bioplastics	40	40	23	11	6

Source: Researcher's compilation

The frequency analysis of consumer awareness regarding bioplastics, based on the responses of 120 participants:

- I am aware that bioplastics are made from renewable biological sources.
- A strong awareness is evident, with 46 respondents (38.3%) highly agreeing and 55 (45.8%) agreeing, showing that nearly 84.1% are aware of the renewable origin of bioplastics. Very few disagreed or were unaware, indicating high clarity on this aspect.
- I can differentiate between bioplastics and conventional plastics. Awareness is moderate here, with 28 (23.3%) highly agreeing and 53 (44.2%) agreeing, totaling 67.5%. However, 27 respondents (22.5%) strongly disagreed, reflecting that a notable portion still struggles with this differentiation.
- I have seen the term “bioplastics” on product packaging or advertisements. Only 51 respondents (42.5%) agreed or highly agreed, while 45 (37.5%) remained neutral and 24 (20%) disagreed, indicating limited visual exposure to bioplastics in media or packaging.
- I am aware of the environmental benefits of using bioplastics over traditional plastics. Awareness is fairly high, with 34 (28.3%) highly agreeing and 49 (40.8%) agreeing, totaling 69.1%, indicating a general understanding of bioplastics' eco-friendly nature.
- I know that bioplastics are biodegradable or compostable under certain conditions. This area shows mixed awareness; only 51 respondents (42.5%) agreed, while 29 (24.2%) remained neutral and 40 (33.3%) disagreed, showing a lack of clarity about biodegradability conditions.
- I understand the role of bioplastics in reducing plastic pollution. A strong majority (92 respondents or 76.7%) agreed or highly agreed, demonstrating high awareness of bioplastics' role in addressing pollution.
- I am aware of the availability of bioplastic products in the market. This statement had the strongest agreement: 76 (63.3%) highly agreed and 20 (16.7%) agreed, showing 80% of respondents are aware of market availability.
- I have read or heard about government initiatives promoting the use of bioplastics. Awareness is moderate, with 74 (61.7%) agreeing or highly agreeing, but 30 (25%) neutral and 16 (13.3%) disagreeing, suggesting partial exposure to policy-level promotion.
- I am informed about the disposal and recycling methods for bioplastics. Only 59 (49.1%) showed agreement, while 36 (30%) remained neutral and 25 (20.9%) disagreed, indicating knowledge gaps in disposal awareness.
- I know the difference between biodegradable plastics, compostable plastics, and bioplastics. A majority (80 respondents or 66.6%) agreed or strongly agreed, showing a decent understanding, although 17 respondents (14.1%) disagreed, suggesting the need for clearer differentiation in public messaging.

Overall, while general awareness about bioplastics is relatively high, specific knowledge areas like biodegradability conditions and disposal methods reveal room for improvement.

ANOVA and t-test analysis

H_0: There is no significant difference in awareness regarding bioplastics among consumers across different gender groups.

Table 3: t-test: awareness regarding bioplastics among consumers across gender

Levene's test for equality of variances	t-test for equality of means						
	F	Sig.			Sig. (2-tailed)	Mean difference	Std. error difference
Equal variances assumed	.915	.341	.949	118	.344	1.25694	1.32386
Equal variances not assumed			.990	113.490	.324	1.25694	1.26949

Source: Researcher’s compilation

To test the hypothesis There is no significant difference in awareness regarding bioplastics among consumers across different gender groups, an independent samples t-test was conducted. Levene’s Test showed a p-value of 0.341, indicating that the assumption of equal variances holds. The t-test result (equal variances assumed) gave a t-value of 0.949 with a p-value of 0.344, which is greater than 0.05. Thus, the null hypothesis is not rejected, suggesting that there is no statistically significant difference in the level of awareness regarding bioplastics between male and female consumers.

H_0: There is no significant difference in awareness regarding bioplastics among consumers across different age groups.

Table 4: Awareness regarding bioplastics among consumers across age

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	234.726	3	78.242	1.574	.199
Within Groups	5766.866	116	49.714		
Total	6001.592	119			

Source: Researcher’s compilation

To test the hypothesis There is no significant difference in awareness regarding bioplastics among consumers across different age groups, a one-way ANOVA was conducted. The results show that the F-value is 1.574 with a p-value of 0.199, which is greater than the significance level of 0.05. This indicates that the differences in mean awareness scores among the four age groups are not statistically significant. Therefore, the null hypothesis is not rejected, implying that consumers' awareness regarding bioplastics does not differ significantly based on age group.

H_0: There is no significant difference in awareness regarding bioplastics among consumers across different educational qualification.

Table 5: Awareness regarding bioplastics among consumers across educational qualification

ANOVA					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	188.210	3	62.737	1.252	.294
Within Groups	5813.381	116	50.115		
Total	6001.592	119			

Source: Researcher's compilation

To test the hypothesis There is no significant difference in awareness regarding bioplastics among consumers across different educational qualifications, a one-way ANOVA was performed. The analysis produced an F-value of 1.252 with a p-value of 0.294, which is greater than the 0.05 significance level. This indicates that the differences in awareness scores among the various educational groups are not statistically significant. Hence, the null hypothesis is not rejected, suggesting that consumers' awareness regarding bioplastics does not vary significantly based on their level of educational qualification.

H_0: There is no significant difference in awareness regarding bioplastics among consumers across different income groups.

Table 6: Awareness regarding bioplastics among consumers across income

ANOVA					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	154.070	2	77.035	1.541	.218
Within Groups	5847.521	117	49.979		
Total	6001.592	119			

Source: Researcher's compilation

To test the hypothesis There is no significant difference in awareness regarding bioplastics among consumers across different income groups, a one-way ANOVA was conducted. The results show a Between Groups Sum of Squares of 154.070, with a Mean Square of 77.035, and an F-value of 1.541. The p-value is 0.218, which is greater than the 0.05 level of significance. This indicates that the variation in awareness levels across different income groups is not statistically significant. Therefore, the null hypothesis is not rejected, suggesting that income does not significantly influence consumers' awareness of bioplastics.

Conclusion

The present study was undertaken to assess the level of awareness among consumers regarding bioplastics and to determine whether demographic variables such as gender, age, educational qualification, and income influence consumer awareness. The findings from the frequency analysis revealed that while consumers possess a fair level of general awareness about bioplastics, there are notable gaps in specific areas such as disposal methods, product labeling, and understanding of composability. A significant number of respondents were aware that bioplastics are derived from renewable biological sources and contribute to reducing plastic pollution. However, fewer participants showed clarity on differentiating bioplastics from conventional plastics or understanding their correct disposal and recycling procedures.

Inferential statistics using t-tests and ANOVA were conducted to evaluate whether awareness levels varied significantly across different demographic segments. The independent samples t-test showed no significant difference in awareness levels between male and female respondents. Likewise, the one-way ANOVA results indicated no statistically significant difference in awareness across age groups, educational qualifications, and income levels. These findings support the null hypotheses framed for each demographic factor, suggesting that consumer awareness regarding bioplastics is fairly uniform across different groups.

The results highlight the need for targeted educational campaigns and broader information dissemination strategies to improve consumer understanding of bioplastics, particularly in terms of product identification and environmentally responsible usage. As bioplastics gain importance in addressing environmental concerns, enhancing consumer awareness becomes crucial to encouraging adoption and proper usage. Stakeholders including policymakers, environmental organizations, and businesses should work collectively to bridge the awareness gaps and promote sustainable consumer behavior.

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Social Science

Invisible hands: the challenges and lived realities of migrant workers in Delhi and the need for inclusive development

Himanshi Verma[1], Isha Agrawal[2] and Nikhil Jain[2*]
[1] Assistant Professor, College of Vocational Studies, University of Delhi, Delhi, India
[2] College of Vocational Studies, University of Delhi, Delhi, India
*Corresponding Author: Himanshi Verma
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Abstract
This research paper looks at the various challenges faced by migrant workers in urban India. It focuses on their poor working conditions, lack of respect and recognition at work, and ongoing denial of minimum wages required by Indian labor laws. Using a thorough literature review and data from semi-structured interviews with 54 migrant workers in Delhi, this study examines the daily struggles of workers in construction, sanitation, and other informal sectors. The literature shows a clear pattern of systemic neglect, including inadequate living conditions, exclusion from welfare programs, mental stress, and weak enforcement of labor protections. Migrant workers experience not only economic hardship but also social and emotional isolation, often working in unsafe and abusive environments. The interview findings support existing research and highlight the urgent need for inclusive policy changes, legal enforcement, and social acknowledgment to protect the dignity and rights of migrant workers. By combining personal insights with scholarly analysis, this paper aims to deepen the understanding of urban labor migration and its human costs in today's India.

Keywords: Migrant workers, internal migration, social inclusion, wage theft

Introduction

Internal migration has long been a defining feature of India's demographic and economic landscape (Bhagat, 2011; Singh & Sirkeci, 2021) [3, 16]. According to the 2011 Census of India, approximately 45.4 crore people, about 37% of the national population, live outside their place of birth. In practical terms, a UNESCO study on the Social Inclusion of Internal Migrants in India estimates that three out of every ten Indians are internal migrants, a trend further reinforced by labour force estimates showing continued growth in mobility over the past decade (Ministry of Statistics & Programme Implementation [MOSPI], 2021). This large-scale movement is driven primarily by rural-to-urban migration, where individuals seek better livelihoods in cities (Bala, 2017; Kundu, 2018) [2, 6]. Delhi, as India's capital and one of its largest urban economies, remains a magnet for this flow. Migrants are drawn by its vast construction sites, bustling marketplaces, expanding service sector, and the promise sometimes illusory of higher wages and regular work (Chandrakanta *et al.*, 2023) [4].

The push factors behind this movement are deeply structural: shrinking agricultural plots, erratic monsoons, declining farm incomes, and a lack of non-farm employment opportunities in rural areas (Prasad, 2025; Podh, 2024) [13, 12]. For many, migration is not a choice but a necessity to ensure survival and support for their families (Ansari, 2016) [1]. The "pull" of Delhi lies in the perception that it offers continuous demand for unskilled and semi-skilled labor, where "a willing pair of hands" can always find work (Lakhchaura & Tara, 2023) [7].

Yet, the reality that greets new arrivals is far harsher than the expectations. Migrants often end up in overcrowded, makeshift settlements, one-room shacks of tin, tarp, or scrap materials, sometimes shared by more than ten people. Basic amenities such as drinking water and sanitation are scarce; water may flow for only an hour or two daily, toilets are communal and overused, and open drains create unhygienic, mosquito-prone environments (Nagpal & Srivastava, 2025) [11]. Healthcare access is equally limited: public clinics are distant and overstretched, while even the cheapest private consultation can cost several days' wages (Mallya & Shrinivas, 2011) [9].

Working conditions are equally precarious. On construction sites, laborers mix concrete, carry heavy loads, and climb bamboo scaffolding without helmets or safety harnesses. Domestic workers, often women, spend twelve-hour days cleaning and cooking, yet remain "part-time" in employment records depriving them of benefits or security. Industrial workers operate noisy, hazardous machinery without protective gear. Wages are frequently below legal minimums, and delayed payments are common. The absence of formal contracts and the prevalence of cash payments make legal recourse nearly impossible (Mahalakshmi & Balamurugan, 2023) [8]. Women workers additionally face gender-based pay disparities and harassment in male-dominated workspaces (Shazia & Khan, 2022) [15].

Beyond material hardship lies emotional and psychological strain. Many migrants, particularly young men and women who have never left their home villages, experience profound isolation in an unfamiliar city. Communication with families is brief and costly, festivals feel hollow without loved ones, and homesickness can spiral into depression. Coping mechanisms vary from relying on community networks or family and friends. Illness or injury often pushes households into debt, as high-interest loans from local moneylenders fill the gap left by inaccessible formal credit (Khan & Arokkiaraj, 2021) [5].

Despite these adversities, migrant workers display resilience by creating informal support systems. People from the same home district often live together, share food, and exchange job information. In some slum clusters, residents contribute to informal savings funds to help members with emergency expenses such as medicine or train fares. Civil society organizations, charitable groups, and a few proactive trade unions have introduced mobile health clinics, legal helplines, and skill training programs (Rajan & Bhagat, 2022) [14]. Policy ideas such as portable ration cards under the One Nation One Ration Card (ONORC) scheme, low-cost dormitories near job hubs, identity-linked accident insurance, and neighborhood legal-aid desks have been discussed, though implementation remains uneven (Srivastava *et al*., 2020) [17].

This study builds on earlier scholarship but adds fresh, ground-level narratives drawn from in-depth conversations with 54 migrant workers in Delhi, men and women employed as masons, painters, security guards, domestic helpers, and street vendors. Through these open-ended interviews, we capture their reasons for migration, the process of finding work and shelter, the risks they face daily, and the coping strategies they deploy when resources, health, or hope run thin. When juxtaposed with statistical evidence and previous research, these voices provide a worker-centered perspective on Delhi's development, revealing the paradox of a city whose growth depends on migrants yet often denies them basic dignity and security.

By foregrounding these lived experiences, the research aims to illuminate both the structural challenges and the grassroots resilience that define the migrant worker experience. Ultimately, the findings seek to guide policymakers, urban planners, and civil society actors toward more inclusive, rights-based urban governance—one in which Delhi's growth is not built on the silent suffering of those who sustain it, but on the principles of fairness, safety, and social justice.

Literature review

The situation of blue-collar workers, especially internal migrants in urban India, has gained more scholarly attention due to their systematic denial of rights, poor working conditions, and lack of social dignity. Although these workers are crucial to India's urban economies, they often find themselves stuck in insecure jobs, unsafe living situations, and low-wage positions with little legal protection. The studies reviewed highlight these structural inequalities and stress the need for effective policy change. Lakhchaura and Tara (2023) [7] offer a close-up view of migrant workers in Delhi. They show that the absence of community support, awareness, and job stability puts these workers at risk of long-term poverty. Ray and Balamurugan (2023) [8] also discuss the gap between the hopes migrants have and the harsh realities they encounter. Many live in overcrowded slums and work in informal sectors without wage security. Building on this, Mathur (2024) explores the socioeconomic challenges faced by labor migrants living in slums. She stresses their exclusion from social protection schemes and the shortcomings of initiatives like the One Nation, One Ration Card (ONORC). Her research highlights the disparity between policies and the real-world situations migrants face. Despite working full-time, many do not earn even the legal minimum wage. Sharma and Jose (2020) examine regional migration trends to Delhi. They identify Uttar Pradesh and Bihar as key sources of migrant labor. They argue that while migration contributes to urban economic growth, it also leads to increased pressure on housing, sanitation, and healthcare, further marginalizing these communities. Bag, Seth, and Gupta (2016) significantly add to this topic by comparing slum conditions in three metropolitan cities - Delhi, Mumbai, and Kolkata. Their extensive survey shows clear inequalities in housing, sanitation, education, and job conditions among slum residents, particularly recent migrants. The study indicates deep material deprivation and notable differences between cities, especially in Delhi, which suffers from poor civic infrastructure and overcrowding. Bala (2017) [2] takes a broader look at migration patterns in India, noting the high levels of rural-urban migration from underdeveloped states due to job shortages, droughts, and poor living environments. She highlights that most migrants end up in informal settlements with inadequate infrastructure, making them highly vulnerable to exploitation and health risks. Chandrakanta *et al*. (2023) [4] provide a different perspective by examining the emotional and psychological effects of migration on construction workers in Delhi. They argue that migrants face not only financial difficulties but also mental health challenges, homesickness, and social exclusion. Their research highlights the unseen trauma experienced by workers due to long hours, low wages, limited medical access, and discrimination, especially following the COVID-19 pandemic. Ansari (2016) [1] backs this view by documenting the legal, social, and educational problems migrant workers encounter, such as lacking identity, limited educational access for their children, and insufficient legal assistance. He points out the need for focused inclusion efforts, including labor protections and support for mental health. The body of literature shows a common theme: current legal and institutional frameworks fall short of protecting the rights and dignity of internal migrants and blue-collar workers. The failure to enforce labor laws, particularly regarding minimum wage and safe working conditions, appears throughout the studies. Additionally, the mental and emotional burdens of migration, including feelings of isolation and distress, add an often-overlooked aspect to their exploitation.

Key themes identified in literature

- Insufficient legal enforcement of minimum wage laws and labor protections (Mathur, 2024; Bala, 2017) [2].

- Poor living and working conditions in urban slums (Bag *et al*., 2016; Sharma & Jose, 2020).
- Mental health challenges and social exclusion among migrant workers (Chandrakanta *et al*., 2023; Ansari, 2016) [4, 1].
- Exploitation based on gender and caste in the informal labor market (Ray & Balamurugan, 2023) [8].
- Need for rights-based, inclusive urban development policies (Lakhchaura & Tara, 2023; Mathur, 2024) [7].

Synthesis: interconnected themes and research gaps

Combining these strands, the literature surfaces several interrelated themes:

Legal and Policy Gaps: While frameworks exist, poor enforcement and lack of portability prevent effective protection (Mathur, 2024; Srivastava & Sutradhar, 2016).

Urban Marginalization: Migrants live and work in unsafe, underserved zones, amplifying health, housing, and sanitation risks (Bag *et al*., 2016; Sharma & Jose, 2020).

Psychosocial Distress: Mental health issues and social isolation are prevalent, compounded by identity crises, limited access to services, and pandemic shocks (Chandrakanta *et al*., 2023; Ansari, 2016; Kesar *et al*., 2021) [4, 1].

Intersectional Exploitation: Gender and caste hierarchies compound exploitation in informal employment (Ray & Balamurugan, 2023; Majumder, 2021) [8].

Policy Shortfalls and Aspirations: While migrants strive for upward mobility and recognition, inclusive policy remains elusive (Lakhchaura & Tara, 2023; Mathur, 2024; Deshingkar & Akter, 2009) [7].

These insights affirm that the resilience and agency of migrant workers are constrained by structural neglect. The literature further reveals significant gaps—particularly in linking lived experiences with macro-level governance failures and in proposing integrated, context-specific implementation models. The literature highlights a clear need for change: systemic reforms are essential to close the gap between policy and reality. Migrant workers, vital to India's urban growth, remain overlooked and unprotected. Future research and policy should focus on enforcing labor laws, ensuring access to welfare programs, providing mental health support, and raising public awareness to restore dignity, safety, and justice for these crucial yet unseen workers.

Objectives

- To investigate the socio-economic and other underlying factors driving migration to Delhi.
- To examine the post-migration challenges and hardships encountered by migrant workers in the city.
- To analyse the coping strategies and adaptive mechanisms employed by migrant workers in navigating these challenges.
- To explore the aspirations, future goals, and expectations of migrant workers, particularly about inclusive development and institutional support.

Methodology

Aim of the study

The main aim of this study is to understand why people leave their homes and villages and come to a city like Delhi, and what kinds of challenges they face once they arrive. This research also prospects to explore how these migrant workers manage to survive challenging circumstances and what they aspire to achieve in the future.

Interview style

The researchers went into local areas where migrant workers live and work. After building a connection and trust, the researcher explained what the study was about in simple language (Hindi, Bengali, Madhubani, Bhojpuri). Any doubts or questions they had were patiently answered. All participants were assured that their names and identities would not be shared and that talking to the researcher would not create any problems for them. Once they were comfortable and gave their oral consent, the researcher began documenting their experiences.

Sample population

The people who took part in this study were migrant workers living in Delhi, originally from Uttar Pradesh, Bihar, and West Bengal. The sample of 54 migrant workers has been taken, including 41 men and 13 women. Each of them had migrated from their home states and was now living and working in Delhi. Participation was entirely voluntary, and they could skip any question or stop at any time. These people work in different sectors—construction, housekeeping, street vending, security services, and other informal jobs.

Research approach

This research adopts a qualitative approach, focusing on personal stories, subjective meaning, and human perceptions. To gather information, the researcher used semi-structured interviews. These are conversations guided by a few key questions, but flexible enough for participants to speak freely and share their thoughts in their own words. The questions were open-ended so that the participants could explain their situations in detail, and the researcher could gently ask more if something needed clarification.

The questionnaire includes questions like: Where are you from? Why did you come to Delhi? What kind of work do you do here? How long have you been working in Delhi? What kind of challenges do you face in your work and daily life? What kind of support do you wish the government or society could give?

These interviews were not rushed. The participants were given time to reflect and speak at their own pace. The researcher always made sure they were comfortable and never pushed them to answer anything they didn’t want to.

Data analysis

Once the interviews were complete, the researcher carefully read and re-read the stories shared by the participants. The responses were studied using thematic and narrative analysis. This means the researcher looked for common themes or patterns in the stories—such as reasons for leaving home, kinds of work they do, living conditions, emotional stress, and how they manage everything with limited resources.

Ethical consideration

Throughout the study, the researcher made sure that confidentiality and respect were maintained. All participants were spoken to in a respectful and empathetic way. The goal was not just to collect data, but to give them a safe space to speak honestly about their struggles, hopes, and dreams.

Findings of research

In this study, we spoke with 54 migrant workers currently living in Delhi, out of which 41 were men and 13 were women. The women mostly shared that they migrated due to family reasons or marriage and are now working as domestic helpers, usually at very low wages. Most of the workers we spoke to were unskilled and had migrated from their hometowns because of a lack of job opportunities, poor living conditions, or landlessness. For many of them, coming to Delhi was not a choice made out of ambition, but a step taken for survival.

The majority of these workers are engaged in daily-wage or informal sector jobs, such as construction, cleaning, street vending, or security services. They reported earning very low wages, and many shared that they do not have any written job contracts, making them highly vulnerable to wage cuts, delayed payments, and sudden job loss. Some also mentioned facing discrimination and disrespect at their workplaces, especially women workers.

When it comes to their living conditions, most of the participants live in overcrowded, temporary shelters or rented rooms in informal colonies. Their biggest struggles include unaffordable rent, poor sanitation, irregular water supply, and the constant fear of eviction. Basic facilities like clean toilets, safe drinking water, and medical care were often missing or difficult to access.

Despite all these challenges, many workers expressed simple hopes for a better life. They wished for fair and timely wages, safe and affordable housing, better healthcare, and good schooling for their children. These are not big demands—but basic needs that every worker should receive in return for their hard work.

Their voices and experiences highlight the gap between existing laws and the everyday reality of migrant workers in Delhi. While they continue to contribute to the growth and functioning of the city, their own lives remain full of uncertainty, struggle, and invisibility. Their stories remind us that behind every building, every clean home, and every street market, there are real people with real dreams—who deserve dignity, protection, and a better future.

This table presents the demographic characteristics of a sample group, providing insights into their sex, marital status, and age distribution in terms of marital status, the largest segment of the sample is married with family residing in Delhi, making up 57.4% (31 individuals). Single individuals represent 31.5% (17 individuals), and those married with family in their hometown constitute 11.1% (6 individuals)

Table 1

Demographic characteristics	Percentage (%)	No. of sample (N)
Sex		
Male	75.9%	41
Female	24.1%	13
Marital status		
Single	31.5%	17
Married (family in Delhi)	57.4%	31
Married (family in hometown)	11.1%	6
Age group (years)		
Under 18	1.9%	1
18 - 25	20.4%	11
26 - 35	33.3%	18
36 - 50	33.3%	18
Above 50	11.1%	6
Total	100.0%	54

The Periodic Labour Force Survey (PLFS) conducted in 2020-21 by the Ministry of Statistics and Programme Implementation gathered specific information on migration as a one-time initiative, with its report titled "Migration in India, 2020-21" released in June 2022. This report highlighted distinct primary reasons for migration between genders: males predominantly migrated in search of employment or better employment opportunities (22.8%) or for direct employment/work (20.1%), while for females, marriage was by far the overwhelming main reason, accounting for 86% of migrations. According to our research, 'better job opportunities' come as a sole reason for migration

Table 2

Background characteristics	Total (%)	N
State		
Uttar Pradesh	32.7%	17
Bihar	30.8%	16
West Bengal	15.3%	8
Uttarakhand	7.7%	4
Rajasthan	5.5%	3
Haryana	3.8%	2
Madhya Pradesh	3.8%	2
Reason for Migration		
Lack of farmland or work	62.3%	33
Better job opportunities	83%	44
Family or friends already here	20.8%	11
Education or training	0%	0
To repay debt	5.7%	3
Duration of Staying at Destination Place (Years)		
< 1 Year	0%	0
1-3 Years	25%	13
3-5 Years	50%	26
More than 5 Years	25%	13

Table 3: Challenge/Problem of migrants

Category	Challenge/Problem	Number of responses	Percentage
Main challenges at work (52 responses)	Low wages	37	71.2%
	Delayed payments	32	61.5%
	Long working hours	21	40.4%
	Harassment or discrimination	22	42.3%
	Unsafe conditions	18	34.6%
	Job insecurity	14	26.9%
	Other (unspecified)	1	1.9%
Main challenges in daily life (52 responses)	High living costs	49	94.2%
	Lack of ID/documents	24	46.2%
	Access to healthcare	24	46.2%
	Childcare/schooling	17	32.7%
	Loneliness/homesickness	16	30.8%
	Debt	6	11.5%
Problems in the living area (54 responses)	Irregular water supply	31	57.4%
	High rent	31	57.4%
	Poor sanitation	30	55.6%
	Risk of eviction	23	42.6%
	Mosquitoes/diseases	19	35.2%
	Overcrowding	4	7.4%
	None of these	4	7.4%

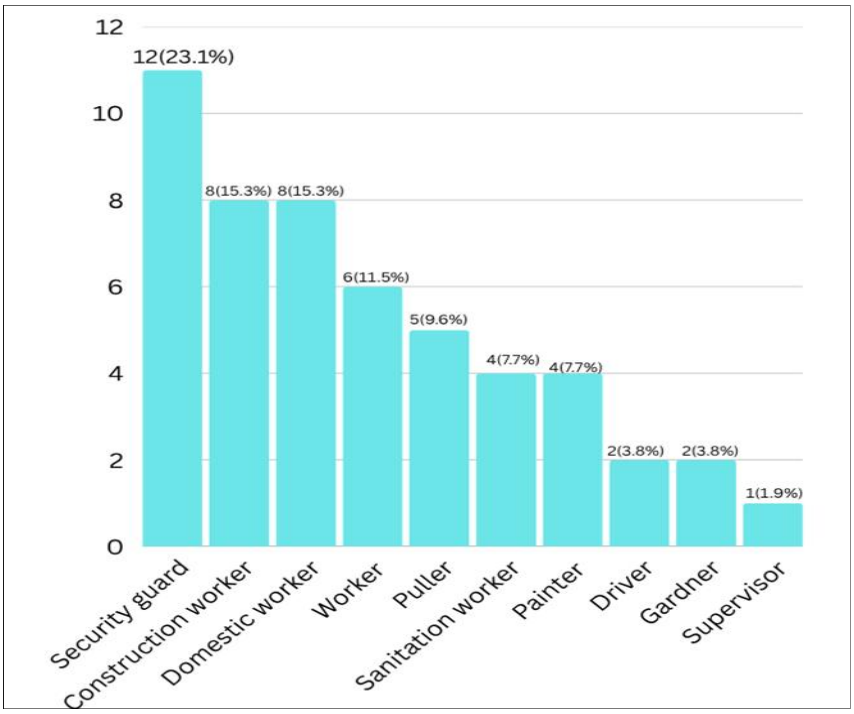

Fig 1: Current employment

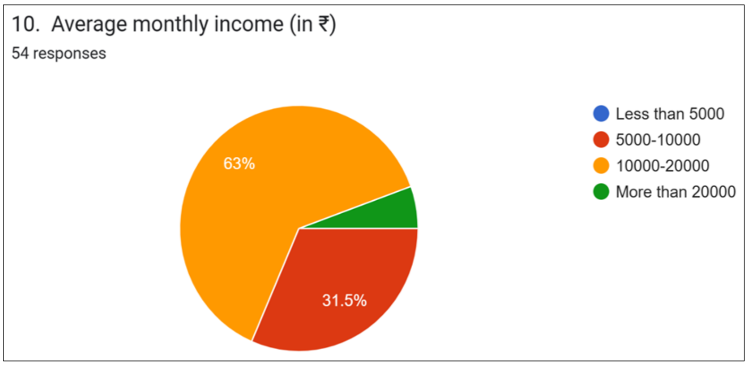

Fig 2: Average monthly income (in ₹)

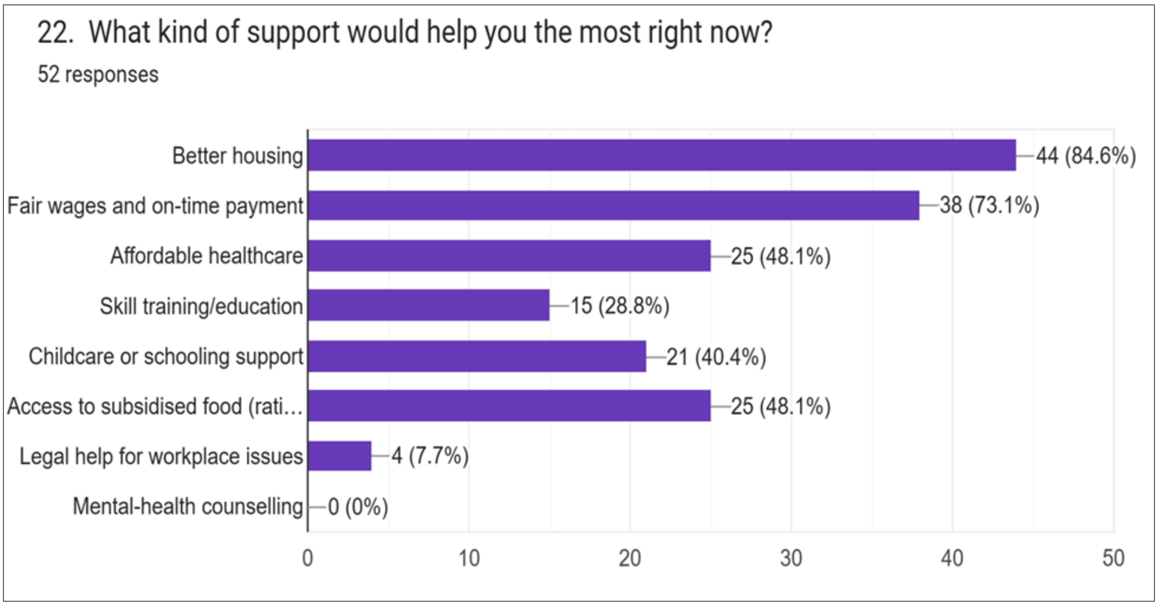

Fig 3: Possible support from the government

Recommendations

a) Ensure proper implementation of existing schemes

India already has a robust policy framework intended to protect informal and migrant labour. Laws such as the Code on Wages, 2019, aim to guarantee fair remuneration; the One Nation One Ration Card (ONORC) ensures food security regardless of location; and Ayushman Bharat – Pradhan Mantri Jan Arogya Yojana (AB-PMJAY) provides health insurance for low-income families. However, the persistent gap between legislation and on-ground impact reflects weak enforcement, bureaucratic hurdles, and inadequate inter-departmental coordination.

To address this, regular third-party audits should be conducted to assess the reach and effectiveness of these programs, combined with strict accountability for local officials. Technology-based monitoring (geo-tagged beneficiary lists, digital dashboards for real-time updates) can minimise corruption and leakage. Awareness drives in migrants' native languages should complement enforcement so that schemes are both available and accessible to the intended population.

b) Link e-Shram cards with wage payments

The e-Shram portal, launched by the Ministry of Labour and Employment, provides a centralised database of unorganised workers, yet it remains underutilised for wage protection. Linking wage payments directly to the worker's bank account associated with the e-Shram ID can eliminate several problems—wage theft, arbitrary deductions, and payment delays.

This measure would also ensure that workers have a verifiable employment history, which could later help them in securing credit, accessing insurance, or proving eligibility for government benefits. Integrating this with Aadhaar authentication would create a secure, transparent, and traceable wage payment mechanism, protecting workers from exploitative middlemen.

c) Set up on-site registration desks

A significant barrier to accessing benefits under the Building and Other Construction Workers (BOCW) Act, 1996, is the cumbersome registration process. Migrant workers often have neither the time nor the resources to travel to government offices, leading to chronic under-registration.

On-site registration desks, stationed at large construction projects, industrial zones, and factory clusters, can solve this. Staffed by trained government or NGO personnel, these desks could handle documentation, provide guidance on eligibility, and issue temporary receipts instantly. This would dramatically reduce exclusion from welfare schemes such as accident insurance, pensions, and education support for workers' children.

d) Improve access to healthcare

Occupational injuries, respiratory illnesses, heat stress, and musculoskeletal disorders are common among Delhi's migrant workforce, yet most have no access to affordable and timely medical care. Existing government hospitals are often far from work sites, and long waiting times discourage workers from seeking treatment.

Mobile health vans equipped with basic diagnostic tools, first-aid facilities, and medicines should be deployed in high-density labour areas. These vans should operate on a fixed weekly schedule, ensuring predictability for workers. Additionally, community health workers could help migrants navigate Ayushman Bharat benefits and other health insurance schemes, while periodic health camps could screen for chronic illnesses common in physically demanding jobs.

e) Build affordable rental housing

Housing insecurity forces migrant workers into overcrowded informal settlements, often without clean water, electricity, or sanitation. This not only impacts health and safety but also limits productivity. The Delhi government, in partnership with private developers and NGOs, should expand dormitory-style, low-cost rental housing near major employment hubs.

Such housing should include shared kitchens, clean toilets, safe drinking water points, and waste disposal systems. Rent should be regulated and subsidised for low-income workers, with transparent allotment processes to prevent middleman exploitation. A well-planned housing policy would reduce commuting costs, improve quality of life, and indirectly enhance work performance.

f) Strengthen the labour helpline

Although Delhi has a labour helpline, its limited operating hours, language barriers, and slow response rates reduce its effectiveness. Expanding it to a 24×7 multilingual service (covering Hindi, Bhojpuri, Bengali, Odia, and other common migrant languages) would ensure timely assistance for emergencies.

The helpline should be integrated with field inspection teams so that complaints about wage non-payment, harassment, or unsafe conditions can trigger immediate action. Regular public awareness about the helpline number—via posters at worksites, wage slips, and local radio—would enhance usage and trust.

g) Organise legal and ID camps regularly

Lack of proper identification documents prevents migrant workers from accessing essential services such as subsidised food, health insurance, and bank accounts. Regularly organised "legal aid and documentation camps" in migrant neighbourhoods can bridge this gap.

These camps should offer on-the-spot Aadhaar enrolment/update, ration card issuance, voter ID corrections, and bank account opening. Legal aid desks can help workers file labour disputes, claim accident compensation, or resolve tenancy issues. Partnering with law schools, legal aid clinics, and pro bono lawyers could reduce costs and improve outreach.

h) Offer evening skill and language training

Since most migrant workers cannot afford to lose daily wages, skill enhancement programs must be scheduled in the evenings or on rest days. Offering short, modular courses in basic Hindi, English, and vocational trades (plumbing, electrical wiring, tailoring, basic computer literacy) can help workers transition to higher-paying and more stable jobs.

Government skill development missions and CSR-funded NGOs could run these centres in or near migrant settlements, with incentives such as completion certificates, job referrals, and subsidised course fees to encourage participation.

i) Spread awareness of rights and benefits

Information poverty is one of the biggest reasons migrant workers remain excluded from welfare programs. Awareness campaigns should be multimodal and multilingual—using posters at bus stands, loudspeaker announcements at worksites, illustrated pamphlets in local languages, and trained peer educators from the migrant community.

Digital platforms such as WhatsApp groups can also be leveraged to share information about upcoming health camps, job openings, or grievance redressal procedures, provided workers have basic digital literacy support.

j) Promote dignity and respect in daily life

Beyond formal interventions, social perception plays a crucial role in shaping migrants' lived realities. Employers and the public must acknowledge their role as essential contributors to the city's functioning. Simple but meaningful actions—ensuring timely payment of wages, providing clean sanitation facilities, supplying protective gear, and showing verbal appreciation—can significantly enhance workers' sense of worth.

Awareness drives in schools, workplaces, and residential communities can challenge stereotypes about migrant labour and promote inclusion. Over time, this cultural shift would complement legal and policy measures in fostering a more equitable urban environment.

Conclusion

The findings of this study reaffirm that migrant workers form the backbone of Delhi's economic growth, sustaining critical sectors such as construction, sanitation, and other informal services. Despite their indispensable contribution, they continue to endure low wages, hazardous working conditions, substandard housing, and restricted access to healthcare and welfare provisions. While numerous governmental schemes exist to safeguard their rights and well-being, gaps in implementation and outreach mean that the benefits rarely reach those most in need. This disconnect reflects not only administrative inefficiencies but also the broader social marginalisation of migrant labour.

Addressing these issues requires a coordinated effort between the central and Delhi governments to strengthen the delivery mechanisms of welfare programs, enforce labour protections, and ensure equitable access to essential services. Equally important is fostering a societal shift toward recognising and respecting the dignity of migrant workers. Inclusive development must extend beyond economic metrics to encompass safety, security, and the human aspiration for a better quality of life. By embedding fairness, protection, and respect into urban policy frameworks, Delhi can evolve into a city where migrant workers are not merely surviving, but living and thriving with dignity, safety, and hope for the future.

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Relevance of the Bhagavad Gita's teachings on ethical leadership in modern corporate governance

Dr. Monika[1*], Divyanshi Shukla[2], Utkarsh Mishra[2], Sakshi Chauhan[2] and Deepanshi Sharma[2]

[1] Assistant Professor, Shivaji College, Delhi University, Delhi, India

[2] Shivaji College, Delhi University, Delhi, India

*Corresponding Author: Dr. Monika

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Abstract

Bhagavad Gita is a classic philosophical and spiritual work containing excellent information about ethical leadership that is very applicable in contemporary business management. In the modern dynamic business world, where ethical dilemmas, stakeholder issues and management problems are rife, The Gita teachings can offer a sense of responsibility in decision making. In the principles of Nishkama Karma (selfless action), Dharma (duty) and Samabhava (equanimity), the corporate leaders have moral toughness, ethical uprightness and moral responsibility. The Gita proposes leadership based on long-term material success by the pragmatic measure of material achievement and moral duty. It provides information about short-term study of the organisation, which studies the influence of the Gita on the corporate governance, stress and tension. Utilising these universal truths to current processes, leaders can create winning plans, inspire their groups and establish corporate compass. Conclusions on organising Gita can be applied to contemporary issues in management and provide detailed guidance to focus on career and personal development.

Keywords: Corporate governance, Bhagavad Gita, Leadership, Organisational culture, Indian knowledge system

1. Introduction

Valuable insights into leadership, state management and the management of things are highlighted in the writings of Indians such as Arthashastra of Kautilya and the Bhagavad. The Arthashastra discusses clever politics, right actions and prudence. Bhagavad Gita explains that to be a good leader is to avoid over attachment to rewarding behaviour in the development of workplace empowerment and these two texts provide a complete picture of how a modern business leader should lead.

"One of the strongest lessons from the Bhagavad Gita comes in Chapter 2, Verse 63: 'Anger gives rise to delusion, delusion leads to the destruction of memory, loss of memory leads to the destruction of intellect and when intellect is destroyed, a person falls." This verse is very relevant for today's managers. In today's fast-paced business world, leaders often rush to make decisions just to beat others. Decisions made when someone is angry, proud or scared often backfire. The Gita teaches that Bhagavatadars should make decisions when they are clear-headed and calm. If Nokia's leaders had taken their time, controlled their feelings and made choices without thinking constructively and lucidly, they would have handled the smartphone revolution better. Their downfall shows how unchecked emotions and ego can cloud judgment and lead to poor decisions. The six organisational philosophical systems or Darshanas, also help with thinking clearly, controlling emotions and using reason - key qualities for good leadership.

Ideas like Karma Yoga from the Gita help leaders focus on their work and duties, not on the results. This makes them less stressed and helps create a better workplace. Not only are these ancient ideas bookish. The modern business executives such as Ratan Tata have applied the teachings to their leadership methods. In addition to this, the studies about modern management that refer to Bhagavad Gita in deriving effective and ethical leadership are more than 5,000. Even the international activities of large organisations. Companies such as Apple and Google, which have experienced an improvement of 23% in the quality of leadership, are in fact examples of using mindfulness in Indian yoga and meditation. Companies with problem-solving techniques based on the Nyaya philosophical approach have experienced as much as 30-percent gains in problem-solving skills. Relevance in wisdom of the Bhagavad Gita is given precedence not only in spiritual understanding but also in practical tips on how to negotiate your way through the aged corporate world nowadays. With these ancient teachings, companies will be able to make more considerate leaders, struggle more with focusing on happiness and business long-term benefits.

2. Literature review

The IKS originates in ancient practises and philosophies of the nation, which are deeply ingrained in the Indian knowledge system. It touches and covers various fields such as mathematics, astronomy, medicine, Language and spiritual wisdom which are commonly found in such writings as the

Vedas, the Upanishads, the Puranas and also epics like the Mahabharata, Ramayana etc. The Bhagavad Gita is particularly one of these works that encapsulated many aspects of Indian wisdom and gave profound information on the areas of ethics, governance, duty and spirituality. In this literature review, the scholarly discourse on restoration and integration of IKS is discussed with the Bhagavad Gita being a main concept.

Other scholars, such as A. K. Bag (2014) [2] and P. T. Raju (2015) has noted that IKS was an independent entity designed to maintain perennial balance in the society, founded on principles related to dharma (duty), artha (prosperity), kama (pleasure) and moksha (liberation). The Bhagavad Gita, a component of the Mahabharata, reflects the feasibility of these goals in terms of both the duties of each person and the community at large.

According to Khanna and Katyal (2017), organisational culture is crucial in establishing success and sustainability in contemporary management. With the Bhagavad Gita and its wisdom, it becomes much easier to influence this culture because of leadership and to make a positive contribution to organisational culture through organising.

In his article, Strategic Management Insights, published in 2018, Bhatt (2018) explored the strategic aspects of the Bhagavad Gita and suggested that the concepts in it could be utilised in strategic management.

Bhagavad Gita: A Synthesis paper addressed teachings by the Gita on being prepared, versatile and infusing ethics into strategic decisions. As reported by Chauhan and Maheshwari (2023), leadership based on the Bhagavad Gita is associated with a subtle effect on corporate culture: it affects ethical behaviour, promotes workplace empowerment and trust development. When a leader wants to use the wisdom of the Gita in contemporary management world, the key is to accomplish such positive impacts as he/she takes care of the implementation problems. Employees feel purposeful when they work under leadership that is committed to an inspiring mission that resonates with these values. This unity purpose can give people more motivation and unity in the workplace leading to better company culture.

To investigate the psychological nature of decision making in response to the challenges of leadership, Gita *et al*. (2023) compared cognitive processes surrounding the teachings of the Gita. Gita is about mental discipline and self-conscience, and it trains a leader with the ability to solve the conflict always constructively and in a clear manner. Although the Bhagavad Gita is full of wisdom, the wisdom that is present within it, researchers realised that there was some uncovering that is needed to understand how it is useful in different organisational set ups.

DM Arvind Malik (2024), in his work Unveiling Ancient Wisdom: Influence of Bhagavad Gita on Modern Management and Leadership, attempts to combine spiritual guidelines of the Bhagavad Gita with the practise management system to build a culture founded on the implications of purpose, integrity and development focuses on exploring the nature of leaders in becoming more applied, understanding their work team better and give cleanout to their organisations.

3. Research objectives

- To examine the relevance of the Bhagavad Gita's teachings on ethical leadership.
- To investigate how leadership influenced organisations' Gita affecting endeavour culture.
- To assess how relevant the lessons of the Bhagavad Gita are to contemporary business governance.

4. Research methodology

This study is based on secondary data. First, 25 papers were gathered from Scopus, Google Scholar and Research Gate. 17 papers were selected for in-depth study following a thorough screening procedure that prioritised relevance. The paper's analysis, which includes a literature review and topic analysis, is qualitative in nature.

5. Background of the Bhagavad Gita

The Bhagavad Gita, commonly referred to as the Gita, is a revered Hindu scripture that is a segment of the widely known Indian epic, the Mahabharata. Comprising 700 verses penned in Sanskrit, the Gita explores the ideological dimensions between Lord Krishna and Arjuna at the Kurukshetra battlefield during the crucial war depicted in the Mahabharata. It is located within the Bhishma Parva of the Mahabharata, specifically in Book 6, Chapters 23 - 40 and it is largely accepted that the Bhagavat Gita was composed between the 5th and 2nd centuries BCE, though some scholars suggest an earlier date. The text is presented in verse format and falls under the organisational classification of Hindu scriptures. In the Bhagavad Gita, the dialogue unfolds on the Kurukshetra field just before the conflict between the Kauravas and Pandavas. When the Pandava prince Arjuna experiences moral uncertainty and hesitation about battling his relatives and teachers, Lord Krishna, as his charioteer, shares divine knowledge, guiding him on the concepts of Dharma, righteousness and the soul's eternal nature.

6. Concept of knowledge in the Bhagavad Gita

The Bhagavad Gita talks about two kinds of knowledge: material knowledge, which is about the physical world and spiritual knowledge, which connects us to something bigger. Knowledge, as it is taught in the Gita, is not about reading or finding out something: it is about transforming our thoughts and emotions, making us one with the universe. It reveals that there is a distinction between what is known of the world and what is known of greater truths about life in the text. It states that the true knowledge consists in uniting these two types of knowledge. According to such experts as J. Krishnamurti and Swami Vivekananda, according to the Gita, what can lead us out of our own ego and live in harmony with the universal suggestion are the knowledge and the use of universal suggestion bulletin. In Chapter 4, Krishna includes as an example how knowledge that has been obtained by a person who has achieved some degree of understanding can clear up confusion and guide someone towards development. This implies that in the context of intellectual instrumentation, spiritual knowledge may assist individuals seek harmony and attain healthy growth of individualities and society en general.

7. Relevance of the Bhagavad Gita in modern world

The Bhagavad Gita is also relevant in the modern world, presenting concepts of ethics, duty, self-discipline and spirituality. Its teachings go beyond what is taught in common sense and offer scientific insight into different situations in life as discussed below:

- **Support for personal development & mental fortitude**

Bhagavad Gita also teaches about self-control, steadiness and composure, and enables one to overcome the challenges of life with boldness, conviction and clarity. It teaches prudence on how to conquer doubts, fears and uncertainties in personal plights one may be undergoing. It develops self awareness and inner peace and expresses a harmonised, satisfying life through meditation and self-realisation.

- **Stress relief, healthy living and mental wellness**

The Bhagavad Gita promotes de-causing anxiety through effort (as opposed to results) (Nishkama Karma). It also goes further to facilitate meditation (Dhyana Yoga) to relieve stress and increase the focus with regard to ones life objective. It provides organisations with a sense of life, death and eternal soul, cure-of-fears and attachments, causing people live healthier life.

- **Influence on leadership & decision-making**

Highlighted in the Bhagavad Gita is selfless action (Karma Yoga), which is beneficial when applied by leaders, professionals and those engaged in entrepreneurial ventures. It recommends responsible yet uninvolved decision making and the focus on duty rather than personal gain and builds ethical leadership defined through integrity, accountability and fairness.

- **Significant organisational & corporate environments**

By focusing on diligent work without obsession with attaining rewards, one vital principle of organisational development, the Bhagavad Gita advocates the imperative of such work. It provides information on how to deal with workplace stress and competition and organisational issues and can kick start any professional challenge with confidence. The promotion of endorsing a middle line view of success and failure develops long-term stability and resilience, acknowledging of professional and personal life.

- **Universal message of spirituality & harmony**

The Bhagavad Gita identifies Bhakti Yoga (Devotion), Jnanayaoga (knowledge) and Karmanayoga (action) as distinct orders of spiritual progression. It has emphasised the idea of unity among diversity and thus its teachings are identifiable in the people, the organisational religions and cultures. spreading a life with meaning and purpose provides the necessary instruction in personal and spiritual fulfilment.

8. Modern interpretations of IKS and the Bhagavad Gita

The relevance of the Bhagavad Gita in the contemporary world has gained prominence in the present day literature, in which it is considered as being a guide in addressing contemporary problems in the world such as pressures on environment and personal happiness. Employing the doctrines in the Gita about detachment and duty (dharma), scholars like R. C. Zaehner (1969) discussed these concepts as significant tools that an individual could use to overcome the current conflicts. This emphasis of the Gita on selflessness and renunciation also speaks directly to the fight of environmental conservation, in which it is crucial to bring back balance between humans and nature. Amid the prophetic mysteries that pervade the knowledge system of the west, the Bhagavad Gita offers a counter to the divisive point of view that is so typical of Western culture. The insights on self-realisation and interconnectedness expressed in the Gita provide a integrated theory of knowledge that unites material and spiritual worlds and this is essential in restoring the integrity of Indigenous Knowledge Systems (IKS) under the conditions of globalisation (S. N. Dasgupta 1991).

9. Restorating and integrating IKS

The recovery and integration of Indigenous Knowledge Systems (IKS) play a central role in the existing discourse on education and knowledge systems in India. Scholars such as G. S. Sahni (2020) encourage the idea that indigenous knowledge systems should be restored in a contemporary post-colonial Indian context that tends to be biased towards Western educational paradigms. In this context, Bhagavad Gita is a beef indispensable text in this olding since it shows the essence of spiritual understanding adult into action. The Bhagavad Gita spells out on the essence of action (karma), devotion (bhakti) and knowledge (jnanas). In modern usages, including those of E. S. Ramasamy (2017), suggests that the triad offers a comprehensive view of human development. With an emphasis on selfless action (karma yoga), and wisdom (jnanayoga), the Gita provides a pattern through which harmony within and among individuals can be restored and implemented in educational, governmental and social circles. IKS cannot be incorporated in the standard academic knowledge without the involvement of all other forms of wisdom experiential and spiritual visions. B. R. According to Amberedkar (1946), to truly develop, a nation should absorb the indigenous philosophies which are appealing to the values of justice and equality as well as spiritual development. In the Bhagavad Gita, we find a platform through which this integration could be done and these two dimensions are intertwined.

10. Teachings that can be extracted from the Bhagavad Gita in corporate life and management

The Bhagavad Gita and management have integrated into everyday life as they are practised by individuals both at home and in their workplaces. Groups of individuals establish specific goals based on factors such as managing time, resources, materials, machinery, finances, policies and more. It serves as a method for accomplishing tasks, through which managers can motivate individuals to work towards their objectives efficiently and effectively. The management process is defined as involving planning, organising, staffing and controlling human efforts to reach targeted goals. The Bhagavad Gita is considered a comprehensive guide for enhancing the effectiveness and efficiency of employees in achieving goals through concepts such as transforming individual weaknesses into strengths, delegating responsibilities, selecting the right team members, understanding the challenges of the work environment, having a charismatic leader to motivate, energize and advise during challenges and initiating awareness of ground realities. The Bhagavad Gita establishes a social contract in the Working-Equilibrium through ideas and behaviours, aims and outcomes, strategies and realities, as well as products and markets. Management has consistently served as a method to tackle crises and challenges across animate, inanimate, technical and behaviour-focused primary functions to achieve objectives within a specified timeframe and utilising available resources. Failures in management lead to chaos, disorder, waste, neglect of tasks, destruction, depression and stress. Effective management practices necessitate the optimal management of the 3Ms (Men, Money & Materials) through activities that align with varying situations and environments. Humans, prominently placed at the beginning of the management concept, highlight their importance in management practices. The Bhagavad Gita is the foundational source for various other management philosophies, which will be explored in the following sections.

The Bhagavad Gita explores diverse ideas related to contemporary management, which may encompass the following concepts:

- **Battlefield of life**

The context of the Gita serves as a metaphor for the battlefield of daily existence, more accurately, the internal struggle within oneself. It illustrates the ongoing conflict between positive and utilising desires, preferences and moral choices.

Lesson- It emphasises how individuals find a balance in their lives to achieve their aspirations.

- **Karma and action**

Krishna’s response to Arjuna’s despair on the battlefield of Kurukshetra, “This is not the way of the one great in spirit,” highlights how individuals and organisations continuously endeavour to advance despite numerous obstacles and challenges.

Lesson- Be deeply engaged in action or Karma but remain detached from the outcomes or the rewards of those actions, embodying Nishkam Karma Yoga.

- **Management of anger**

Lord Krishna expressed that attachment to sensory pleasures leads to desires and unfulfilled desires give rise to anger; thus, modern psychology suggests that anger often manifests from repressed desires.

Lesson- The essence of our existence revolves around our responsibilities and duties, with a significant focus on achieving peaceful coexistence with others.

- **Work culture**

The Bhagavad Gita outlines two primary types of work environments: 'Daivi Sampat' and 'Asuri Sampat.' The former is characterised by reduced fear, purity, divinity, tranquillity, a comprehensive atmosphere, absence of faults, greed and lust along with being ethical, humble and spiritually enriched, while pride is also a factor. Conversely, the latter is defined by a culture driven by ego, jealousy, distrust, personal desires, inadequate performance and incompetence.

Lesson- Embracing the Daivi Sampat organisational behaviour for achieving organisational excellence by fostering the development of mental advantages within the workplace.

- **The utilisation of available resources**

Before the Mahabharata war, Duryodhana chose to ally with the sizable army of Lord Krishna (Krishna Sena), while Arjuna decided to enlist the support of the Lord of Wisdom (Krishna).

Lesson- Resources are finite, make careful and effective choices in utilizing the limited resources available.

- **Commitment to duty**

A well-known verse (Shlokas) from the Bhagavad Gita states, "Karmanye vadhikaraste Ma Phaleshu Kadachana, Ma Karmaphalaheturbhurma Te Sangostvakarmani," which translates to performing your responsibilities without being attached to the outcomes."

Lesson- Commitment to duty entails fulfilling one’s responsibilities to society rather than getting caught up in self-interest and pleasure.

11. Challenges and opportunities for integrating IKS

Restoration and integration of Indigenous Knowledge Systems (IKS) do not come easy. Another serious problem is the existence of big western knowledge systems which underling native knowledge traditions and is often suppressing them. Scientists like V. K. Choudhary (2018) indicate that the introduction of Western scientific and educational systems has led to the downfall of local epistemologies. In this context, the Bhagavad Gita offers a different point of view and emphasises the cyclical nature of knowledge which can be integrated into new educational models. Merging IKS using interdisciplinary approaches involving a combination of traditional and modern technologies also has opportunities. Such integration can be found in the Bhagavad Gita which emphasises the interplay between life. In areas that include sustainable agriculture the teachings of the Gita have the potential to provide practical solutions built on ancient Indian philosophy that are relevant to scientific practises now.

12. Discussion

The article Unveiling Ancient Wisdom: The Bhagavad Gita influence on Modern Management and Leadership demonstrates that ancient religious texts such as the Bhagavad-Gita could help in contemporary management to achieve better outcomes with excellent lessons and recommended rules to follow. Discovering such concepts will enable managers to achieve success, fulfilment and manage a balance between the material and the spiritual development. Utilisation of traditional Indian wisdom may have the potential to benefit in greater opportunities to participate on the management practise and expanding horizons to meet current challenges. Increased attention towards these texts promises great benefits to individuals and organisations in the future. The Hindu Bhagavad Garita teachings have been very applicable in the management practise of the modern world because it gives a lot of insight on ethics, making of decisions, being stress free, and leading others. Combining all these principles, organisations can foster an efficient and at the same time, flexible and substantially motivated workforce. When used properly the classical knowledge of the Gita can help create a better, more harmonious and balanced work environment, factors that will make the organisation succeed in the long haul.

13. Conclusion

In conclusion, management can integrate the teachings of the Bhagavad Gita with the current management needs to provide an ethical and comprehensive perspective on individual and organisational growth. In this paper we have discussed that Indian Ethos particularly to be explained in the Bhagavad Gita is a well encompassed flexible solution to managerial problems in the modern-day world considering not only the economic implications as we know it, but also the ethical and moral implications of leadership. This is the type of strategy that targets both the long-term organisational success and making a positive contribution in the overall it affects the whole society.

14. The way forward

Occupational implications of the lessons of the Bhagavad Gita (in certain organisational contexts and sectors) might be investigated further in the future. Longitudinal studies could measure the effectiveness of Gita-inspired management methods on social performance, staff health and company performance in the mid-term. Also, analysing relationship between set of teachings recorded in the Gita, with other disciplines like psychology, neuroscience and sustainability, might help us understand how they impact upon organisational behaviour and human interaction. Future studies may compare the Bhagavad Gita with other Ancient philosophies to identify similarities and contrasting perspectives regarding leadership and management such as Confucianism, Taoism or Stoicism. Within the framework of the digital age, they might be able to develop online services or solutions that provide management and leadership advice with reference to Bhagavad Gita. These resources could equip the means and direct support to application of Gita principles in the workplace.

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Invisible costs of digitization: technostress in India's financial sector

Gauri Gupta[1*] and Ashok Kumar Pokhriyal[2]

[1] Research Scholar, School of Commerce, HNB Garhwal University, Srinagar, Uttarakhand, India

[2] Professor, School of Commerce, HNB Garhwal University, Srinagar, Uttarakhand, India

*Corresponding Author: Gauri Gupta

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Abstract

India's financial sector is undergoing rapid digital transformation, driven by initiatives like Digital India and fintech innovations. While these changes enhance efficiency and financial inclusion, they also introduce technostress psychological strain caused by digital overload, evolving skill demands, and techno-invasion. This paper explores technostress as an emerging yet under-addressed challenge in India's banking sector, highlighting its invisible costs on employee productivity, decision-making, and mental well-being. The study emphasizes the need for policy interventions, empathetic digitalization strategies, and organizational support mechanisms to mitigate technostress and ensure a sustainable, human centric digital economy aligned with India's Viksit Bharat 2047 vision.

Keywords: Techno-stress, Financial sector, Productivity, Decision making, Mental well-being

Introduction

Digital transformation in India is a multifaceted process aimed at enhancing economic growth, fostering self-reliance, and improving efficiency across various sectors. This transformation is driven by the integration of digital technologies, which are essential for fostering innovation and strengthening operational capabilities. Within the financial sector, this shift is accelerated by initiatives such as Digital India, which advocate for widespread adoption of digital payments, fintech innovation, and inclusive financial access. With policies emphasizing digital payments, fintech innovations, and expanding financial inclusion, technology has become deeply embedded in banking and financial services.

As institutions increasingly embrace AI-enhanced services and tech-driven systems to remain competitive, new challenges have emerged particularly those affecting the human workforce. While digital transformation brings significant advancements, it also introduces new challenges that often go unnoticed. One of the most pressing human-centric challenges is technostress-a psychological strain resulting from individuals' inability to cope with modern technological changes, digital overload and evolving skill demands (Tarafdar *et al.*, 2017). Technostress arises from rapid technological changes, digital overload, and evolving skill expectations, leading to cognitive, emotional, and behavioral pressures on employees. The proliferation of AI-enhanced banking services, the expansion of fintech ecosystems, and the continuous drive for efficiency have intensified the technological demands on financial institutions. Although these innovations promise improved service delivery, cost efficiencies, and broader financial inclusion, they simultaneously impose cognitive and emotional pressures on employees, especially within banking, which is both technology-intensive and customer-facing. These pressures referred to as the "invisible costs" of digital transformation manifest in reduced productivity, poor decision-making, job dissatisfaction, and even mental health consequences. As Mehta & Sundararajan (2022) [8] note, while digital ecosystems enhance accessibility and competitiveness, they also introduce subtle workplace stressors that hinder human adaptability.

Consider a relationship manager at a Mumbai branch who begins her workday managing five different digital systems simultaneously responding to customer queries on WhatsApp, processing loan applications through AI-powered platforms, monitoring sales dashboards, attending virtual training on updated KYC protocols, and managing an overflowing email inbox. By midday, she reports feeling mentally exhausted despite handling fewer customers than she did five years ago. This experience reflects what researchers term technostress.

For banking professionals, who are required to constantly adapt to new digital systems while managing customer expectations, these pressures can result in reduced productivity, impaired decision-making and spill-over effects. The banking sector is particularly vulnerable to these adverse outcomes. While digital inclusion enhances access and operational efficiency, it simultaneously imposes a cognitive load on employees, making technostress an unavoidable consequence of the ongoing digital revolution in India's financial landscape. Thus, while digital transformation continues to reshape India's financial sector, addressing the employee-centric implications of this shift is critical for sustainable growth and organizational wellbeing. This paper explores technostress as an emerging yet under-addressed challenge in India's banking sector, highlighting its invisible costs on employee productivity, decision-making, and mental well-being

Understanding technostress

Definition and evolution

The term "Technostress" was first introduced by Craig Brod (1984) in the book '*Technostress: The Human Cost of the Computer Revolution*' when personal computers were just starting to infiltrate workplaces, describing it as a "modern disease of adaptation caused by an inability to cope with new computer technologies." Over the decades, technostress has evolved beyond mere computer usage, encompassing a broader spectrum of digital technologies such as AI, mobile banking apps, CRM systems, and cybersecurity protocols (Tarafdar *et al*., 2015) [12]. Technostress has evolved into a complex and pervasive challenge, fueled by ongoing digital transformation that continues to redefine workplace dynamics, communication norms, and everyday technological interactions. Table 1 depicts how techno-stress evolved over the years.

Table 1: Evolution of technostress over years

Period	Key Developments
1980s–1990s	▪ Coined by Craig Brod (1984); minimal tech presence in India ▪ Stress limited to IT professionals and academics using early computing systems
2000s	▪ IT outsourcing boom increases tech exposure ▪ Rise of techno-overload and techno-complexity in call centers and software firms ▪ Initial studies emerge
2010–2015	▪ Smartphone adoption expands digital interaction and blurs work-life space ▪ Technostress impacts banking, education, healthcare ▪ Academic interest intensifies
2016–2020	▪ CRM systems and mobile banking cause frontline stress ▪ Empirical research links stress to productivity ▪ Technostress evolves to include data privacy concerns, cybersecurity, and the need to upskill continually
2020–2024	▪ Pandemic forces remote work and online service delivery ▪ Surge in techno-invasion and techno-uncertainty ▪ Bibliometric spike in Indian research
2025 Onward	▪ Technostress seen as a strategic HR and policy issue ▪ Studies focus on inhibitors and sectoral interventions ▪ Interest grows in technostress audits

The study of technostress has evolved considerably since Brod's foundational work. Early research in the 1980s and 1990s treated technostress primarily as an individual adaptation problem—assuming that proper training would resolve technological anxieties. This perspective positioned technostress as a temporary phenomenon that would disappear as workers gained familiarity with computers.

However, research in the 2000s revealed more complex dynamics. Weil and Rosen (1997) [14] demonstrated that technostress persisted even among experienced technology users, suggesting systemic rather than individual causes. Tarafdar *et al*. (2007) [13] developed a comprehensive conceptual framework identifying how specific technological characteristics create stress, mediated by organizational context and individual differences. Their work established technostress as a legitimate organizational concern requiring structural interventions rather than merely individual adaptation.

The 2010s brought increased sophistication to technostress research. Ayyagari *et al*. (2011) [2] distinguished between technological features and techno-stressors, arguing that technology itself doesn't inherently cause stress—rather, stress emerges from how organizations implement and manage technology. This distinction proved crucial for developing effective interventions. Tarafdar *et al*. (2014) further refined the concept by differentiating techno-eustress (positive, motivating technological challenge) from techno-distress (negative, debilitating strain), recognizing that technology can energize some employees while exhausting others.

Recent research has expanded beyond individual psychological impacts to examine team dynamics, organizational culture, and broader societal implications. La Torre *et al*. (2019) [7] explored how technostress affects work-family balance, particularly as remote work technologies erase traditional boundaries between professional and personal life. Bondanini *et al*. (2020) [3] conducted a comprehensive scientometric analysis revealing exponential growth in technostress research, with emerging themes including artificial intelligence anxiety, cybersecurity concerns, and digital surveillance.

Types/Causes of Techno-stress (or techno-stressors)

Technology does not inherently induce stress; instead, technostress arises from the organizational context in which it is introduced, the expectations placed on employees, and the degree of support offered during its implementation. Techno-stressors are the events faced by individuals (Ayyagari *et al*., 2011) [2]. These have the potential to create dress in an organisation's environment due to interaction with ICTs (Hang *et al*., 2022) [6]. Identifying and understanding the causes of techno-stress can help in developing policies and strategies for integrating technology with employees in a healthy manner. Various authors have identified several reasons for techno-stress, known as techno-stressors or techno-stress creators.

Broadly it can be categorized into five key dimensions:

- **Techno-overload**: Employees are forced to work faster and longer.
- **Techno-invasion**: Technology blurs work-life boundaries.

- **Techno-complexity**: Systems are too complicated, making employees feel inadequate.
- **Techno-insecurity**: Fear of job loss due to technological advancements.
- **Techno-uncertainty**: Frequent changes in technology causing stress.

Technostress in India's financial sector

Digitalization trends in banking & finance

The Indian financial sector is witnessing unprecedented digitization:

- Banks are increasingly adopting AI-driven customer service bots, digital KYC, and blockchain for secure transactions.
- Government initiatives like Jan Dhan Yojana, Aadhaar-based services, and RBI's Digital Currency further necessitate technological adoption across all banking layers.

Technostressors in the financial sector

While these digital initiatives enhance operational efficiency, they inadvertently escalate techno-stress levels among employees. Research reveals sectoral and institutional disparities in technostress exposure.

- Private banks often push digital sales aggressively, leading to techno-overload and performance pressure.
- Regional rural banks face techno-complexity due to legacy systems coexisting with new software—resulting in system incompatibilities and duplication.
- Public sector banks, while slower to digitize, grapple with techno-insecurity amid automation of clerical tasks.

A recent study by Sharma & Ghosh (2023) involving banking professionals across five states reported that 68% experienced moderate-to-high technostress symptoms, with urban branches showing higher techno-invasion and rural branches displaying greater techno-complexity. These patterns align with infrastructural and training asymmetries observed in regional banking contexts. Table 2 shows examples of techno-stress creators in financial sectors.

Table 2: Techno-stressors in financial sector

Techno-stressor	Manifestation in the financial sector
Techno-Overload	Pressure to handle increased volumes of online transactions and digital services.
Techno-Invasion	Constant accessibility via mobile apps and remote work expectations.
Techno-Complexity	Struggling with complex fintech systems, AI platforms, and regulatory tech updates.
Techno-Insecurity	Fear of being replaced by AI-driven automation and digital-only banking models.
Techno-Uncertainty	Frequent updates in compliance protocols and evolving cybersecurity threats.

Invisible costs: Impacts and outcomes

Techno-stress results in a variety of outcomes such as dissatisfaction, fatigue, anxiety, and overwork, leading to a negative effect on individual productivity (Tarafdar *et al*., 2007; Alam, 2016; Ragu-Nathan, 2008) [13]. Technostress manifests in multiple adverse outcomes, often interlinked and cascading, as shown as Table 3. Increased reliance on technology has introduced a 'dark side' for employees, contributing to techno-stress: strain caused by excessive digital interaction and system complexities (Bondanini *et al*., 2020) [3].

Table 3: Technostress manifests in multiple adverse outcomes

Outcome	Manifestation
Cognitive Strain	Fatigue, attention fragmentation, reduced executive functioning
Productivity Drop	Missed deadlines, lower output quality, task avoidance
Resistance Behavior	Passive resistance, refusal to adopt new technologies
Emotional Burnout	Anxiety, withdrawal, detachment from organizational goals
Attrition Risk	Turnover intention, especially among younger and mid-career professionals

Studies by Das & Bandyopadhyay (2022) found that productivity in digitized banking environments was significantly mediated by technostress levels. Employees reporting high technostress scored lower on customer engagement metrics and had higher absenteeism rates.

Barriers to addressing technostress

Despite its critical implications, techno-stress remains under-addressed in the Indian financial sector. Key barriers include:

Lack of Awareness

Organizations often prioritize technology infrastructure over employee digital well-being. The intangible nature of technostress makes it less visible in performance evaluations.

Policy Myopia

Digital policies largely focus on infrastructure, digital literacy for customers, and cybersecurity, neglecting employee adaptability and psychological readiness.

Inadequate Training & Support

Most digital training programs are tool-specific rather than stress-management oriented. Employees are expected to learn on-the-go, which escalates techno-complexity and frustration.

Organizational culture resistance

Leadership often underestimates the emotional impact of digitization, perpetuating a culture where asking for support is seen as incompetence.

Implications for policy and practice

Technostress demands recognition within national development frameworks such as *Viksit Bharat 2047* and the evolving Digital India 2.0 roadmap. Recommendations include:

- **Structured Digital Training**: Mandatory onboarding for new tech tools with certification modules.
- **Techno-ergonomic Design**: User-friendly platforms and reduced system redundancy.
- **Managerial Empathy**: Supervisors trained to recognize stress signals and offer support.
- **HR Policy Evolution**: Inclusion of digital wellness in performance management and wellbeing assessments.
- **Tech Deployment Strategies**: Phased rollouts, sandbox testing, and employee feedback integration.
- **Mindfulness Training:** Workplace mindfulness programs, paired with IT-literacy training, lead to reduced technostress, increased job satisfaction, and improved performance.

These interventions, when linked with leadership commitment and employee involvement, can transform technostress from a productivity drain to a catalyst for inclusive transformation.

Conclusion

While digitization has unlocked new efficiencies in Indian banking, its invisible costs—particularly technostress—require urgent academic and policy attention. Viewing workplace technology adoption as both a technical and human transformation is essential. This chapter advocates for empathetic digitalization: systems designed not only for functionality, but also for mental ergonomics and sustainable human engagement. Future research should expand empirical validation of technostress models across sectors, refine measurement tools, and link technostress mitigation to organizational performance outcomes.

Exploring technostress as an emerging challenge in India's financial sector amidst the aggressive push for digital transformation. While Digital India initiatives aim to catalyse growth through technology, the hidden psychological costs borne by employees can hamper productivity and impede the nation's journey towards a Viksit Bharat. Addressing technostress is thus critical for ensuring a sustainable and human-centric digital economy.

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The gender gap in stem entrepreneurship: women, challenges and interventions

Vartika Kushwaha
Research Scholar, Department of Ancient Indian History and Archaeology, University of Lucknow, Uttar Pradesh, India
*Corresponding Author: Vartika Kushwaha

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Abstract
This paper examines the persistent gender gap in STEM entrepreneurship in India, focusing on the structural and cultural barriers that hinder women from fully participating in innovation-driven enterprises. Using a combination of secondary data analysis from national entrepreneurship reports, policy frameworks, empirical data and qualitative case studies of women-led STEM startups, this study highlights successful interventions, including government initiatives, corporate incubators, and educational reforms that promote women-led innovation and identifies key challenges such as societal biases, limited access to funding, and insufficient policy support. The research is placed within the framework of the Viksit Bharat 2047 strategic blueprint, which recognizes gender inclusion as essential to holistic national development. The paper argues that targeted interventions and policies to empower women entrepreneurs in STEM will not only reduce the gender gap but also drive innovation and economic growth, contributing significantly to India's vision of becoming a developed nation by 2047. It proposes actionable strategies to promote inclusive STEM entrepreneurship. The paper aligns its findings with the theme, arguing that empowering women in STEM is crucial to achieving a self-reliant, innovation-driven, and equitable economy. Recommendations include gender-responsive venture capital policies, STEM education incentives for girls, and public-private partnerships to bridge the gap, ensuring women contribute equitably to India's technological and entrepreneurial future.

Keywords: Gender Gap in STEM, Women Entrepreneurship, Viksit Bharat 2047, India

1. Introduction

The Global Gender Gap Index annually benchmarks the current state and evolution of gender parity across four key dimensions (subindexes): Economic Participation and Opportunity, Educational Attainment, Health and Survival, and Political Empowerment. It is the longest-standing index tracking the progress of numerous countries' efforts towards closing these gaps over time. This year, the Global Gender Gap Index benchmarks gender parity across 148 economies, providing a basis for the analysis of gender parity developments across two-thirds of the world's economies. India ranks 131 out of 148 countries, with particularly low scores in economic participation and opportunity subindex - the pillar essential for meaningful gender parity. Women continue to earn less than a third of what men do and female labour force participation remains stubbornly low. These are not just social indicators. They are signs of a structural failure holding back national progress. India is now a global economic power, a digital innovator, and home to the world's largest youth population. But the World Economic Forum's Global Gender Gap Report (2025) is a sobering reminder that when it comes to gender equality, India remains far behind.

As per the Ministry of Statistics and Programme Implementation's Periodic Labour Force Survey 2023–24, India's female labour force participation rate (FLFPR) has climbed to 41.7%, marking a significant rise after a prolonged phase of stagnation. This surge is more pronounced among rural women (47.6%) compared to urban women (25.4%), revealing persistent barriers such as limited access to formal jobs, inadequate workplace safety, and entrenched social norms. The disparity is even starker in STEM fields. As reported by the UNESCO Institute for Statistics in 2021, women make up only 31.5% of researchers globally. This gap between education and employment highlights systemic hurdles that industries are uniquely positioned to address.

The economic implications are substantial. According to McKinsey Global Institute, integrating an additional 68 million women into India's workforce could potentially increase the nation's GDP by up to $700 billion by 2025. Similarly, World Bank projections indicate that achieving a 50% female participation rate could boost GDP growth by 1%. Conversely, if women continue to be excluded or drop out of the workforce, the dependency ratio will climb more rapidly, burdening a shrinking labour base and threatening fiscal sustainability. Reversing this trajectory requires cohesive strategies that bridge health, labour, and social protection policies.

Central to this vision is the empowerment of women and the promotion of gender inclusion across all sectors, particularly in STEM fields. Despite progress in education and workforce participation, women entrepreneurs in STEM continue to face significant barriers that limit their potential and economic contribution.

2. Women LED enterprises: case studies and success stories

Despite these challenges, there are examples of successful women-led startups in technology and innovation, which highlight the potential for broader societal and economic impact. The analysis also points to a growing ecosystem of mentorship programs, incubators, and policy initiatives that are beginning to address these gaps.

Several Indian women have broken the glass ceiling in STEM entrepreneurship. Entrepreneurs like Ruchi Kalra (Oxyzo), Aditi Avasthi (Embibe), and Dr. Aditi Sen De (Quantum Physicist) offer inspiration and demonstrate the potential of women-led innovation in STEM fields. Their journeys highlight the importance of strong educational foundations, global exposure, access to networks, and strategic mentorship.

Another notable initiative is She Leads Tech by Facebook India, which has supported over 500 women-led startups in tech. Similarly, WE-Hub in Telangana, India's first state-led incubator for women entrepreneurs, focuses specifically on tech-based businesses. These programs show that when supportive ecosystems are created, women can lead innovation and build impactful, scalable enterprises.

Dr. Aditi Gupta, Founder of a HealthTech Startup. She is a PhD in biotechnology, identified a gap in affordable diagnostic solutions for rural healthcare. Despite her strong academic background, she faced hurdles in acquiring seed funding due to investor bias towards male-led startups. She eventually secured funding through a women-focused accelerator program and leveraged mentorship to navigate the business landscape. Her startup developed a low-cost diagnostic device that quickly gained traction in underserved areas. Dr. Gupta's journey underscores both the barriers and the value of targeted intervention.

Nevertheless, such stories remain exceptions rather than the rule. The challenge lies in replicating such support structures at scale, particularly in underserved regions and emerging STEM sectors. India's demographic dividend cannot be fully leveraged unless such isolated successes become normalized pathways for thousands of aspiring women innovators.

3. Challenges

Among the various sectors that will play a pivotal role in achieving this vision, STEM (Science, Technology, Engineering, and Mathematics) entrepreneurship occupies a central position. However, the underrepresentation of women in STEM entrepreneurship presents a significant barrier to achieving inclusive growth. Women's participation in entrepreneurship in India has been steadily growing, but significant disparities remain, especially in STEM-driven sectors. While India produces a large number of women STEM graduates i.e., 43%, but only a small fraction transition into entrepreneurship. The current share of women in India's STEM workforce is around 27%, below the global average, and their presence in leadership roles or as founders is even lower. Multiple studies reveal that women-led startups in STEM domains form less than 10% of the total, highlighting a sharp attrition between education and entrepreneurial practice.

Key structural challenges include access to capital. Women entrepreneurs often struggle more than their male counterparts to secure funding, due to both unconscious bias and lack of access to networks. Additionally, societal expectations regarding family responsibilities often limit women's ability to scale their ventures. Moreover, STEM entrepreneurship often demands high-risk tolerance, technological autonomy, and prolonged engagement with predominantly male-dominated spaces, making it less accessible or welcoming for women, especially in Tier 2 and Tier 3 cities. The burden of unpaid domestic responsibilities and caregiving roles also restricts women's ability to fully engage in entrepreneurial activities, particularly in high-intensity, high-growth sectors.

Even though more women in India are gaining access to education, their health and autonomy still lag behind. This reflects a long-standing neglect of women's reproductive health, preventive care, and nutrition, problems that weigh heaviest on those from rural and low-income communities. When women are not healthy, real economic participation simply isn't possible. Alarming evidence comes from the National Family Health Survey (NFHS-5), which shows that nearly 57% of women aged 15 to 49 are anaemic. This not only affects their ability to study and work but also makes pregnancy riskier. This isn't just a health statistic - it's a mirror of a much larger failure to place women's health at the heart of national development. Addressing this requires more than token programs. It calls for meaningful investments in primary health care, better nutrition, and accessible services that allow women to live healthier, more empowered lives. Boosting health budgets, especially at the local level, is a critical first step toward ensuring women can claim their rightful place in education, work, and society.

4. Policy and existing interventions

To bridge the gender gap meaningfully in STEM entrepreneurship, a combination of targeted interventions and policy reforms is essential. Financial inclusion programs that prioritize women-led ventures can help close the funding gap. Government and private sector partnerships can create more women-focused incubators and accelerators, providing not just capital but also mentorship and network access.

The Government of India has recognized the importance of gender-inclusive entrepreneurship and has introduced several schemes to address the issue. Initiatives like Startup India, Stand-Up India, TREAD (Trade Related Entrepreneurship Assistance and Development), and the Women Entrepreneurship Platform by NITI Aayog are notable efforts. These schemes offer credit, mentorship, incubation support, and market access specifically to women entrepreneurs.

However, these interventions often fail to address the unique challenges faced by women in STEM domains. While general support structures for entrepreneurship exist, there is a lack of targeted initiatives that foster women's leadership in high-tech sectors like AI, biotechnology, clean energy, aerospace, and deep-tech startups. Moreover, most schemes are urban-centric and have limited penetration in rural and semi-urban regions.

Policy reforms aimed at encouraging women in STEM fields should also address the dual responsibility many women face. Flexible work policies and support systems for women entrepreneurs can make a significant difference. Finally, changing societal narratives around women in technology and leadership through media and community engagement is crucial for long-term change.

There is a need for more granular, sector-specific policies that recognize the intersectionality of gender with geography, class, and educational access. Inclusion in STEM entrepreneurship cannot be achieved by economic policy alone, it must also be a function of educational reform, cultural change, and institutional accountability.

5. Suggestions and Conclusion

India can draw from successful international models that have narrowed the gender gap in STEM entrepreneurship. Countries like Canada, Sweden, and Israel have developed ecosystem-wide frameworks that include: STEM entrepreneurship grants specifically for women, Mandatory gender impact assessments in funding and innovation policies, Inclusive design of incubation spaces and networking platforms, STEM mentorship programs in high schools and universities with female mentors, Tax incentives for companies that invest in women-led STEM enterprises.

To ensure women are central to the STEM entrepreneurship landscape of a developed India by 2047, a multi-tiered strategy is required. The roadmap proposed is as follows: Educational Reforms, Policy Interventions, Access to Capital and Infrastructure, Mentorship and Networking, Inclusion in Digital India Vision, Decentralization of Incubators, Monitoring and Evaluation.

Adapting these frameworks to the Indian context, with a focus on local cultural sensibilities and infrastructural realities, can accelerate progress. For example, a STEM-focussed rural entrepreneurship model can integrate digital labs, AI-enabled agricultural solutions, and clean energy startups led by women with support from local institutions.

India does not lack frameworks or ambition; the slogans are there. What is required is real investment: in public health systems that prioritise women's needs; in care services that redistribute unpaid work, and in policies that see women not as beneficiaries, but as builders of the economy. India must treat gender equality as central to its economic and demographic future. At the current pace of progress, it may take over a century to close the global economic gender gap and India lags behind even that trajectory.

As India charts its course toward *Viksit Bharat 2047*, the role of women in STEM entrepreneurship must transition from the margins to the mainstream. Bridging the gender gap in this critical area is not only a matter of social justice but a strategic imperative for innovation-led, inclusive development. A gender-balanced entrepreneurial ecosystem in STEM will contribute to job creation, technological advancement, and national self-reliance.

India stands at a crucial demographic crossroads. Even as it continues to benefit from a youthful population, the share of senior citizens is set to almost double by 2050, accounting for around 20% of the total population. A significant portion of this group will be elderly women, many of them widows, who are more likely to face financial and social dependency. At the same time, the working-age population will contract, while the demand for elder care will grow sharply. In this scenario, sustained economic growth will be impossible without ensuring that women - who make up half the population; are healthy, empowered, and fully engaged in the workforce. Gender equality can no longer be viewed solely as a matter of justice; it has become an economic and demographic imperative. The World Economic Forum's Global Gender Gap Report serves not merely as a global ranking but as a clear warning: if India does not place gender equality at the centre of its development strategy, it risks undermining the very progress it has worked so hard to build.

This paper argues that a comprehensive and intersectional approach - combining educational reform, economic incentives, mentorship, and structural transformation is vital. India's success as a developed nation by 2047 will, in no small measure, depend on how effectively it empowers its women to lead in science, technology, and enterprise.

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Cyber security challenges in human resource technology: protecting employee data in the digital age

Prerna Srivastava[1*] and Kirti[1]

[1] Assistant Professor, Department of Management, Integrated Academy of Management and Technology, Ghaziabad, Uttar Pradesh, India

*Corresponding Author: Prerna Srivastava

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Abstract

In the age of digital revolution, Human Resource Technology (HRTech) has emerged as a key facilitator for organizations to automate hiring, on boarding, payroll, employee management, performance management, and workforce analytics. Yet, the growing adoption of digital platforms, cloud computing, and data-based decision- making in (HRM) brings along substantial cyber security threats. These are due to the private and sensitive nature of worker information, such as personally identifiable information (PII), financial data, health information, background reports, and performance histories, which make HR systems potential targets for cyber attackers, This review critically examines the integration of Artificial Intelligence (AI) into Human Resource (HR) systems and its implications for cyber security. As organizations accelerate their digital transformation journeys, HR systems are increasingly responsible for storing and managing large volumes of sensitive employee data, necessitating robust cyber security frameworks. The study focuses on identifying key cyber security risks, evaluating AI-based security solutions, and assessing their effectiveness in protecting employee information such as salaries, performance evaluations, and personal identifiers.

With the spread of remote work and mobile access to HR systems, endpoint security is now more difficult to control. Moreover, applications of artificial intelligence (AI) and machine learning (ML) in hiring and employee monitoring raise ethical issues and new attack surfaces, including algorithm manipulation and data poisoning.

Sources were chosen for relevance to AI use in HR systems, their contributions to cyber security, and empirical information regarding threats and countermeasures. The review points out the convergence of HR management and information security, listing primary challenges and best practices for protecting data in modern organizational environments.

Findings reveal that while AI significantly enhances anomaly detection and automates security responses, it simultaneously introduces new risks, including AI-driven attacks and algorithmic biases. Notable solutions include AI-enabled encryption, behavioral threat detection, and AI-powered security training simulations. The dual-edged nature of AI underscores the need for adaptive security frameworks that evolve alongside emerging technologies. For HR professionals, embracing AI-based security tools offers a proactive approach to data protection, but it also demands a re-evaluation of traditional cyber security strategies. The paper further recommends that policymakers consider stringent, AI-focused regulations to address the unique threats posed by intelligent systems. Ultimately, the study advocates for a forward-looking, aggressive cyber security strategy to ensure the resilience and trustworthiness of HR technologies.

The abstract also highlights the need to implement a strong cybersecurity practice within HRTech environments. This involves practices such as end-to-end encryption, multi-factor authentication, periodic vulnerability scans, access controls, employee training and awareness programs, and incident response planning. Strategic coordination between HR and IT functions is required to instill security culture and build HR systems resilient to adapting cyber threats.

In summary, while HR Tech provides operational efficiencies and enhanced decision-making, it also introduces significant cybersecurity threats that need to be addressed immediately and in the long run. Organizations need to consider cyber security as an essential aspect of HR technology adoption and governance to safeguard their employees' data, ensure trust, and preserve business continuity in a digital-first ecosystem.

Keywords: Data Privacy, Cyber security, HR Technology, Data Protection, AI in HR

1. Introduction

The digital evolution has significantly reshaped human resource management by introducing automated software and cloud-based systems capable of managing a wide range of administrative tasks, including payroll processing, benefits administration, recruitment, and performance appraisals. Collectively known as Human Resource Technology (HR Tech), these platforms have become ubiquitous across organizations of all sizes due to their user- friendliness, scalability, and cost-effectiveness.

Despite their advantages, HR Tech systems introduce a new layer of cyber security vulnerabilities, particularly in relation to the protection of personally identifiable information (PII). Employee records often contain sensitive data such as Social Security numbers, bank account details, medical records, and employment history. As a result, HR databases are frequently targeted by cybercriminals seeking to exploit or monetize this information.

The increasing reliance on digital HR infrastructure raises serious concerns about data integrity, confidentiality, and compliance with global data protection regulations. Ensuring the security of HR systems is not only a matter of technical necessity but also a legal and ethical obligation.

This research paper examines the most critical cyber security threats facing HR Tech platforms, explores the regulatory landscape, and presents a set of best practices and technical countermeasures to mitigate risk. The goal is to provide human resource professionals, IT security leaders, and organizational stakeholders with the insights needed to protect employee data in an increasingly digital and interconnected environment.

Purpose of the study

The aim of this research is to perform a thorough examination of the current cyber security environment, focusing especially on the discovery of threats and the formulation of effective defense mechanism in the digital age. Through an analysis of recent trends, up –and-coming technologies, and tried-and-true-best practices, this research hopes to improve our current understanding of the issues of contemporary cyber security and offer viable solutions for mitigating risk and cyber threat protection.

2. Literature review

Critical cyber risks in digital HR environments

2.1 User-targeted threat vectors

Human resources personnel are frequent targets of phishing campaigns designed to manipulate them into disclosing confidential information or inadvertently granting unauthorized access to organizational systems. Cybercriminals often employ tactics such as impersonation emails, counterfeit job applications, and fraudulent W-2 requests. These methods exploit the trust inherent in HR communications and capitalize on the high-level access HR staff typically hold to sensitive employee data.

2.2 Breach of confidential HR records

One of the most critical threats facing Human Resource Technology (HR Tech) systems is the unauthorized access to sensitive employee data. Such incidents often result from sophisticated cyber attacks that exploit system vulnerabilities or user behavior. High-profile cases, such as the 2017 Equifax data breach, underscore the potentially severe consequences of such compromises—including identity theft, regulatory penalties, legal liability, and long- term reputational harm. These breaches demonstrate the urgency of implementing robust data protection measures within HR systems, particularly given the volume and sensitivity of personally identifiable information (PII) they contain.

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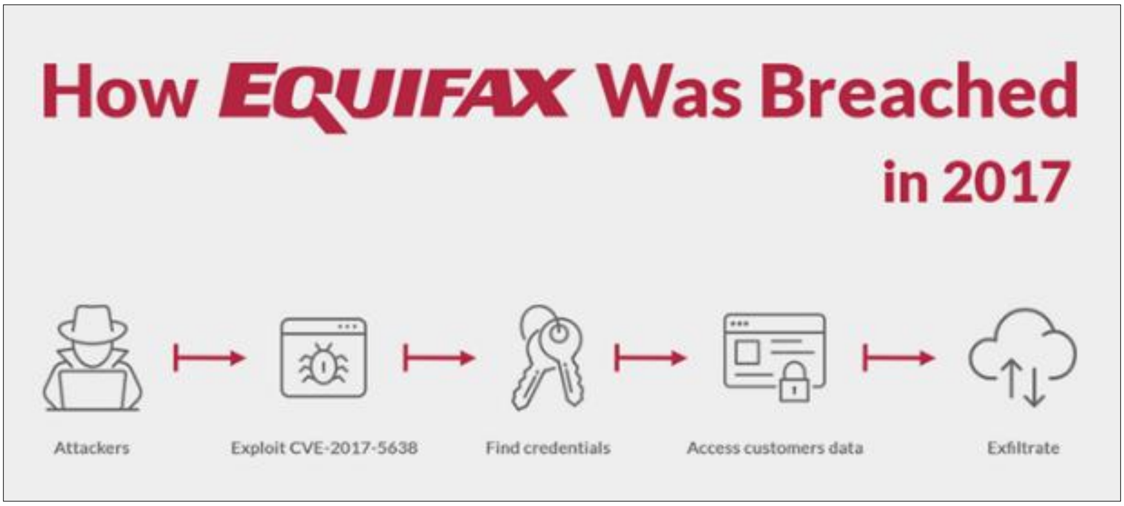
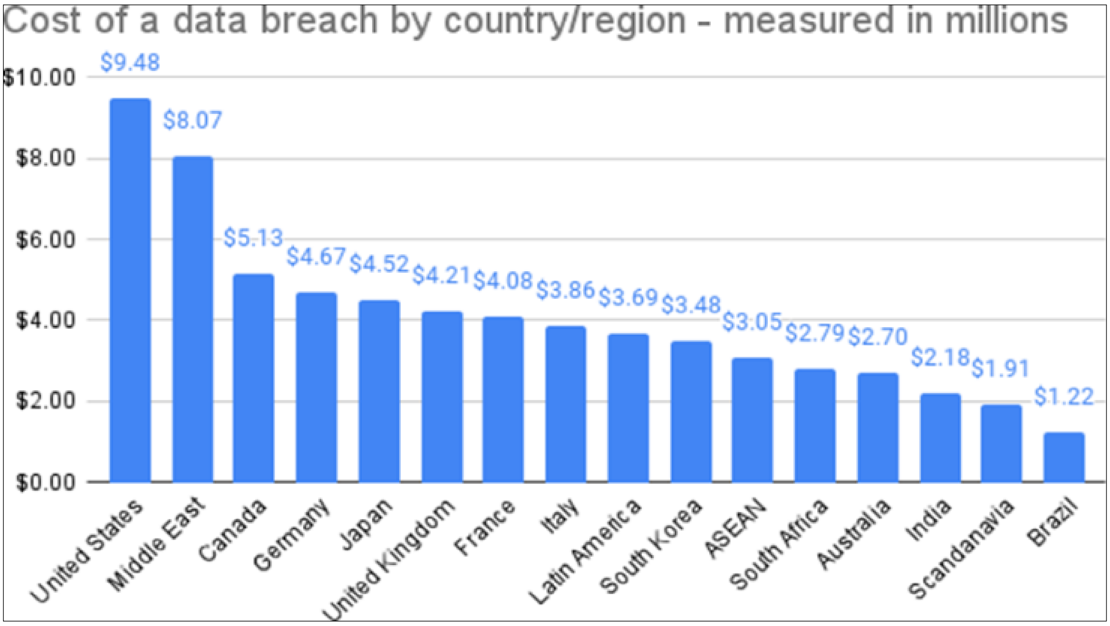


Source: https://blog.0x7d0.dev/history/how-equifax-was-breached-in-2017/

Fig 1

2.3 Organizational insider vulnerabilities

Employees, contractors, and third-party vendors with authorized access to organizational systems can pose significant security risks, either through intentional misconduct or inadvertent actions. These internal actors may exploit their access privileges, leading to data leakage, policy violations, or system compromise. According to IBM's 2024 *Cost of a Data Breach Report*, insider-originated incidents account for approximately 22% of all data breaches in enterprise environments. Human Resource systems are particularly susceptible, given the elevated level of access they require and the volume of sensitive personal data they manage.



Source: www.breachsense.com

Fig 2

2.4 Risks associated with external service providers

A significant portion of human resource operations is either outsourced or closely integrated with third-party service providers, including payroll processors, benefits administrators, and background screening firms. While these partnerships enhance efficiency and specialization, they also expand the organization's cyber security attack surface. A breach occurring at any point within the supply chain can lead to the compromise of sensitive employee data. The 2020 Solar Winds incident serves as a notable example, where attackers exploited a vulnerability in a third-party vendor to infiltrate multiple organizations, demonstrating the far-reaching implications of supply chain security failures.

2.5 Access control weaknesses

The absence or inadequate implementation of role-based access control (RBAC), multifactor authentication (MFA), and periodic account audits can lead to excessive privilege assignments, thereby significantly increasing the risk of unauthorized data exposure within HR systems.

3. Corporate compliance and regulatory obligations

Organizations must navigate a complex regulatory environment for employee data protection. Key regulations include:

- California Consumer Privacy Act (CCPA). This act grants employees the right to know what personal information is collected and how it is used.

Source: https://databrackets.com/event/how-to-comply-with-california-consumer- privacy-act-draft/

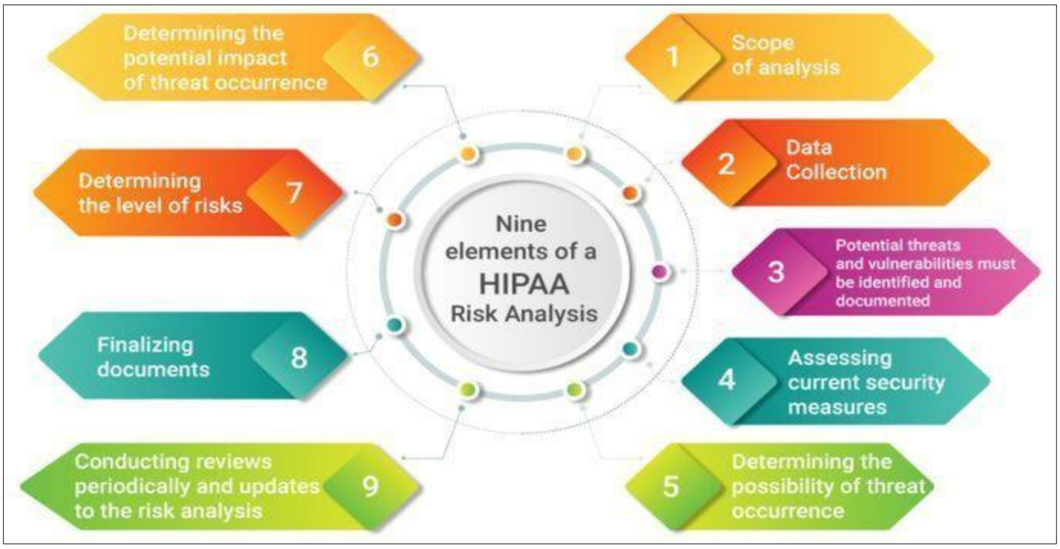
Fig 3

- General Data Protection Regulation (GDPR). This law enforces strict data handling, consent, and breach notification requirements for organizations that operate within or process data from the European Union.

Source: https://gttb.com/compliance-regulatory-requirements/eu-general-data-protection- regulation-gdpr/

Fig 4

- ISO/IEC 27001 and SOC 2. These provide frameworks for information security management and auditing. Non-compliance can lead to significant financial penalties and damage to reputation.
- Health Insurance Portability and Accountability Act (HIPAA). This law regulates the handling of health-related employee data.



Source: https://www.pinterest.com/pin/9-elements-of-a-hipaa-risk-analysis-- 841539880370207746/

Fig 5

4. Cybersecurity innovations in human resource management

Human Resource Management (HRM) has become a data-heavy function. It handles large amounts of sensitive information, such as personal identification details, financial records, health data, and performance metrics. As companies speed up their digital transformation, securing HR systems has become a crucial issue. Cybersecurity innovations are vital for reducing risks, ensuring compliance with regulations, and maintaining employee trust.

- Artificial Intelligence (AI) for Threat Detection Modern HR systems are using Artificial Intelligence (AI) and Machine Learning (ML) more often to spot patterns that suggest security threats. These technologies can: - Detect unusual user behavior (e.g., odd login times or locations) – Send real-time alerts for unauthorized access attempts – Improve fraud prevention during hiring and payroll processing AI-driven cyber security tools speed up response times and improve accuracy in handling threats.
- Blockchain for Secure Recordkeeping Although still new, blockchain technology shows great potential in HR cyber security. It can: - Create tamper-proof employee records and credentials – Confirm the authenticity of education and employment histories – Secure HR transactions like contract signing and benefit distribution Blockchain's decentralized nature improves transparency and cuts the risk of data manipulation or insider attacks.
- Role-Based Access Control (RBAC) and Identity Management To stop unauthorized access to employee data, organizations use Role-Based Access Control (RBAC) systems. These systems ensure that users only see the information necessary for their jobs. When combined with Identity and Access Management (IAM) platforms, these tools allow for: - Centralized control over user permissions – Automatic removal of access when employees leave the organization – Integration with Multi-Factor Authentication (MFA) to strengthen login security
- Automated Compliance and Audit Tools Laws like the General Data Protection Regulation (GDPR) and California Consumer Privacy Act (CCPA) require organizations to manage HR data responsibly. Cyber security tools now help automate compliance by: - Tracking data access and changes – Generating audit trails – Managing consent and data retention policies This cuts down on administrative tasks and helps HR departments comply with changing legal standards.
- Cloud-Based Security Solutions As HR functions move more to the cloud, organizations are adopting new cloud security solutions to protect data storage and transmission. These solutions include: - End-to-end encryption (e.g., AES-256, TLS 1.3) – Intrusion detection systems (IDS) – Cloud access security brokers (CASBs) that monitor data transfers between users and cloud platforms Cloud-native security tools provide scalability and real-time protection suited for modern HR processes.
- Security Awareness and Employee Training Platforms Cyber security innovation includes more than just technology; it also involves better employee training platforms. Interactive e-learning modules, phishing simulations, and gamified training sessions are commonly used to educate HR professionals and employees about security best practices. These tools help create a culture of cyber security awareness within the organization.

5. Expansion and operational capabilities

HRTech has also developed significantly with the emergence of Software as a Service (SaaS) products, mobile accessibility, artificial intelligence, and data analytics. These systems like Workday, Oracle HCM Cloud, and BambooHR now encompass various functions such as recruitment, onboarding, processing payroll, benefits administration, and monitoring performance.

Digital risk landscape

The HR digitization has widened the attack surface for hackers. Centralization of data, cloud storage, third-party integrations, and remote access points raise the chances of security breaches. Moreover, the volume and sensitivity of HR data increase the stakes for the organizations.

Research methodology

Primary data: "A timed questionnaire will be completed through Google Forms or email to collect preliminary data. Furthermore, semi-structured interviews will be done with chosen HR leaders and cyber security experts to gain more in-depth ethical insights."

Secondary Data: A thorough review of scholarly journals, case studies, industry reports, and organizational policies dealing with HR data management and cybersecurity shall be conducted.

1. Case study

Capital One Data Breach (2019).

Background

Capital One, one of the largest banks in the U.S., experienced a data breach which revealed information of more than 100 million customers as a result of a misconfigured firewall in their AWS (Amazon Web Services) cloud environment.

What happened

Data stolen were names, addresses, credit scores, and social security numbers

The incident was discovered and highlighted by an outside researcher who observed the data on GitHub.

Primary challenges

Misconfigured cloud infrastructure.

Poor cloud security governance.

Potential insider threat from cloud service staff.

Late detection of abnormal activity in cloud environment.

Lessons learned

Configuring cloud environments properly and auditing them on a frequent basis is critical. Use the principle of least privilege for access controls.

Audit and log all cloud activity.

Perform routine penetration testing and vulnerability scans.

Source: capitalonedatapaper.pdf

2. Case study

The Equifax Data Breach (2017)

Topic: Cybersecurity Failure in Data Protection Industry: Credit Reporting / Finance

Background

Equifax is a major United States consumer credit reporting agency that experienced a record-breaking data breach in 2017 where 147 million people's sensitive personal information, including names, Social Security numbers, birth dates, addresses, and driver's license numbers in some instances, was compromised

How the breach happened

Vulnerability: Apache Struts web application framework employed by Equifax contained a known vulnerability (CVE-2017-5638).

Patch failure: Although the vulnerability was made public in March 2017, Equifax did not implement the required security patch within a reasonable amount of time.

Exploitation: Attackers took advantage of this weakness in May 2017, gaining unauthorized access to systems at Equifax. Lack of Detection: The attackers went undetected for more than two months before the breach was detected late in July 2017. Major Cybersecurity Failures

Area description

Patch Management Failure to patch and update known vulnerabilities Detection and Response Delayed detection of the breach provided attackers with extended access Data Encryption Sensitive data not encrypted properly Internal Security Policy Weak internal controls and lack of accountability Public Response Poor response to the incident and delayed public reporting of the breach

Consequences

- **Reputational harm:** Massive loss of consumer trust and brand reputation.
- **Financial sanction:** Equifax settled with the FTC, CFPB, and states for $700 million. Leadership Consequences: The CEO, CIO, and CSO all left.
- **Regulatory attention:** Increased regulatory emphasis on data protection throughout the financial industry.

Lessons learned

- **Prompt Patch Management:** Organisations need to have automated patch identification and deployment systems.
- **Monitoring in Real Time:** Monitoring networks in real time will identify anomalies and prevent breaches early.
- **Encrypt Sensitive Data:** Even if information is accessed, encryption lowers the threat of misusing it.
- **Incident Response Planning:** A tried and true cybersecurity incident response plan is crucial.
- **Security Culture:** Cybersecurity isn't solely an IT problem—it needs to be an organizational priority.

Conclusion

The Equifax breach is a textbook example of how lack of fundamental cybersecurity hygiene can cause ruinous outcomes. It also shows the value of regulatory compliance, active risk management, and inter-departmental cybersecurity cooperation.

Source: https://www.researchgate.net/profile/Jason-Thomas-21/publication/337916068_A_Case_Study_Analysis_of_the_Equifax_Data_Breach

Comprehensive approaches to safeguarding HR data

Ensuring the confidentiality, integrity, and availability of HR data is critical in modern organizations. As custodians of sensitive employee information, HR departments must adopt comprehensive data protection strategies. The following best practices reflect current standards in cyber security and data governance, tailored specifically for HR functions.

Source: https://pipeline.zoominfo.com/operations/data-governance

Fig 6

- **Data encryption and minimization**

Data encryption is essential to protect both stored and transmitted HR information. It is recommended to utilize Advanced Encryption Standard (AES-256) for data at rest and Transport Layer Security (TLS 1.3) for data in transit. These protocols provide robust protection against interception and unauthorized access. Furthermore, organizations should adhere to data minimization principles by avoiding the retention of unnecessary or outdated personal data, thus limiting potential exposure in the event of a breach.

- **Continuous monitoring and security auditing**

Proactive monitoring and auditing mechanisms are critical for early threat detection. Regular penetration testing and vulnerability assessments help identify system weaknesses before they can be exploited. The maintenance of detailed audit logs enables organizations to track access and modification activities, facilitating the investigation of suspicious or anomalous behavior.

- **Access management and role-based controls**

Effective access management is foundational to HR data security. Organizations should implement Role-Based Access Control (RBAC) to ensure that individuals can only access information necessary for their defined responsibilities. This principle of least privilege minimizes the risk of unauthorized data exposure. Additionally, enforcing Multi-Factor Authentication (MFA) and mandating regular password updates significantly reduces the likelihood of credential-based attacks.

- **Vendor and third-party risk management**

HR functions often rely on third-party vendors for payroll processing, recruitment platforms, or cloud-based HR systems. To mitigate associated risks, organizations should ensure that vendors comply with recognized cyber security frameworks (e.g., ISO/IEC 27001, SOC 2). Rigorous due diligence must be conducted to evaluate vendors' data protection practices, and all contracts should include binding cyber security and data handling clauses.

- **Incident response and legal compliance**

An effective incident response plan is essential for managing data breaches and minimizing impact. This plan should be periodically tested and include HR-specific scenarios, such as unauthorized access to employee records. Furthermore, organizations must remain compliant with applicable data protection regulations (e.g., GDPR, CCPA) by adhering to mandatory breach notification timelines and maintaining proper documentation.

- **Security awareness and training**

Human error remains a significant vulnerability in information security. Therefore, it is imperative to provide comprehensive cyber security awareness training for HR personnel. Training should include instruction on identifying phishing attempts, social engineering tactics, and secure handling of confidential data. These initiatives should be incorporated into both initial employee onboarding and ongoing professional development programs.

Conclusion

In the digital era, data serves as both a critical asset and a potential liability. The protection of employee information within Human Resource (HR) technology systems has emerged as a strategic priority for organizations. With increasing reliance on cloud platforms, artificial intelligence tools, and third-party software for essential HR functions—such as recruitment, payroll, and performance management—the risk of cyber threats has grown substantially. These include data breaches, phishing schemes, identity theft, and insider threats, all of which pose significant risks to employee privacy and organizational integrity.

This research underscores the multifaceted cyber security challenges HR professionals face and the pressing need for a proactive, multi-layered defense strategy. Key measures include implementing robust access control mechanisms, encrypting sensitive data, conducting regular security assessments, and fostering a culture of cyber security awareness across all organizational levels. Moreover, as regulatory frameworks such as GDPR, HIPAA, and CCPA continue to evolve, compliance has become not just a technical necessity but a legal and ethical imperative.

Ultimately, safeguarding employee data is a shared responsibility—not limited to the IT department, but extending to HR, leadership, and every employee. As digital transformation reshapes the HR landscape, organizations that prioritize resilient, adaptive, and privacy- centric cyber security practices will be best positioned to uphold trust, ensure compliance, and achieve sustainable operational success.

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Climate risk and its impact on financial markets - a conceptual perspective

Dr. Vinamrata Akash
Assistant Professor, Motilal Nehru College, University of Delhi, Delhi, India
*Corresponding Author: Dr. Vinamrata Akash
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Abstract
The growing urgency to comprehend and manage climate risks extends far beyond the realm of environmental science—it has become a central concern for the global financial system. Climate change presents multidimensional risks that can disrupt asset valuations, strain financial stability, and challenge traditional risk management frameworks. This conceptual study synthesizes existing literature and policy insights to explore climate change as a systemic financial risk, emphasizing both physical and transition dimensions. It examines vulnerabilities in key financial sectors such as banking, insurance, energy, and real estate, while evaluating policy frameworks including the Task Force on Climate-related Financial Disclosures (TCFD) and ESG-based regulations. By drawing from secondary academic and institutional sources, the paper presents a conceptual framework that links climate dynamics with financial system resilience, contributing to policy innovation and future research pathways.

Keywords: Climate risk, Financial stability, Systemic risk, ESG, Transition risk, Sustainable finance

Introduction

The urgency to understand and address climate risks is no longer confined to environmental policies; it now permeates the very fabric of financial and economic systems. Financial markets across the globe are increasingly confronting the complexities and uncertainties generated by climate change. As the global economy becomes more interdependent and capital markets integrate across borders, the ripple effects of climate-induced disruptions pose systemic threats to stability and growth.

Climate risks are not merely environmental issues but financial threats of profound magnitude. The interconnectedness of markets implies that the physical impacts of climate change—such as rising sea levels, wildfires, and floods—and the transition to low-carbon economies together reshape investment patterns, asset valuations, and credit structures. Physical risks involve direct damage to infrastructure and supply chains, while transition risks arise from regulatory, technological, and policy shifts toward decarbonization (Carney, 2015) [4]. Both require immediate recognition in financial risk assessments.

The need for this study arises from the growing realization that climate change is transforming from an environmental and humanitarian issue into a systemic financial risk. Frequent and severe climate events have resulted in massive asset losses, insurance claims, and disruptions in productivity across sectors. Simultaneously, policy measures such as carbon pricing and emission regulations create uncertainties for industries dependent on fossil fuels. Inadequate climate-related disclosures and fragmented regulatory frameworks exacerbate the difficulty in managing these challenges effectively.

This study aims to develop awareness of the systemic nature of climate risks, highlight sectoral vulnerabilities, and underscore the importance of integrating climate considerations into existing financial risk management frameworks.

Objectives of the study

- To conceptualize climate risk as a systemic threat to financial stability.
- To analyse vulnerabilities in key sectors such as Banking, Insurance, Energy, and Real Estate.
- To evaluate existing policies and disclosure mechanisms addressing climate risks.
- To explore the role of ESG principles and regulatory frameworks in mitigating risks.
- To propose future strategies for sustainable financial governance.

Literature and theoretical framework

In recent years, scholars and policymakers have increasingly recognized the interlinkages between climate change and financial markets. The notion of climate risk as a *systemic* financial risk has been central to several studies (Battiston *et al*., 2017) [2]. The theoretical foundation rests on the dual dimensions of physical and transition risks.

Physical risks emerge from climate-related disasters and gradual environmental degradation (IPCC, 2022) [7]. Such risks directly affect asset valuations, productivity, and infrastructure. Transition risks, conversely, stem from structural economic changes, including policy reforms, technological innovations, and shifts in consumer behavior as economies pursue low-carbon growth (Carney, 2015) [4].

Empirical and conceptual studies have shown how both risk types affect global finance. Dietz *et al*. (2016) [6] estimated the "climate value at risk" for global financial assets, finding that long-term exposure could wipe out significant portions of global wealth. The Network for Greening the Financial System (NGFS, 2019) [11] underscored how financial institutions face material exposures from climate-sensitive portfolios.

Sector-specific research illustrates this further: banks are vulnerable through loans to carbon-intensive industries (Klusak *et al*., 2021); insurance companies face escalating claims from natural disasters (Monasterolo & Raberto, 2019) [10]; and real estate markets experience devaluation in coastal and high-risk areas (Keenan *et al*., 2018) [9].

To promote resilience, policy frameworks like the Task Force on Climate-related Financial Disclosures (TCFD, 2017) [13] and the EU Sustainable Finance Taxonomy have sought to enhance transparency and market discipline. However, persistent implementation gaps remain, particularly in ensuring consistent ESG adoption (Bolton *et al*., 2020; Ameli *et al*., 2020) [3].

This study synthesizes these theoretical insights into a unified conceptual framework that acknowledges climate change as a cross-cutting systemic risk, requiring coordinated financial, regulatory, and policy responses.

Research methodology

This paper adopts a Descriptive, conceptual research methodology, grounded in a qualitative and analytical approach. It synthesizes insights from existing literature, policy documents, and global frameworks to develop a comprehensive understanding of climate risk and its implications for financial markets.

The study examines secondary data from academic literature, policy frameworks, and global reports on climate finance. Given the emerging and multi-dimensional nature of climate risks, a conceptual methodology enables in the synthesis of fragmented knowledge and provides a strong theoretical foundation for future empirical research.

Sources of Data The study has been made using secondary sources, i.e Academic Peer-reviewed journals and various studies on climate- finance, systemic risk, and sustainable financial systems.

Reports and Publications from IPCC reports, World economic Forum publications, IMF and World Bank documents on the climate risks., & Policy Documents from National and international regulations on ESG and climate.

Sectoral vulnerabilities in financial systems

Climate change has profound implications for financial markets and institutions, reshaping how credit, investment, and risk management function across sectors. The physical impacts of climate events—floods, droughts, wildfires, and rising sea levels—combine with transition pressures such as policy shifts, carbon pricing, and technological disruption to create multifaceted financial vulnerabilities. These risks do not exist in isolation; they are deeply interconnected through market linkages, supply chains, and global capital flows. Understanding these sectoral vulnerabilities is vital for regulators, investors, and policymakers to prevent the amplification of climate shocks into systemic financial crises.

Banking sector

Banks represent one of the most exposed pillars of the financial system when it comes to climate-related risks. Climate change can affect banks through both physical risks (damage to property and infrastructure from extreme weather events) and transition risks (losses from the revaluation of assets and liabilities as the economy moves toward decarbonization).

Physical disasters such as floods, hurricanes, and heatwaves directly impair the value of collateral used to secure loans. For instance, when manufacturing plants or residential properties in flood-prone regions are destroyed or damaged, their market value plummets, eroding the security underlying bank loans. Consequently, non-performing assets (NPAs) increase, squeezing profitability and capital adequacy ratios. A 2023 report by the Network for Greening the Financial System (NGFS) indicated that banks with high exposure to climate-sensitive industries—such as agriculture, construction, and energy—could see loan default probabilities rise by 15–20% under severe physical risk scenarios.

Moreover, banks face growing transition risks as economies decarbonize. Institutions heavily invested in carbon-intensive sectors like coal, oil, and steel face the risk of asset stranding—where once-profitable assets lose value due to regulatory changes, technological shifts, or demand decline (Bolton *et al*., 2020) [3]. For example, the European Central Bank's climate stress tests (2022) showed that banks with high fossil fuel exposure could face loan losses equivalent to 4% of their total credit portfolio by 2030 under a delayed transition scenario.

Additionally, reputational risk and investor activism increasingly influence banking operations. Banks that continue to fund environmentally damaging projects face public scrutiny and potential withdrawal of capital by ESG-conscious investors. Global financial institutions such as HSBC, BNP Paribas, and Citi have begun aligning lending portfolios with the Paris Agreement goals, demonstrating a gradual but significant transformation in banking strategies. Yet, many regional and domestic banks in emerging economies still lag in integrating climate risk into credit assessments, leaving them vulnerable to shocks.

Insurance sector

The insurance industry stands at the forefront of climate exposure, bearing the brunt of rising catastrophic losses due to extreme weather events. As Monasterolo and Raberto (2019) [10] highlight, the increasing frequency and severity of hurricanes, floods, and wildfires challenge the traditional actuarial models that underpin insurance pricing and risk pooling. When climate events become both more intense and less predictable, insurers struggle to accurately estimate premiums, reserves, and reinsurance costs.

Between 2010 and 2023, global insured losses from climate-related disasters doubled, according to Swiss Re Institute (2024), averaging over USD 110 billion annually. Yet, a significant portion of total economic losses remains uninsured, creating a widening "protection gap." This gap implies that while insurers face growing claims, households and businesses also absorb rising out-of-pocket costs, amplifying financial stress and slowing economic recovery. In some cases, insurers have withdrawn coverage from high-risk regions—such as wildfire-prone areas of California and flood zones in the UK—creating new forms of financial exclusion.

Transition risks also impact insurers' investment portfolios. Insurance companies typically manage large asset bases, often invested in long-term bonds, real estate, and equities. As the world transitions toward a low-carbon economy, assets tied to fossil fuel production or high-emission industries could lose value, undermining investment returns and capital reserves. European insurers like Allianz and AXA have already started divesting from coal-based assets, signalling a shift toward sustainability-oriented investment strategies. However, such reallocation can also lead to short-term portfolio volatility and valuation uncertainty.

The solvency of the insurance sector, therefore, depends not only on risk-based pricing and reinsurance but also on its capacity to anticipate and adapt to long-term climate trajectories. Regulatory initiatives, including the EU's Solvency II Directive and the Task Force on Climate-related Financial Disclosures (TCFD), are pushing insurers to disclose climate risk exposure more transparently and build resilience through diversification and adaptive modelling.

Energy sector

The energy sector lies at the heart of both the problem and the solution to climate change. As one of the largest sources of global greenhouse gas emissions, it is subject to intense regulatory scrutiny and profound structural transformation. The transition from fossil fuels to renewable energy is accelerating globally, yet the process introduces substantial financial and operational risks for existing energy companies.

Fossil fuel producers and utilities with significant carbon-intensive assets—such as oil fields, coal mines, and refineries—face the threat of asset stranding as climate policies tighten. According to the International Energy Agency (IEA, 2023), achieving net-zero emissions by 2050 could render up to USD 1.4 trillion in oil and gas assets stranded, resulting in significant write-downs for investors and lenders. This transition risk is further compounded by technological advances in renewable energy, energy storage, and electric mobility, which erode the market share of traditional fossil-based energy firms.

Bolton *et al*. (2020) [3] note that policy interventions such as carbon taxes, emission caps, and subsidies for green technology can significantly alter firm valuations and investor behavior. For instance, the introduction of the EU Carbon Border Adjustment Mechanism (CBAM) is expected to shift competitiveness dynamics across global energy and industrial markets. Companies that fail to innovate or diversify into renewable portfolios risk financial instability or bankruptcy.

At the same time, renewable energy firms are not immune to risk. They face high upfront capital costs, long payback periods, and technological uncertainties. Moreover, supply chain dependencies—for instance, the reliance on rare earth minerals from geopolitically sensitive regions—introduce new dimensions of market risk. Thus, while the energy transition promises long-term sustainability, it requires massive financial realignment, green infrastructure investment, and innovation to ensure both profitability and resilience.

Real estate sector

The real estate sector is among the most visibly affected by physical climate risks, given its direct dependence on geography, land use, and infrastructure resilience. Properties located in coastal regions, floodplains, or drought-prone zones face increasing exposure to climate hazards, leading to depreciation, higher insurance costs, and declining investor interest (Keenan *et al*., 2018) [9].

In the United States alone, the First Street Foundation (2022) estimated that over USD 108 billion in property value could be lost by 2050 due to increased flood risk. Similarly, rising sea levels threaten low-lying coastal regions in South and Southeast Asia, potentially displacing millions and reducing the value of coastal real estate. For financial institutions, this translates into mortgage-backed security (MBS) risks, as property devaluations can impair collateral values and lead to defaults.

Climate change is also reshaping urban planning and investment preferences. Cities and developers are increasingly integrating climate resilience into real estate valuation models—factoring in flood defenses, green spaces, and sustainable building materials. Investors are favouring "green buildings" certified under standards like LEED or BREEAM, which not only reduce environmental impact but also attract higher rental yields and occupancy rates. On the policy side, several governments are linking infrastructure financing to environmental criteria, further incentivizing climate-smart development.

However, the uneven distribution of climate risk creates socio-economic disparities. Low-income communities, often residing in the most vulnerable areas, face higher exposure but lower adaptive capacity. Without targeted policy interventions, such vulnerabilities could lead to long-term displacement, asset inequality, and credit risk concentration in marginalized regions.

Systemic financial implications

The cumulative effect of these sectoral vulnerabilities transcends individual firms and industries, posing a systemic threat to the stability of the global financial system. The Federal Reserve Bank of San Francisco and the Bank for International Settlements have emphasized that climate risk is a source of financial risk, not merely an environmental concern. Because financial markets are highly interconnected, losses in one sector—such as insurance or real estate—can rapidly spill over into others, amplifying systemic fragility through feedback loops.

For example, widespread defaults in flood-affected regions can erode banks' asset bases, prompt deleveraging and tightening of credit. Simultaneously, insurance companies facing massive payouts may liquidate assets, driving down market valuations. This can create a chain reaction of credit contraction, market volatility, and declining investor confidence. Moreover, sovereign debt may also be affected: countries highly dependent on carbon-intensive exports or vulnerable to natural disasters could experience credit downgrades, raising borrowing costs and constraining fiscal space.

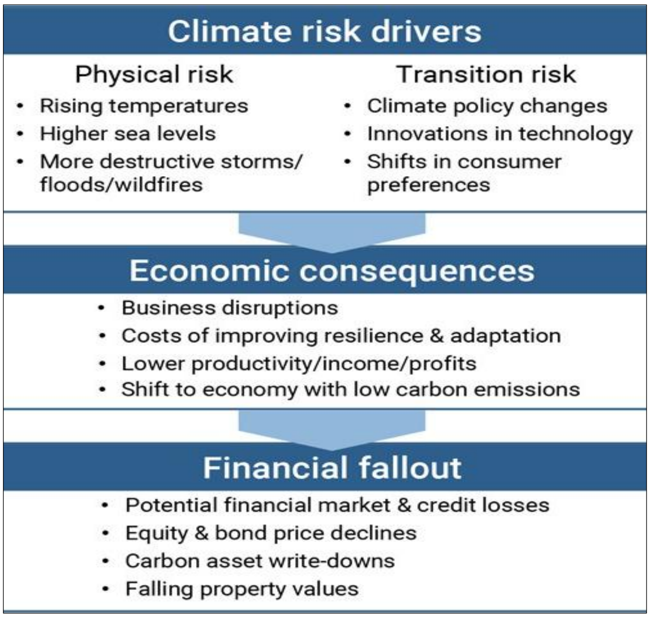
Recognizing these systemic risks, global regulatory bodies such as the Financial Stability Board (FSB), NGFS, and Basel Committee on Banking Supervision have begun integrating climate considerations into macroprudential frameworks. Central banks now conduct climate stress tests, assessing how prolonged physical or transition shocks might impact solvency and liquidity across sectors.

Ultimately, the integration of climate risk into financial governance represents both a challenge and an opportunity. Institutions that adapt early—through sustainable finance, green bonds, and enhanced risk disclosure—can mitigate exposure while capitalizing on emerging opportunities in renewable energy, resilience infrastructure, and carbon markets. Conversely, delayed action could expose financial systems to abrupt, large-scale corrections, endangering both economic growth and global stability.

Climate risks are no longer confined to environmental and humanitarian domains; they have emerged as systemic threats to global financial stability.

Physical risks from extreme weather events damage infrastructure and disrupt economic activities, leading to reduced productivity and asset devaluation. For instance, hurricanes and floods can wipe out physical assets, reducing collateral for loans and increasing default rates in the banking sector. Moreover, prolonged droughts can severely affect agricultural yields, diminishing the repayment capacity of farmers and agri-based enterprises. Heatwaves and wildfires also pose significant threats to manufacturing and energy infrastructure, resulting in operational shutdowns and insurance losses. In coastal regions, rising sea levels can erode land values and displace communities, weakening local credit markets. Collectively, these climate-induced shocks not only strain financial institutions' balance sheets but also ripple through broader economic systems, heightening systemic risk and market volatility.

The transition risks, on the other hand, stem from shifts in policy, technology, and consumer preferences. The implementation of carbon-pricing, stricter emission standards, and growing adoption of renewable energy technologies may lead to significant repricing of high-carbon assets, creating financial instability for institutions heavily invested in fossil fuel sectors. Both types of risks demand proactive strategies from regulatory bodies and financial institutions to ensure market stability. Additionally, sudden regulatory changes can render existing business models obsolete, forcing rapid asset write-downs and capital reallocation. Investor sentiment is increasingly influenced by ESG considerations, which can amplify market volatility for non-compliant firms. Furthermore, companies that fail to innovate or transition to low-carbon alternatives risk reputational damage, reduced access to financing, and heightened credit risk exposure.



Source: *Federal Reserve Bank of San Fancisco*

Policy frameworks and disclosure mechanisms

Global financial governance has evolved to recognize the materiality of climate-related risks. Frameworks such as the TCFD (2017) [13] have laid the foundation for standardized disclosure practices, promoting transparency in climate-related financial reporting. The EU Sustainable Finance Taxonomy and Paris Agreement have further guided institutions toward integrating environmental considerations into financial decision-making.

In many jurisdictions, regulators are mandating climate stress testing, scenario analysis, and risk disclosure to ensure that markets can internalize climate costs. For instance, the Bank of England, European Central Bank, and NGFS advocate that central banks incorporate climate risk into prudential supervision (Bolton *et al*., 2020) [3].

Nevertheless, the enforcement of these policies remains inconsistent across countries. Several studies (Chua, 2022; Auzepy *et al*., 2023) [5, 1] highlight disparities in disclosure quality and the lack of harmonization in reporting standards. There is also a need to align national regulatory practices with global frameworks to prevent greenwashing and ensure credibility in ESG investments.

Enhanced disclosure mechanisms not only improve investor confidence but also enable financial institutions to allocate capital more efficiently toward sustainable assets. In doing so, they contribute to long-term economic resilience and climate adaptation.

Strategic directions for future research and policy innovation

To mitigate the systemic impacts of climate risks, both policymakers and financial institutions must pursue coordinated strategies emphasizing innovation, transparency, and inclusivity. Future research and policy efforts should focus on the following directions:

- **Developing robust climate risk assessment tools:** Financial institutions must incorporate both physical and transition risks into their risk modeling frameworks. Climate-adjusted credit scoring and stress testing can help in pricing climate exposure accurately.
- **Strengthening mandatory disclosures:** Regulatory bodies should ensure compliance with global disclosure standards such as TCFD, making climate risk reporting mandatory for major corporations and financial intermediaries.
- **Creating incentives for green investments:** Governments can provide tax benefits, subsidies, and guarantees for renewable energy projects and sustainable financial instruments such as green bonds.
- **Encouraging public-private partnerships:** Collaborative models involving government, private investors, and multilateral institutions can enhance climate resilience and finance adaptation infrastructure.
- **Promoting academic-policy integration:** Future studies should empirically test the effectiveness of regulatory measures and examine cross-sectoral linkages of climate risks, helping bridge the gap between theory and implementation.

This conceptual study contributes to both policy and academia by laying the groundwork for developing a unified framework that views climate risks as systemic financial threats requiring collective global action.

Conclusion

Climate change has emerged as a defining challenge of the 21st century, carrying profound implications for global financial stability. The intersection of environmental and financial risks underscores the urgency of integrating climate considerations into mainstream financial governance. By synthesizing literature and policy evidence, this study reveals that climate risks—whether physical or transition-related—pose systemic threats to banking, insurance, energy, and real estate sectors. Effective risk assessment tools, strong disclosure mechanisms, and coordinated international policies are essential to safeguard financial markets.

A collaborative global approach is needed to ensure that financial systems not only survive but evolve to support sustainable growth amid rising climate uncertainties. Aligning finance with sustainability is not merely a moral imperative—it is an economic necessity for future resilience.

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The role of automation and AI in shaping the future of employment

Dr. Poonam Devi[1] and Rima Alagh[1*]

[1] Assistant Professor, Department of Commerce, Sirifort Institute of Management Studies, Guru Govind Singh, Indraprastha University of Delhi, Delhi, India

*Corresponding Author: Rima Alagh

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Abstract

The presence of Artificial Intelligence (AI) and automation of work provides a revolution in the world of work. But at the same time, this can threaten human potential in employment. This research was conducted to see the influence exerted by AI and automation on human employment. This research will be carried out using a descriptive qualitative approach. The data used in this study comes from various research results and previous studies that still discuss the use of AI and automation in the world of work. This study found that AI and automation are currently replacing many jobs. However, some bits of intelligence belonging to humans, such as intuition and empathy, are still difficult for AI to imitate. Even though the existence of AI and automation can be a threat to humans in the workforce, with the increase in human resource skills then humans who adapt will not be replaced by machines, but there will be the integration of human-machine work, where AI and automation do not replace humans but become tools for human labor.

Keywords: Artificial Intelligence, Employment, Automation

1. Introduction

Outstanding progress in artificial intelligence (AI) and automation has been made over the past twenty years. In terms of artificial intelligence, this technology is advancing quickly and is anticipated to transform operations globally. AI refers to hardware or software designed to exhibit intelligent behaviors similar to those of humans. The purpose of developing AI is to enable computing systems to replicate human intelligence to carry out specific tasks autonomously. Despite the advantages of increased ease and efficiency that this technology offers, surveys in the human resources sector reveal significant apprehension among the workforce regarding this technological shift. Employees are worried about the effects of automation on the job market and overall productivity. However, certain economists argue that this technological advancement will generate new employment opportunities, as there is a constantly growing demand for skilled individuals capable of managing and maintaining increasingly advanced AI and automation systems.

1.1 AI and Automation

The ability of machines, particularly computers and robots, to carry out tasks that normally call for human intelligence is known as artificial intelligence (AI). Problem-solving, judgement, language comprehension, pattern recognition, and experience-based learning are some of these activities. AI-powered systems may evaluate data, make judgements, and enhance their performance without needing to be explicitly programmed for every task, in contrast to conventional machines or software that adhere to predetermined instructions. Because of this, they are very helpful in a variety of industries, including customer service, healthcare, banking, and transportation. Intelligent automation is the result of combining automation and artificial intelligence. By itself, automation is the use of technology to carry out tasks without the need for human involvement. Usually, these are ordinary or repetitive jobs.

A simple automation system might, for instance, fill out forms or categorise emails. By adding AI capabilities, intelligent automation goes one step further and enables systems to do more than just carry out tasks; they can also learn from them, adjust to changing circumstances, and make wise decisions. This indicates that as time passes, the system's efficiency increases. For example, a standard chatbot in customer service may react to consumer enquiries by following a script. However, a chatbot driven by AI is able to comprehend the context of queries, tailor answers, and even draw lessons from previous exchanges to enhance subsequent discussions. Similar to this, intelligent automation in manufacturing may identify product flaws and make real-time process adjustments to prevent failures. Automation and artificial intelligence (AI) are revolutionising sectors by boosting output, decreasing errors, and facilitating quicker decision-making.

These systems are anticipated to manage increasingly complicated jobs as they develop, further boosting productivity and creativity across industries. But along with technology advancements, society must also confront issues like employment displacement and ethical dilemmas brought on by their emergence.

1.2 Can AI and automation work together?

The use of software to reduce human effort isn't new news for the business community. Artificial Intelligence [6] on top of it has opened a whole new possibility. Automation is provided for a very limited range of reducing human work. But by combining artificial intelligence with automation, one will be able to reduce not just human effort but also totally remove the need for such intervention altogether. This kind of combination in artificial intelligence in automation is known as automation continuum (or intelligence, Robotic Process Automation)

2. Literature review

I. Artificial Intelligence (AI)

According to Jogiyanto, artificial intelligence (AI) refers to a machine or intelligent device, typically a computer, capable of executing tasks that would normally require human intelligence. As per Kusumadewi, AI is a branch of computer science that enables machines (computers) to perform tasks similar to those accomplished by humans. In Suparman's view, AI is a specialized area within computer science aimed at developing software and hardware that can closely replicate certain functions of the human brain. (Nahavandi *et al*., 2022).

According to John McCarthy, artificial intelligence (AI) is both a field of study and a method for designing intelligent machines, along with sophisticated computer programs or applications. AI represents a progression toward the creation of computers, robots, or applications that operate intelligently, similar to human behavior. (Cioffi *et al*., 2020)

Computer science, biology, psychology, language, mathematics, and engineering are among the fields that contribute to artificial intelligence. The ability to reason, learn, and solve problems is a crucial step in the development of artificial intelligence-related computers. Though not yet flawless or accurate, AI's methods for problem-solving involve structuring knowledge and information such that users can readily access and comprehend it. These methods can also be readily adjusted to fix mistakes and be useful in a variety of scenarios. (Nozari & Sadeghi, 2021).

From the various paragraphs above, it is clear that artificial intelligence is a technique for giving a computer intelligence and the capacity to think like a human in order to solve problems and break down these thought processes into crucial steps. (Hoffmann, 2022).

II. Automation

Automation (which translates to "self-study" in Greek), robotization, industrial automation, or numerical control is the process of replacing human operators with control systems like computers to operate industrial machinery and process controls. A significant reduction in human needs as sensors and work mentality results from industrialisation, which is a stage in the implementation of mechanisation where humans carry out the concept of permanent mechanisation of industrial machines as operators by placing machines as assistants following physical work demands. (Pańko *et al*., 2022).

The meaning of automation in order to increase productivity, efficiency, and flexibility, automation is a technology that combines the application of mechanics, electronics, and computer-based systems through processes or procedures that are typically organised according to an instruction program and combined with automatic control (feedback) to ensure whether all instructions have been carried out correctly. Fords in Detroit were the first to adopt the term automation. This phrase refers to machine tools and mechanical devices that are utilised to create a continuous manufacturing line. (Wang *et al*., 2022).

According to Santoso, automation is the process of automatically regulating a tool's operation, which can take the position of humans in observation and decision-making. There is relatively little human intervention in controlling because the current control system is beginning to transition to automation (Santoso *et al*., 2020). Because it is more thorough, safe, and efficient than a manual method, an autonomously controlled equipment system is much more convenient. Ghifari then made the case that automation is a scientific discipline that necessitates the replacement of manual machines with automated ones in order to streamline current living processes. (Mehmood *et al*., 2020).

III. Employment

According to the traditional perspective, people have the biggest impact on a country's ability to succeed. This is because if there are no human resources to digest nature (land) in a way that is beneficial to life, then nature is worthless. In this case, Adam Smith's classical theory acknowledges that economic growth is driven by the effective utilisation of human resources. To sustain economic growth after it has begun, more (physical) capital accumulation is needed.

To put it another way, economic advancement depends on the effective use of human resources (Javanmardi *et al*., 2023). Thomas Robert Malthus is considered a classical thinker who made a significant contribution to the development of economic principles, second only to Adam Smith. Malthus's Principles of Population is his best-known work. Even though Malthus was a supporter of Adam Smith, the book makes clear that not all of his beliefs aligned with Smith's. On the one hand, Smith believes that specialisation and the division of labour will always benefit human welfare. Malthus,
however, had a gloomy outlook on humanity's future (Blanco, 2020). It is measurable that one of the main components of production is land. In many cases, the construction of highways, factories, and other structures has reduced the amount of land that can be used for agriculture. Malthus believed that in order to meet human needs, the population of humans increased significantly faster than agricultural production. Malthus thought that population control was required because he did not think that technology could grow more quickly than the population. This is a moral constraint, according to Malthus (Zhou *et al*., 2021). Classical economic theory states that an economy based on market power equilibrium will always be reached by the mechanism. All available resources, including labour, will be fully utilised in a balanced posture. Therefore, unemployment does not exist in a system that is based on market dynamics. If there are no jobs, people will rather labour for less money than not get paid at all.

Employers will be encouraged to hire more of these people because of their willingness to take a lower salary (Kretschmer *et al*., 2022). A critique of the classical system by John Maynard Keynes was that it lacked an automatic adjustment mechanism that would guarantee the economy would reach equilibrium at full employment. In reality, the labour market does not operate according to the traditional notion mentioned above.

Wage rates will be reduced wherever there is a labour union in order to safeguard the interests of the workforce (Dimand, 2020). The income level of the populace may decline even if the wage rate is reduced. People's purchasing power will decrease when some members of society experience a drop in income, which will ultimately lead to a loss in overall consumption levels.

3. Research methodology

a) Objectives of the study

- To identify the role of automation and AI in shaping the future of employment
- To identify which job sectors are most affected by automation.

b) Methods of data collection

This research will be carried out using a qualitative approach. Research data will be analysed using descriptive methods. The data used in this research are derived from mixed results of previous studies and those that remain relevant to the content of this research.

c) Source of data collection

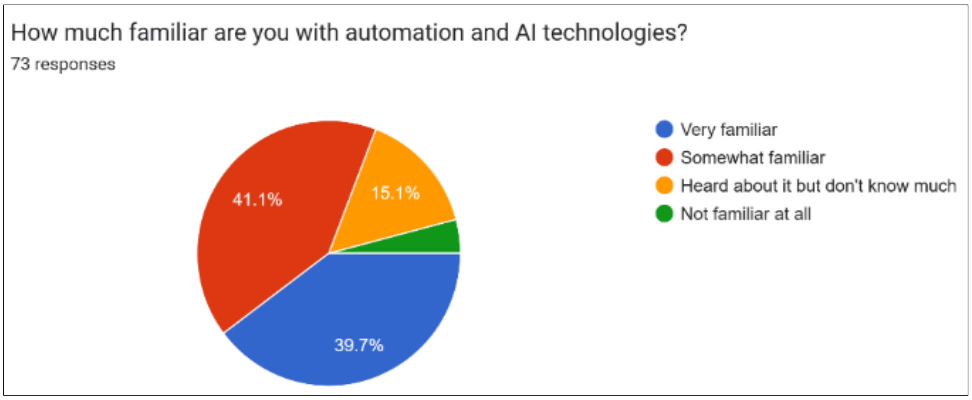
The research data was collected from primary sources, and we prepared a questionnaire consisting of 10 questions and 74 responses.

d) The following are sample Questions

- Name?
- Email ID
- Occupation?
- Industry/ Field of work?
- How familiar are you with automation and AI technologies?
- Do you believe AI and automation will significantly affect your industry in the next 5–10 years?
- In your opinion, what is the biggest benefit of AI in the workplace?
- Which skills do you believe will be the most valuable in an AI-powered future?
- Which job sectors are most affected by automation?
- Do you believe that AI will create more jobs than it eliminates in the long term?

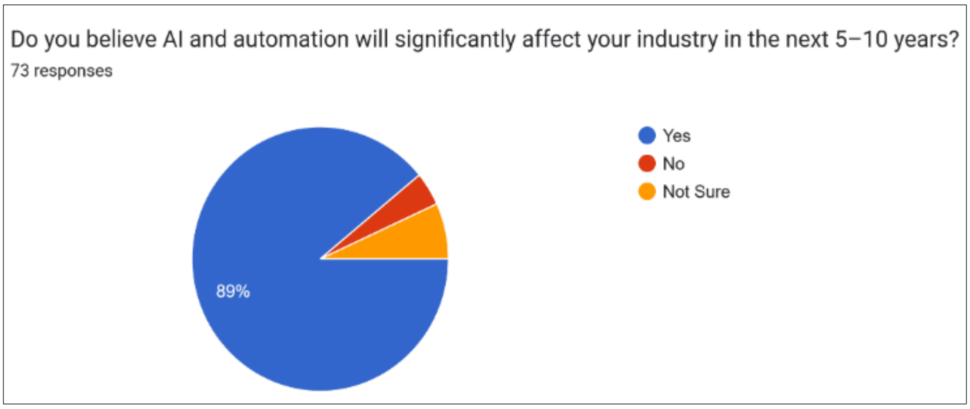
4. Data collection (Responses to the questionnaire)

A) How familiar are you with automation and AI technologies?



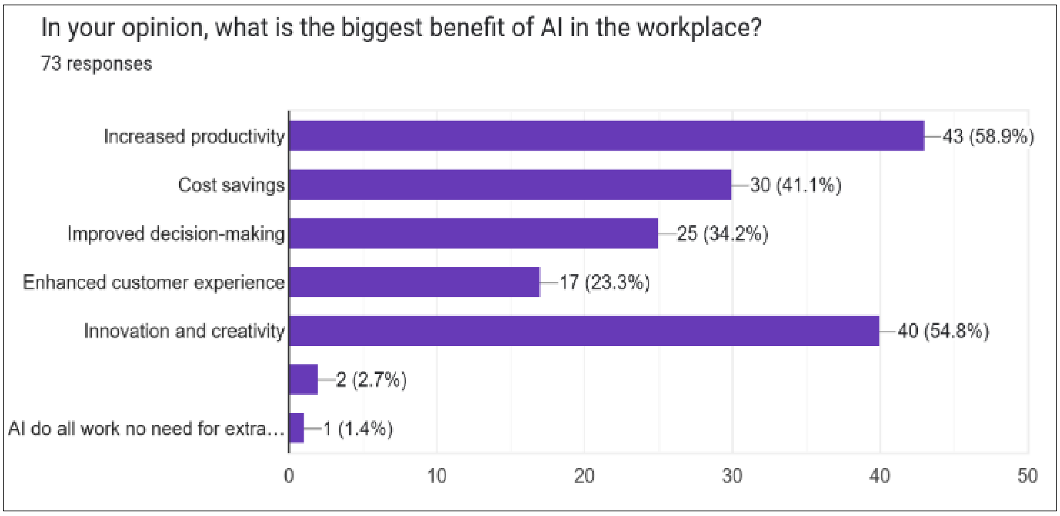
Available online at: https://forms.gle/TBkaWGZi6TSyBeHn7

B) Do you believe AI and automation will significantly affect your industry in the next 5–10 years?



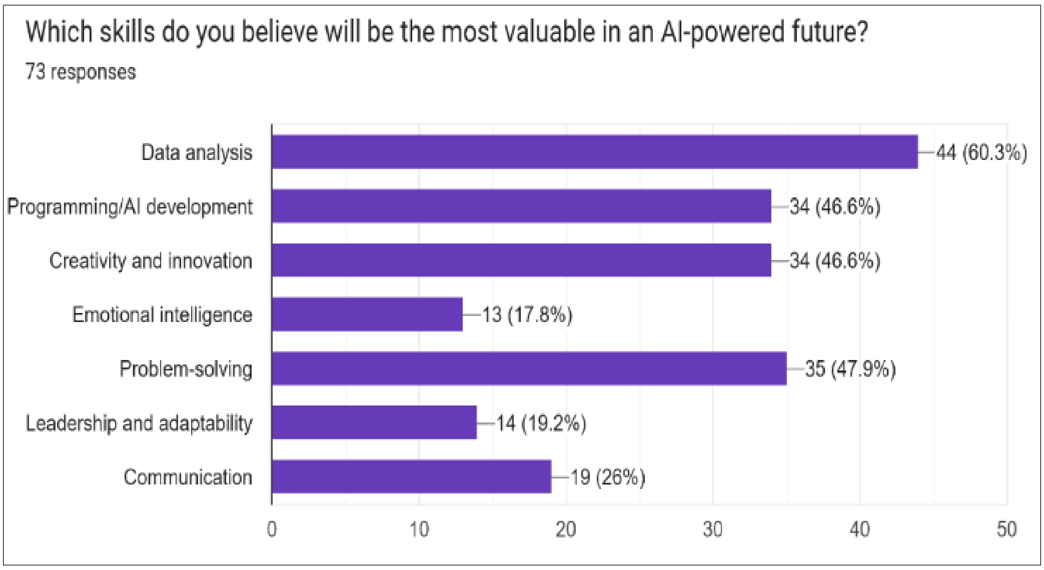
Available online at: https://forms.gle/TBkaWGZi6TSyBeHn7

C) In your opinion, what is the biggest benefit of AI in the workplace?



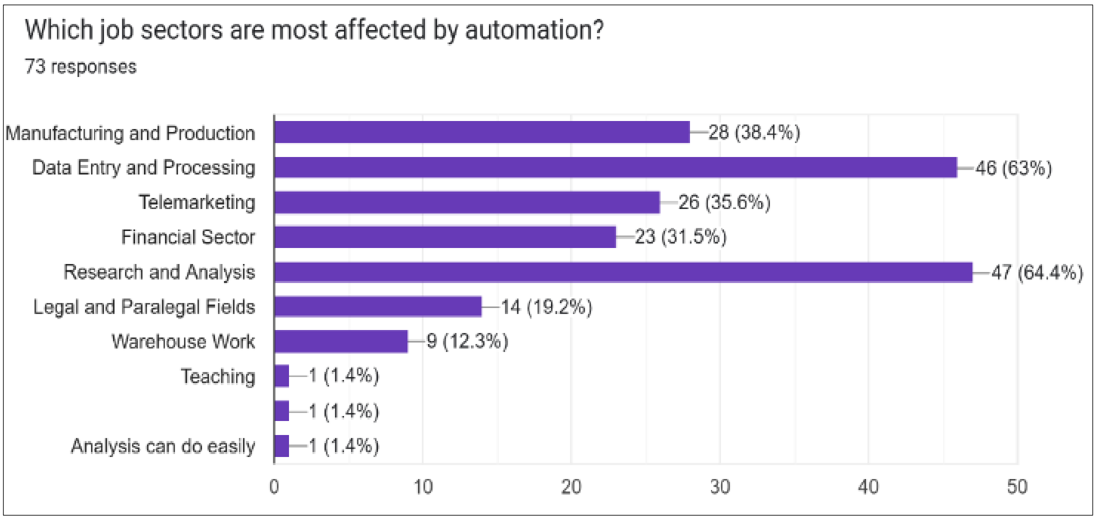
Available online at: https://forms.gle/TBkaWGZi6TSyBeHn7

D) Which skills do you believe will be the most valuable in an AI-powered future?



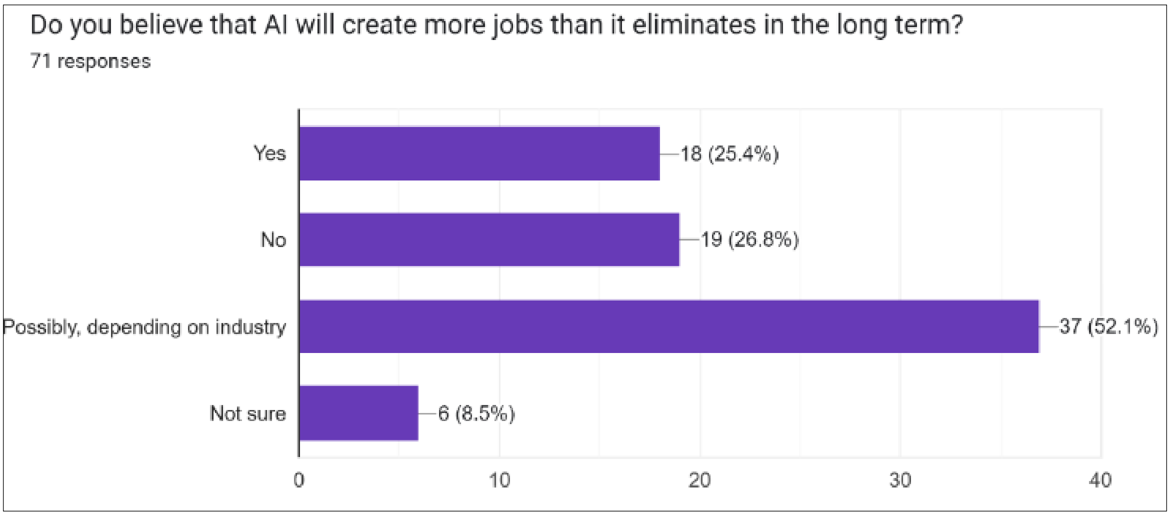
Available online at: https://forms.gle/TBkaWGZi6TSyBeHn7

E) Which job sectors are most affected by automation?



Available online at: https://forms.gle/TBkaWGZi6TSyBeHn7

F) Do you believe that AI will create more jobs than it eliminates in the long term?



Available online at: https://forms.gle/TBkaWGZi6TSyBeHn7

5. Data analysis and its interpretation

- Roughly 40% of respondents are very familiar with AI/automation, and 41% are somewhat familiar—combined, over 80% have at least basic familiarity, while just around 15% have heard of it but don't know much, and ~4% are not familiar at all.
- A strong majority (89%) expect AI and automation to significantly impact their industry in the next 5–10 years, with only a small minority unsure or unconvinced.
- The most cited workplace benefit of AI is increased productivity (58.9%), closely followed by innovation and creativity (54.8%).
- Other perceived benefits include cost savings (41.1%), improved decision-making (34.2%), and enhanced customer experience (23.3%).
- Looking ahead, data analysis is seen as the most valuable skill (60.3%), followed by problem-solving (47.9%), programming/AI development, and creativity/innovation (both ~46.6%).
- Communication skills are considered important by a smaller share (~26%).
- Job sectors viewed as most affected by automation include legal/paralegal fields (64.4%), research & analysis (also ~64.4%), and data entry & processing (63%).
- Others like manufacturing (38.4%) and telemarketing (35.6%) are also flagged, whereas teaching and warehouse roles are much less mentioned.
- On whether AI will create more jobs than it eliminates, 52.1% say "possibly, depending on industry," while 26.8% say no, and 25.4% say yes, with about 8.5% unsure.

5.1 Automation

The purpose of Automation is to get the monotonous and repetitive tasks done by machines which also improves productivity and results in cost-effective and more efficient results. Many organizations use machine learning, neural networks, and graphs in automation. Such automation can prevent fraud issues in financial transactions online by using technology.

6. Conclusion and Recommendations

I. Conclusion

High awareness of AI, a vast majority of respondents (over 80%) are familiar with AI and automation—either very or somewhat familiar—indicating strong baseline awareness in the workforce. Strong expectation of Industry disruption, nearly 9 in 10 believe their industry will be significantly impacted within the next 5 to 10 years, reflecting wide anticipation of change. Primary Benefits: Productivity & Innovation enhanced productivity (59%) and boosted innovation/creativity (55%) are viewed as the leading advantages of integrating AI into workplace processes. Valued Skills for the Future Data analysis tops the list of future-critical skills (60%), followed closely by problem-solving, programming/AI development, and creative thinking, highlighting demand for both technical and creative competencies. Automation Risk Concentrated in Specific Sectors Legal/paralegal roles, research & analysis, and data entry/processing are perceived to be most vulnerable (~63–64% citing risk), with manufacturing and telemarketing also flagged, but less so. Job Creation Outlook Is Mixed. Just over half (~52%) believe AI's impact on jobs will vary by industry, while opinions are split among those who feel AI will either create more jobs (25%) or eliminate them (27%), indicating uncertainty about net employment effects.

While respondents see AI as a powerful catalyst for efficiency and creativity, they also recognize that job-related risks and opportunities will differ across fields. Emphasizing data literacy, adaptability, programming fluency, and creative problem-solving is essential for navigating this evolving landscape.

II. Recommendations

Launch Targeted Upskilling and Reskilling Programs. Provide training in data analysis, programming/AI development, and digital literacy, supporting the ~60% of respondents who see data and tech skills as essential. Focus on Human-Centric Soft Skills: Develop creativity, emotional intelligence, communication, adaptability, and problem-solving, which respondents value highly (up to ~47%) and which AI cannot easily replicate. Address Job Displacement Risks Since roles like data entry, legal/research, and routine processing are seen as most vulnerable (~63–64%) reinforce pathways into higher-value functions or entirely new roles through role redesign and mobility. Cultivate a Culture of Continuous Learning. Encourage lifelong learning and curiosity (as Bill Gates advocates) through micro-learning, mentorships, and reverse mentoring—especially to ease concern over job obsolescence or FOBO. Embed AI Literacy and Tool Adoption. Familiarize employees with basic AI tools and workflows—like KPMG's internal training—so they can work with AI rather than fear it, boosting productivity and innovation. Communicate Strategy and Purpose Share a clear vision about how AI will augment roles rather than replace them, alleviating anxiety and promoting trust within the workforce. Build Ethical Oversight and Governance Ensure ethical frameworks and accountability mechanisms are in place to govern AI use responsibly and maintain worker wellbeing and trust.

Plan Workforce Transition Strategically Recognize that job displacement and creation vary by sector. Facilitate redeployment opportunities and partner with educational institutions or government initiatives to support transitions. Given widespread familiarity and belief in AI's potential, organizations should leverage these perceptions through proactive training, transparent communication, and robust human–AI collaboration strategies. This ensures the workforce can thrive in roles where uniquely human qualities like creativity and judgment add the most value.

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Innovative sustainability: employing eco-friendly paints and packaging to transform fashion

Amarpreet Kaur
Assistant Professor, Department of Fashion Design, Chandigarh School of Business, Chandigarh Group of Colleges, Jhanjeri, Mohali, Punjab, India
*Corresponding Author: Amarpreet Kaur
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Abstract
The fashion industry is one of the primary causes of environmental degradation, characterized by high waste, a significant carbon footprint, and the use of high levels of toxic chemicals in the manufacturing process. With sustainability becoming increasingly important, innovations like green packaging and sustainable paints are emerging as the industry's primary solutions to minimize its environmental footprint. This paper examines the potential of these innovations to reduce the environmental footprint of the fashion industry. Green packaging, composed of biodegradable, recyclable, and low-waste materials, presents a potential alternative to conventional plastic-based packaging that contributes to global pollution. Sustainable paints, developed from non-toxic, natural, or green sources, are replacing the toxic chemicals used in the dyeing and finishing processes. These substitutes have the potential to reduce waste and chemical pollution, while also increasing the industry's focus on sustainability.
Using a mixed-methods approach, the research combines an extensive literature review with case studies of fashion businesses that adopt green packaging and eco-friendly paints. Key findings reveal that while environmentally friendly paints and green packaging are on the rise, cost, scalability, and consumer education remain chief issues. However, businesses using them are reaping improved image, zero environmental damage, and loyal consumers. The implication is that increased adoption of such innovation can potentially reduce the environmental impact of the fashion industry by a considerable amount and trigger more widespread industry-wide reform towards sustainability.

Keywords: Green packaging, Sustainable paints, Fashion industry, Environmental impact, Circular economy, Eco-friendly materials, Sustainable dyes

Introduction
The fashion industry is one of the most significant and most environmentally damaging sectors, contributing significantly to global waste, carbon footprint, and resource consumption. Sustainability is now a driving force in all industries, prompting them to adopt greener practices. The two most essential sectors for change are packaging and the materials used for production.
Moreover, Green packaging and eco-friendly paints are becoming increasingly effective solutions to mitigate the environmental impact of the fashion industry. The biodegradable, recyclable, and low-waste material is a substitute for plastic-based packaging, which is notorious for polluting the environment. Similarly, eco-friendly paints made from natural or non-toxic materials are now popular as an alternative to the toxic chemicals typically used in fabric finishes. These devices have the capability of significantly reducing the carbon footprint of fashion products while enhancing overall environmental sustainability.
This paper explores the potential of green packaging and green paints to transform the environmental strategies of the fashion industry. The two most important areas are now more focused; this helps the individual identify environmental benefits and issues on a mass scale. Through this, we will explore ways to reduce the carbon footprint in the fashion industry and create a greener, more sustainable future in fashion.

Literature review
Fashion is among the most significant contributors to global environmental pollution, with packaging and production chemicals significantly contributing to its ecological footprint. Green packaging and eco-friendly paints have thus become critical solutions to mitigate these environmental issues. Green packaging refers to the use of materials that are less wasteful and less harmful to the environment, including biodegradable, recyclable, or compostable options that replace regular plastic. As Ritch (2019) [9] indicates, green packaging technologies such as plant-based plastics and water-soluble films have become increasingly popular as alternatives to conventional non-biodegradable plastic packaging, which pollutes the world. Companies like Stella McCartney and Patagonia have successfully incorporated these substitutes into their supply chains, underscoring the growing viability of sustainable packaging (Koch, Nussbaumer, & Sutherland, 2021) [8].
Similarly, eco-friendly paints, which consist of natural pigments, plant-based dyes, and water-based, non-toxic

formulations, are replacing the hazardous chemical dyes that have long been used in textile finishing. Fletcher and Tham (2014) [6] note that conventional synthetic dyes contain toxic chemicals, including formaldehyde and heavy metals, which are detrimental to both human health and the environment. Sustainable paints, however, minimize chemical runoff and water usage, providing a more environmentally friendly choice. Eco Enclose (2020) [1] demonstrates how sustainable fashion brands are incorporating plant-based dyes and water-based finishes, which significantly reduce their environmental footprint. However, there are challenges, especially in terms of cost and scalability of the solutions. The high cost of production and scarcity of sustainable packaging and paints often make it difficult to achieve mass adoption. However, increasing consumer demand for sustainability is pushing the pace (Joy, Sherry, Venkatesh, Wang, & Chan, 2012) [7]—The Impact of Conventional Paints on the Environment in Fashion.

Green packaging in fashion

Current trends in fashion packaging

The green packaging plays a vital role in mitigating the pollution increase caused by the packaging used in the market for fashion products. As we are all aware, the traditional and classical method of making fashion packaging, which often consists of plastic and non-biodegradable materials, contributes to the accumulation of waste and creates pollution. Nowadays, to achieve sustainable goals, industries are using biodegradable materials to create new packaging, such as leaves, cornstarch, mushrooms, and seaweed. These types of products are biodegradable and help eliminate landfill waste. For example, Stella McCartney's plant-based material is used to create the new packaging, promoting sustainable practices.

However, the new trend is recyclable packaging, in which they may use recycled paper, sun boards, and recycled plastic. They use the term the packaging has come under the recycling and upcycling process. Companies like Patagonia and Adidas are at the forefront of using this process to create their brand packaging, which falls under the categories of recycling and upcycling.

In addition to this, compostable packaging is being used by brands like Puma, which provides packaging that is both safe and considered waste-free. Thus, these kinds of initiatives taken by the big brands for sustainable packaging are the best steps for sustainable practices.

Case studies on sustainable paints and green packaging in the fashion industry

Stella McCartney—Sustainable Paints and Packaging: Brands like Stella McCartney are at the forefront of sustainable fashion. They are working on sustainable packaging and dyes so that they can contribute to reducing pollution at a global level. The company's workers are also giving their 100% effort, proceeding with the development of new products through recycling processes, such as those for paperboard and cardboard. Moreover, MC Cartney avoids using synthetic products to produce new products; instead, they also approach natural products for dyes, such as turmeric and indigo flower-based colors. They also incorporated biodegradable elements into their design to establish themselves as the label for the most sustainable products, thereby contributing to the achievement of sustainability. (McCartney, 2019) [3]. Not only this, but the study of the company also shows that they use water-based colors, dyes, and packaging, and avoid chemical usage. So that they may produce environmentally friendly products, such as clothing, packaging, and dyes, and then come under the marathon to achieve their sustainable goals.

Patagonia - green packaging and natural dyes

In terms of packaging, brands like Patagonia are on the right track to create sustainable products, utilizing natural dyes and eco-friendly materials. The approach to sustainable achievement: Companies' employees also use recycled materials to produce products, such as garment bags. Cutting down the waste. However, the company also utilized biodegradable and recyclable products, including bioplastics. Patagonia is also working on reducing its environmental impact by using sustainable paints, such as natural dyes, in its fabric lines. For example, the Patagonia company uses plant-based dyes to avoid synthetic and toxic paints (Patagonia, 2020) [4]. This is the actual company's approach to achieving sustainability and a good environment.

Reformation - plant-based dyes and packaging

To create sustainable and eco-friendly packaging, the Reformation company, which is committed to green efforts, has introduced green packaging and organic paints into its operations. They used sustainable packaging to ship their orders. The use of fruits and vegetables includes making the packaging and dyes sustainable. They are always welcoming to natural-based products to avoid synthetic dyes and materials. These kinds of initiatives, taken by the brand, have only reached the target of sustainability and also aim to secure a spot on the top brand list with sustainable products (Reformation, 2020) [5]. Due to this kind of work, Reformation has garnered positive customer reviews, with a focus on sustainability.

Eco enclose

The solution for eco-friendly packaging: The name of a big brand in the packaging that is working for wrapped and packaged in the fashion sector is also taking lots and lots of steps to achieve sustainability through the packaging, as the company knows the packaging plays a vital role in the marketing where they may sell their products process through, also stopping to the polluting the environment. That is the primary reason these types of packaging brands are also working on sustainability and adopting practices such as recyclability and recycling processes. However, it is not the clothing brand. The company Eco Enclose is recognized for manufacturing 100% biodegradable packaging. After offering eco-friendly packaging, they also influence and help big brands like Reformation and Patagonia to adopt more sustainable practices (Eco Enclose, 2020) [1].

H&M conscious collection

The brand, like H&M, used water-based and plant-based dyes for its clothing line. The initiatives taken by H&M for their Conscious Collection have utilized sustainable materials and green packaging. Avoiding chemical usage while making conscious choices can make achieving suitability not that tough. The collaboration between Ellen MacArthur and H&M has set the fashion industry on a sustainable path, resulting in a collection that is conscious of its impact. These initiatives taken by big brands may lead to the adoption of sustainable practices. They also encourage the large audience to adopt these practices after using their products, such as eco-friendly packaging and the dyeing methods they employ (H&M Group, 2020) [2].

Impact on the fashion industry

Big names and brands like Stella McCartney, Patagonia, and Adidas are competing in the global market, where they are all adopting sustainable practices by creating new eco-friendly packaging and dyes. As they are aware, the fashion industry is the largest producer of pollution, generating massive amounts every day. They follow methodologies known for their sustainable practices, such as recyclability and upcycling, to create biodegradable products—the plant-based dyes and flower colors they use as alternatives to chemical-based ones. Although there are challenges, such as increased costs, these innovations complement the growing demand from consumers for sustainability, enabling brands to reduce their carbon footprint and improve their ethical standards.

Current trends in sustainable paints

Instead of using toxic chemicals, the fashion industry is embracing the adoption of sustainable paints, which continues to gain acceptance. These paints are made from natural pigments, plant extracts, and water-based materials, offering environmentally friendly alternatives to synthetic and heavy metal-based paints. These natural dyes are made with henna and turmeric, which are biodegradable and less damaging to the environment. This type of paint is not only beneficial for production, but also reduces water pollution.

The water bodies are polluted with wastewater, and its solvent mixtures enter the entire water; ultimately, this affects the entire aquatic life and poses difficulties for human survival. The wastage of paints and water is primarily attributed to the textile industry's inability to effectively purify them. This is the most critical aspect of reducing the water level. Instead of these activities, the textile industry focuses on sustainable finishing practices through various methodologies, such as recyclability and up cyclability, while also prioritizing biodegradable materials and products. Due to pressure from consumers and government bodies, a growing focus on sustainable fashion trends suggests adopting green manufacturing methods to achieve sustainable practices.

Challenges of traditional dyeing and painting processes

- **Environmental pollution –** As the population of the country increased day by day, companies became dependent on chemical products to meet the needs of consumers, and they produced chemical-based materials and products. The chemical-based colors used by industries are disposed of in the drainage system, and such activities pollute the entire water body. Additionally, it damages aquatic life (Fletcher & Tham, 2014) [6].
- **High water use**—The textile industry uses vast amounts of water to color the fabric, and once used, they throw the color into the rivers. The high-water use in the industry is that the water required is around 5 liters; instead of using less water, they use 15 liters. These kinds of activists directly reduce the water level, and the industry is unable to purify this kind of colored water for reuse (Allwood et al., 2006).
- **Chemical wastewater disposal:** The disposal of the wastewater from the dyeing procedures is a problem of great importance. The wastewater typically consists of toxic chemicals, dyes, and detergents that, if improperly disposed of, can enter the surrounding water systems, causing permanent ecological harm. Textile businesses also lack the infrastructure to treat the wastewater properly.
- **Energy-intensive processes:** Conventional techniques such as dyeing and painting are energy-intensive, particularly if heated water is used in the process. This adds to the overall carbon footprint of the fashion sector. The processes predominantly use fossil fuels, contributing to the industry's environmental footprint.

Toxicity and health hazards: The chemical substances used in traditional dyeing and painting can be harmful to the health of workers, potentially leading to respiratory issues, skin irritation, and chronic diseases due to prolonged exposure to hazardous chemicals. This raises ethical concerns regarding the safety of workers in the fashion sector.

Green packaging solutions

Green packaging involves the use of sustainable materials and methods that reduce the overall environmental impact.

Key sustainable packaging solutions adopted by fashion brands include:

- **Biodegradable and Compostable Packaging:** Biodegradable and compostable packaging, including cornstarch bags, mushroom packaging, and cellulose film, reduces waste and pollution. Stella McCartney has used biodegradable packaging to minimize landfill waste.
- **Recycled materials:** Most companies today utilize recycled material packaging, i.e., plastic and cardboard, which assists in closing the packaging manufacturing loop. For example, Adidas produces packaging from 100% recycled polyester, which helps in curbing the use of virgin materials.
- **Minimalist packaging:** Another area of sustainable packaging is reducing the quantity of packaging in general. Patagonia and Everlane are two companies that have adopted minimalist packaging models, removing

unnecessary packaging elements to reduce waste significantly.
- **Circular packaging models:** Circular packaging involves models where packaging is reused or recycled and brought back, resulting in a sustainable product lifecycle.

For example, fashion store H&M has a recycling initiative where customers bring used clothes and packaging to receive rewards in the form of discounts and incentives for recycling.

Green paint solutions
- **Low-VOC (Volatile Organic Compounds) and No-VOC paints:** Low-harm-chemical-containing paints that enhance air quality by releasing fewer toxic chemicals. Advantages: Healthier indoor air, improved air quality, and reduced pollution.
- **Water-based paints:** Substituting solvent-based paints with water-based paints minimizes the emission of toxic chemicals.
- **Natural paints:** Constructed from plant or mineral-derived pigments along with organic items such as linseed oil and beeswax. These paints are biodegradable and non-toxic.
- **Recycled paint:** Paint produced from reclaimed or reused paint minimizes waste and saves resources.

Conclusion

The use of green packaging and eco-friendly paints within the fashion sector represents a significant step towards reducing the environmental footprint of clothing production and distribution. In the case studies of Patagonia, Stella McCartney, Reformation, and H&M Conscious Collection, it is evident that top fashion houses are incorporating environmentally friendly packaging and sustainable dyeing technologies into their sustainability initiatives. Patagonia's use of 100% recycled paper and Stella McCartney's implementation of biodegradable packaging demonstrate the potential to minimize waste. Reformation and H&M have also utilized eco-friendly paints and dyes to prevent the use of toxic chemicals in the garment creation process.

Emerging trends indicate a growing shift towards natural colorants, vegetable-based paints, and water-based solutions, which minimize water usage and pollution. With increasing demand from consumers for sustainable and ethical fashion, even more brands are expected to adopt these green options, promoting a circular fashion economy. Nevertheless, the industry remains challenged, specifically regarding the scalability and affordability of such green solutions. The prohibitive costs of natural paints and sustainable packaging, along with the color limitations and technical challenges associated with using natural dyes, currently hinder their mass adoption.

However, green packaging and eco-friendly paint offer real solutions to the environmental issues confronting the fashion sector. Through waste reduction, chemical contamination mitigation, and resource conservation, these technologies help create a greener future while demonstrating the fashion sector's ability to lead the way in sustainability. As the approach gains popularity, the industry is set for a paradigm shift towards a circular, environmentally friendly model.

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The role of green finance in achieving inclusive and sustainable economic growth: a systematic review

Amit Yadav[1*], Dr. Suniti Chandiok[2] and Dr. Aparna Mishra[3]

[1] Assistant Professor, Banarsidas Chandiwala Institute of Professional Studies, Delhi, India

[2] Associate Professor, Banarsidas Chandiwala Institute of Professional Studies, Delhi, India

[3] Director, Banarsidas Chandiwala Institute of Professional Studies, Delhi, India

*Corresponding Author: Amit Yadav

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Abstract

In order to combat climate change and advance environmental sustainability, green financing has become a crucial tool. Investigating how green finance contributes to equitable and sustainable economic growth is the goal of this systematic review. Key topics, trends, difficulties, and policy recommendations are identified in this analysis by examining a variety of peer-reviewed articles, policy papers, and institutional reports published between 2018 and 2024. Green finance promotes equitable growth, helps create jobs in green industries, and eases the shift to low-carbon economies, according to research. But obstacles still exist, including a lack of standards, restricted access in developing nations, and regulatory gaps.

Keywords: Green finance, Inclusive growth, Sustainable economic growth, ESG investing, Financial inclusion

Introduction

Economic growth, environmental sustainability, and social inclusion are interrelated aims that have been more prominent in academic, financial, and governmental debates worldwide in recent years. An important turning point in the global development agenda was the adoption of the Sustainable Development Goals (SDGs) by the United Nations in 2015, which called on countries to move toward inclusive and ecologically sustainable economic models. Green finance has become an essential instrument for accomplishing these two objectives in this setting. Financial contributions made toward programs and projects that support environmental sustainability, lower carbon emissions, and preserve natural resources are referred to as "green finance." Green bonds, green loans, climate funds, ESG (Environmental, Social, and Governance) investments, and green banking practices are a few examples of these. Despite its historical emphasis on environmental results, green finance is becoming more widely acknowledged for its capacity to produce a wide range of economic advantages, such as the creation of jobs, the reduction of poverty, and enhanced access to clean energy and infrastructure, particularly in underdeveloped and developing nations.

Simultaneously, it has become imperative to prioritize inclusive economic growth that guarantees equitable opportunities and benefits for all societal segments. Green finance creates opportunities for equitable development, especially for underserved communities, by directing funds toward climate-resilient industries including clean transportation, sustainable agriculture, and renewable energy. The connection between green finance and inclusive, sustainable growth is still poorly understood and dispersed in the literature, despite its increasing importance. By conducting a thorough analysis of previous academic research and institutional reports, this paper aims to close that gap by spotting trends, evaluating efficacy, and suggesting future paths for practice and policy.

Objectives of the study

- To assess the contribution of green finance to sustainable economic development.
- To identify key challenges and policy recommendations for enhancing green finance.
- To assess its contribution to inclusive growth.

Literature review

Green financing has developed into a crucial tool for nations looking to attain sustainable growth without sacrificing equality. In the past five years (2020–2025), experts from India and other countries have made important advances in our knowledge of the relationship between green finance, equitable growth, and sustainable economic change. In order to provide a comprehensive picture of the changing discourse, this literature review pulls from a wide range of research.

A. Indian perspectives on green finance and inclusive growth

India, with its dual challenges of rapid economic development and environmental sustainability, has become a vibrant ground for green finance experimentation and research.

Das and Mukherjee (2023) [7], in *"Green Banking in India: A Catalyst for Sustainable and Inclusive Development"*, emphasised the growing role of Indian banks in mainstreaming environmental risk assessments and introducing green credit lines. According to their research, targeted green funding has significantly improved sustainable agriculture, job creation in renewable industries, and rural energy access.

Roy and Sharma (2024) [15] explored gendered dimensions of green finance in *"Green Microfinance and Women Empowerment: A Study in South Asia"*. Their field study revealed a strong correlation between gender inclusion and green finance, showing that women's access to microloans for clean energy products such as biogas, solar lanterns, and clean cookstoves not only improves environmental outcomes but also increases women's agency, decision-making, and income-generation capabilities.

A study published in *Sustainability (2021)*, with Indian co-authors, examined green finance as a driver of SDGs, especially those related to poverty (SDG 1), clean energy (SDG 7), and climate action (SDG 13). However, it warned that without deliberate measures to include marginalised groups, green finance initiatives risk reinforcing existing inequalities.

Singh and Sharma (2024) [16] conducted an in-depth review titled *"Green Finance Instruments and Economic Development in Emerging Economies"*. They came to the conclusion that clean technology innovation and GDP are positively impacted by financial instruments such as green bonds and ESG-linked investments. However, they also identified some significant obstacles, including inconsistent regulations, a dearth of standard taxonomies, and restricted financing availability in India's rural and informal sectors.

Chakraborty et al. (2025) [3] made a significant methodological contribution through their development of the Inclusive Green Finance Index (IGFI) for BRICS and other emerging economies. This index integrated three key metrics green finance availability, financial inclusion, and green innovation capacity allowing for meaningful cross-country comparisons. Their results highlight the necessity of designing policies holistically, taking impact, affordability, and accessibility into account.

Further, Kumar and Jain (2025) [10] in *"Green Finance in the Global South: Bridging the Inclusion Gap"*, argued that although financial access in India has grown through digital banking and microfinance, green finance remains underpenetrated in Tier-2 and Tier-3 cities. They stressed the importance of blending digital tools with localised governance and environmental education to ensure inclusive green growth.

B. Foreign contributions to the green finance discourse

The potential of green finance to be a transformative force for equitable and sustainable prosperity in different places has been thoroughly examined by international experts.

Zhou et al. (2020) [22], in their widely cited study *"Green Finance and Sustainable Development Goals: Evidence from China"*, analyzed the impact of green credit on provinces with low incomes. They discovered that by directing investments toward greener manufacturing and cleaner infrastructure, green finance tools supported inclusive growth and regional development.

Chen and Li (2021) [5] extended this argument in *"Green Finance, Financial Development and Economic Growth"*, where they studied a panel of emerging markets. Their econometric analysis showed that when backed by strong financial institutions, green finance flows greatly improve environmental quality and economic growth. However, they issued a warning that unless supported by grassroots inclusion methods, top-down cash flows may overlook bottom-tier recipients.

Banga (2021) [1] offered a comprehensive evaluation in *"The Green Bond Market: A Potential Source of Climate Finance for Developing Countries"*. According to her research, green bonds are a valuable way to finance environmentally friendly projects, but they are still mostly found in high-income markets because of a lack of mechanisms for enhancing credit and low investor confidence in developing countries.

Taghizadeh-Hesary and Yoshino (2021) [19], focusing on Asia, underlined in their paper *"The Way to a Green Asia"* the importance of green SMEs and micro-lending schemes. They demonstrated that inclusive green finance policies targeting small and medium enterprises (SMEs) significantly enhance employment, reduce emissions, and promote clean energy transitions in developing Asian economies.

Kuzemko et al. (2022) [11] in *"Climate Finance for Inclusive Growth: Toward Transformative Pathways"* made a critical contribution by emphasizing that green finance must go beyond carbon targets and integrate employment, welfare, and equity as key performance indicators. They proposed a “just transition” framework that merges climate action with social protection systems.

Cheng et al. (2022) [6], in a multi-country analysis *"Does Green Finance Improve Environmental and Social Outcomes?"*, concluded that while green finance reduced carbon intensity, its success was amplified when paired with public accountability mechanisms and stakeholder participation particularly in low-income areas.

Wang and Sun (2023) [21], studying G20 nations in *"Green Finance, Technological Innovation and Sustainable Growth"*, found that inclusive innovation funding models such as clean tech grants for startups and community-based energy projects significantly improved outcomes in employment, health, and carbon reduction.

Rahman and Barua (2024) [13] examined the financial inclusion–green growth nexus in their study across 12 developing countries between 2004 and 2023. According to their findings, financial inclusion by itself has little effect unless it is specifically linked with sustainability objectives, whereas green innovation and foreign direct investment (FDI) greatly boost green economic growth. For significant change, they advise matching credit programs to environmental standards.

International Monetary Fund (2024) [9] published a strategic report *"Green Finance and Inclusive Recovery Post-COVID"*, which argued for national green finance strategies incorporating climate disclosures, standardized taxonomies, and green project pipelines. The report emphasized multilateral cooperation and capacity-building as prerequisites for inclusive impact.

The OECD (2022) [12] echoed similar sentiments in *"Green Finance and Investment: Mobilising Capital for Green and Inclusive Growth"*, advocating for harmonized regulations and tax incentives to attract private capital toward low-income and underserved sectors.

Lastly, UNEP FI (2023) [20] in *"Building Inclusive Green Financial Systems"*, presented case studies where digital green finance tools such as mobile green loans and carbon credit micro-payments enabled financial inclusion for farmers and informal workers in Southeast Asia and sub-Saharan Africa.

Although green finance is a potent force for sustainability, it must be purposefully created to guarantee inclusivity, according to the examined literature from both Indian and foreign academics. The necessity of integrated regulatory frameworks, technical and digital innovation, and localized access to green capital are important topics that show up in all of the studies.

Indian researchers have particularly focused on challenges like rural credit access, green microfinance, and gender empowerment, while foreign scholars have contributed frameworks for just transitions, green innovation, and global financial architecture reforms. The convergence of these ideas highlights that green finance must simultaneously address economic, environmental, and social dimensions to be truly transformative. To realise its full potential, green finance must be embedded within robust regulatory frameworks, transparent ESG standards, and inclusive digital infrastructure, ensuring that sustainability is not a privilege but a shared developmental pathway.

Research methodology

This paper examines how green financing contributes to equitable and sustainable economic growth using a systematic review methodology. This evaluation adheres to PRISMA criteria to guarantee a methodical, transparent, and repeatable methodology. It is qualitative and based on secondary data gathered from institutional reports, policy papers, and peer-reviewed journals that were published between 2018 and 2024. Reputable academic resources including Scopus, Web of Science, JSTOR, ScienceDirect, and Google Scholar were used to source the literature, as were international organizations like the World Bank, OECD, IMF, and UNEP. The criteria for inclusion were restricted to English-language publications that addressed green finance in relation to sustainable development or inclusive growth. Excluded were those that only addressed environmental science or engineering from an economic or financial standpoint.

Terms such as "green finance," "inclusive growth," "green bonds," "ESG investing," and "financial inclusion" were combined in keyword-based searches employing Boolean operators. Key focus areas for the thematic analysis of the chosen studies were financial inclusion, policy and regulatory frameworks, technological innovation, green financial instruments, ESG standards, and alignment with the Sustainable Development Goals (SDGs). The qualitative research was supplemented by quantitative data from institutional sources that covered geographical inequities, sectoral allocations, and trends in green financing flows. Additionally, the study uses a comparative lens to show how Indian and global ideas on green finance differ and are similar. By prioritizing peer-reviewed and institutionally validated resources and triangulating data sources, validity and dependability were guaranteed. This approach made it possible to fully comprehend how green finance works as a socioeconomic and environmental instrument for equitable and sustainable development.

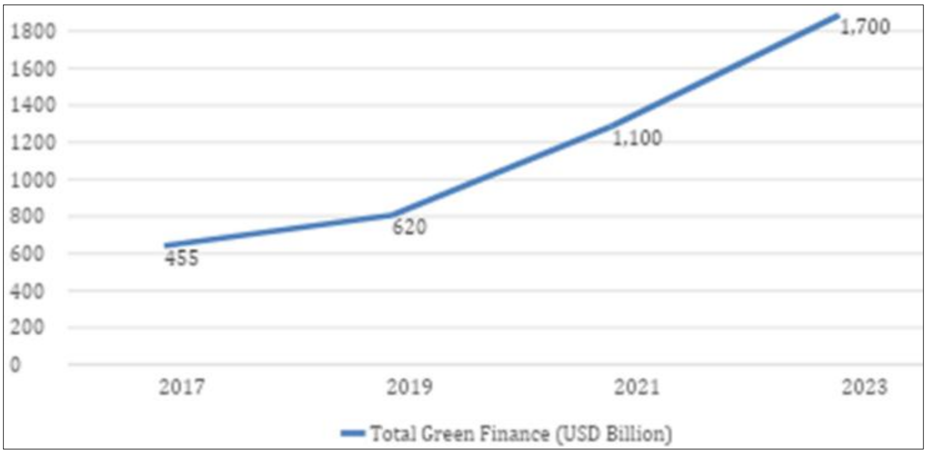
Data analysis

The analysis in this section is based primarily on secondary data sourced from reputed global institutions such as the Climate Policy Initiative (2024), OECD Green Finance Statistics (2024), and the International Capital Market Association (2024). The data highlights recent trends in global green finance flows, sector-wise allocation, and regional disparities in green bond issuance. The study intends to gain significant insights into the global trend toward sustainable finance and its consequences for inclusive economic development by analysing these statistics.

1. Trends in global green finance investments

Table 1: Trends in global green finance investments

S. No.	Year	Total Green Finance (USD Billion)
1	2017	455
2	2019	620
3	2021	1,100
4	2023	1,700



Source: Climate Policy Initiative (2024), Green Finance Flows Report

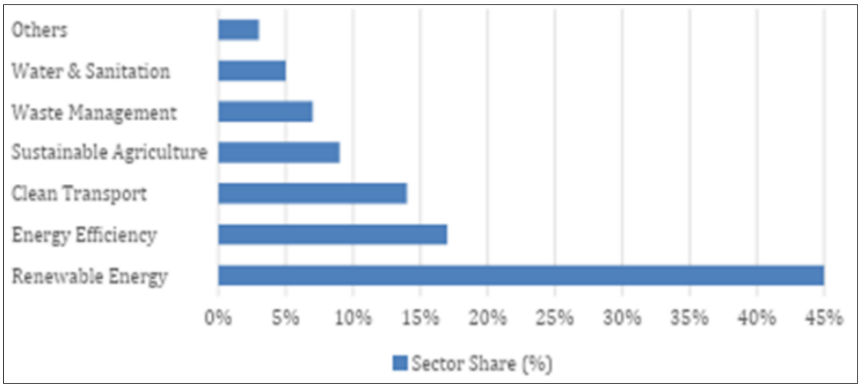
Interpretation

Green finance has seen a fivefold increase between 2017 and 2023, indicating growing global commitment to environmental and sustainable projects. This surge correlates with international policy interventions (e.g., Paris Agreement) and growing ESG investment mandates.

2. Sector-wise allocation of green finance

Table 2: Sector-wise allocation of green finance

S. No.	Sector	Share (%)
1	Renewable Energy	45%
2	Energy Efficiency	17%
3	Clean Transport	14%
4	Sustainable Agriculture	9%
5	Waste Management	7%
6	Water & Sanitation	5%
7	Others	3%



Source: OECD Green Finance Statistics (2024)

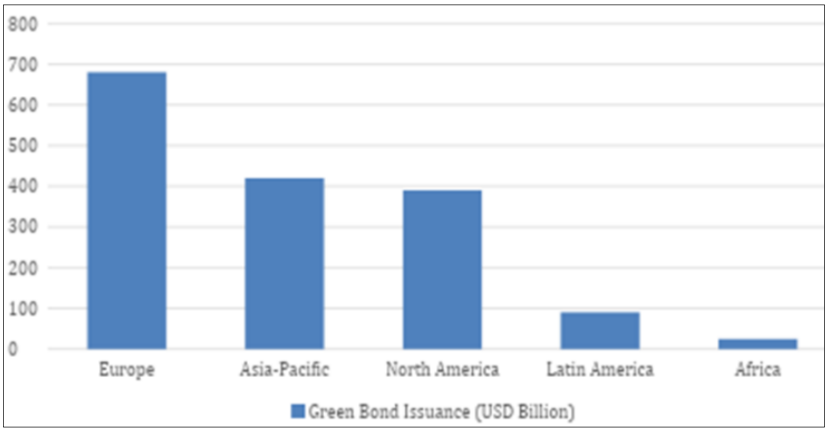
Interpretation

Nearly half of green finance in 2024 was directed toward renewable energy, reflecting its central role in sustainable economic strategies. However, lower shares for agriculture and water indicate potential underinvestment in areas critical for inclusive development.

3. Green bonds issuance by region (2024)

Table 3: Green bonds issuance by region

S. No.	Region	Green Bond Issuance (USD Billion)
1	Europe	680
2	Asia-Pacific	420
3	North America	390
4	Latin America	90
5	Africa	25



Source: International Capital Market Association (ICMA), Green Bond Report 2024

Interpretation

Europe remains the leader in green bond markets, but Asia-Pacific is rapidly closing the gap. The underrepresentation of Africa and Latin America underscores a regional disparity in green finance access, affecting inclusive growth prospects.

Findings and Discussion

With significant ramifications for employment, innovation, and environmental stewardship, the systematic analysis of literature, data trends, and institutional reports amply demonstrates the critical role that green financing plays in promoting sustainable economic growth. The beneficial effects of green finance on job creation, particularly in industries like energy efficiency and renewable energy, are among the most important discoveries. New job possibilities have resulted from investments in solar, wind, and clean transportation, demonstrating that shifting to a low-carbon economy can promote economic dynamism while achieving climate goals.

However, the review also brings attention to critical inclusion gaps. While green finance has successfully attracted funding toward energy and transport infrastructure, key sectors related to basic human needs—such as clean water, sanitation, sustainable agriculture, and food systems—remain underfinanced. This sectoral imbalance limits the broader developmental impact of green finance, especially in rural and marginalized regions where access to basic services is integral to inclusive growth. The role of institutional capacity emerged as another key determinant of inclusive outcomes. Countries with dedicated green financial institutions, such as national green banks, have demonstrated higher effectiveness in aligning green investments with social objectives. These institutions often act as intermediaries that bridge public and private financing, facilitate risk sharing, and promote innovative funding models tailored for developmental impact. Further, the review highlights significant regional disparities in green finance allocation. While developed regions such as Europe and parts of Asia-Pacific dominate green bond issuance and ESG investment flows, developing economies face high capital costs, limited project pipelines, and lower investor confidence. This leads to insufficient funding for climate-resilient infrastructure in areas such as parts of Latin America and Sub-Saharan Africa. As a result, the Global South continues to underutilize green finance's promise to support inclusive and fair economic development. These results highlight the need for a more comprehensive and equity-focused strategy to green finance, one that enhances socioeconomic inclusion while also promoting environmental objectives, particularly for marginalized communities and underdeveloped areas.

Policy recommendations

In light of the findings, the study presents a set of targeted policy recommendations to enhance the effectiveness and inclusivity of green finance frameworks:

a) **Diversify sectoral focus:** Green financial flows urgently need to be redirected away from massive renewable energy projects and toward underfunded but socially important fields like cheap green housing, smallholder agriculture, sanitation, and public health. These sectors have a direct bearing on poverty alleviation, food security, and human development, making them essential for truly inclusive green growth.

b) **Enhance access for the global south:** To bridge regional disparities, governments and international agencies must implement de-risking mechanisms such as blended finance models, first-loss guarantees, and credit enhancements to attract private investors to climate projects in developing countries. Additionally, fostering South-South cooperation, regional green funds, and technology transfer partnerships can empower low-income countries to develop resilient green finance ecosystems.

c) **Improve monitoring and metrics:** Current green finance metrics are predominantly focused on environmental performance (e.g., carbon reduction). Policymakers should develop a broader set of indicators that measure inclusive impacts, such as jobs created, poverty reduction, gender participation, and rural access to green infrastructure. Transparent, disaggregated data will support evidence-based policy adjustments and attract ESG-conscious investors.

d) **Promote financial literacy and inclusion:** For green finance to be truly inclusive, it must be accessible to marginalized groups, including women, rural entrepreneurs, informal workers, and micro-enterprises. In order for these groups to take part in and profit from green economic transformations, it is necessary to increase financial literacy, expand green microfinance, provide digital financial instruments, and implement capacity-building initiatives.

Conclusion

Green finance has become a potent tool at the nexus of environmental sustainability and economic growth. By directing investments toward low-carbon and climate-resilient industries like clean transportation, energy efficiency, and renewable energy, green financing clearly advances sustainable economic growth, according to this systematic study. But it has a significant potential to promote inclusive development by empowering neglected people, improving access to necessary services, and generating jobs. Its importance goes beyond its effects on the environment. Green finance and job creation, especially in the renewable energy sector, are strongly positively correlated, according to a review of data trends and available literature. Countries that have implemented robust green finance institutions and policy frameworks such as national green banks, clear taxonomies, and mandatory climate disclosures tend to experience more inclusive and equitable outcomes. These institutional arrangements play a critical role in attracting both public and private capital, ensuring better alignment of environmental goals with social priorities.

Despite these promising outcomes, the review also highlights critical challenges. There exists a clear sectoral imbalance, where major investments are funnelled into energy and transport infrastructure, while areas like sustainable agriculture, water and sanitation, and public health receive comparatively less attention. These underfunded sectors are crucial for addressing the needs of vulnerable populations and ensuring inclusive growth. Furthermore, the regional disparity in green finance flows, particularly the limited access in low-income and developing regions, continues to impede the equitable distribution of climate finance. A multifaceted strategy is necessary to fully realize the revolutionary potential of green finance. This entails creating inclusive effect indicators, expanding financial literacy at the local level, diversifying sectoral investments, and enhancing access to financing in the Global South through blended finance and de-risking techniques. Integrating green finance with more comprehensive socioeconomic development plans that put equity, resilience, and long-term sustainability first is equally crucial. In summary, green finance should be seen as a strategic facilitator of equitable and sustainable economic development rather than only as a means of funding environmental projects. To guarantee that the advantages of green finance are distributed fairly among all areas and societal segments, policymakers, financial institutions, and international organizations must cooperate to eliminate current obstacles, improve institutional capabilities, and advance regulations. Only then will green finance be able to deliver on its promise of creating a more inclusive, equitable, and greener global economy.

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Social Science

Sustainable investment funds in India: a synthesis of the academic literature

Dr. Sanjay Kumar Hooda[1] and Vipin Sharma[2*]

[1] Professor, Department of Commerce, Indira Gandhi University, Meerpur, Rewari, Haryana, India

[2] Research Scholar, Department of Commerce, Indira Gandhi University, Meerpur, Rewari, Haryana, India

*Corresponding Author: Vipin Sharma

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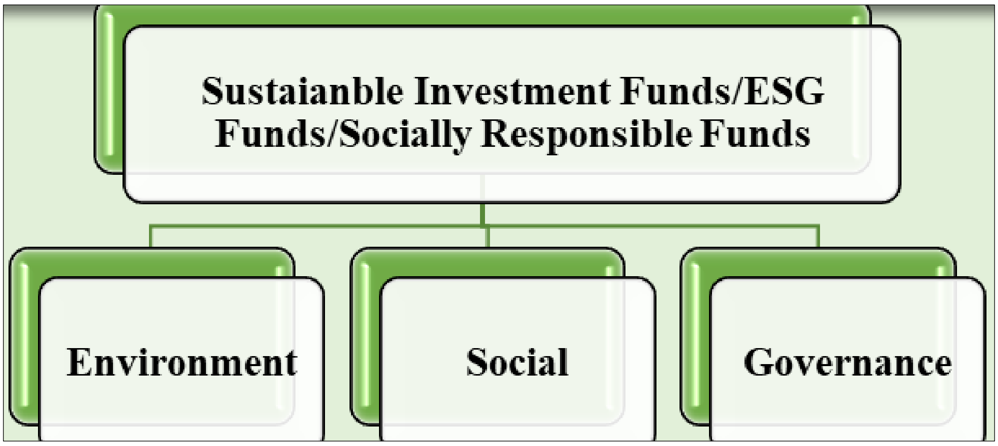
Abstract

Sustainable Investment Funds offer investors alternatives to invest their savings in shares of companies from a different perspective, extending the conventional medium of investing. These mutual funds encourage investors to consider the environment and society in which they live while investing in the stock market. This paper aims to review the existing literature on sustainable investment funds. Sixteen research papers selected from different countries are thoroughly studied. The findings reveal that the concept of SIFs is continuously increasing and gaining popularity. SIFs outperformed conventional funds, particularly in the wake of the COVID-19 outbreak. Some studies have supported the notion that non-SIFs outperform SIFs. However, when investors consider societal and environmental factors while making an investment, they are willing to sacrifice commercial or economic benefits in favor of social benefits.

Keywords: Sustainable Investment Funds, Thematic funds, Environment, Social, Governance

Introduction

The Sustainable Development Goals were developed by the United Nations in 2015 to achieve a sustainable environment and society. These goals can be achieved relatively easily through Sustainable Investing (Sharma & Garg, 2024) [15]. Mutual funds are investment vehicles that pool money from multiple investors to invest in a diversified portfolio of securities, including stocks, bonds, and money market instruments (AMFI, 2024) [1]. They are collective investment vehicles that collect and pool money from various investors. Open-ended schemes, Closed-ended schemes, Interval schemes, Equity funds, Debt funds, Hybrid schemes, Money market funds, Growth funds, Income funds, offshore funds, etc., are the types of mutual fund schemes (AMFI, 2024) [1]. Due to the consistent growth in mutual funds, particularly in green-related funds, every investor desires to comprehend the correlation between mutual funds and ESG. ESG stands for Environmental, Social, and Governance. It is also known as sustainable investing. ESG investing refers to an investment approach where funds are allocated to companies that adhere to ethical practices alongside profitability (IBEF, 2024) [4]. The fund aims to deliver decent financial returns while having a positive environmental impact. To comply with the ethical standards, ESG scores are assessed by research entities such as MSCI, Sustainalytics, and Morningstar. Environmental funds, social funds, governance funds, integrated ESG funds, and thematic ESG funds are the types of mutual funds that fall under the ambit of ESG investing (Press Trust of India, 2024). The SEBI has mandated that the top 1000 listed companies disclose their ESG efforts. In their research paper, Guimarães & Malaquias (2023) [7] revealed that ESG-related funds demonstrated higher risk-adjusted returns during periods of financial constraint. SBI Magnum Equity ESG Fund was the first ESG fund in India. It was launched in May 2018, and since then, the market has seen the introduction of several other ESG-themed funds. The ESG theme or responsible investing garnered popularity post-COVID. Between 2020 and 2021, eight new ESG funds were launched. Experts believe that such funds will attract greater attention in the years to come. ESG mutual funds invest in companies with high ESG ratings and sustainable growth, unlike traditional mutual funds, which focus on profitability and past performance. They also affect positive social and environmental change by investing in companies that reduce their carbon footprint or have good employee practices. ESG funds prioritize sustainability over short-term gains, unlike traditional funds, focusing on financial returns (Responsible Investing Tribune, 2024) [13]. An ESG controversy score measures the frequency and severity of a company's environmental, social, and governance (ESG) controversies. It's calculated and published by financial information providers.



Source: Authors' compilation

Literature review

S. N.	Author's name	Title	Objectives	Research methodology	Findings
1.	Vishali & Shafi M.K. (2024) [20]	Emerging paradigms in socially responsible investment (SRI)—A study with focus on ESG mutual funds in India	1. To explain the concept of Socially Responsible Investment (SRI) in the context of Indian financial markets. 2. To assess the performance of selected ESG mutual funds 3. To examine the opportunities and challenges associated with SRI and ESG funds within the Indian financial markets.	**Sample Data:** Secondary data **Time period:** April 2022 to March 2023 **Tools and techniques:** Four risk-adjusted portfolio performance metrics: the Sharpe ratio, Jensen's Alpha, Treynor ratio, and Sortino ratio	The study finds that Socially Responsible Investment (SRI) is gradually expanding in India, with the ICICI Prudential ESG Fund's Direct Plan-Growth option outperforming other selected ESG funds. In contrast, the Aditya Birla Sun Life ESG Fund's Direct Plan-Growth option ranked the lowest. Despite a growing trend, the expansion of ESG funds in India has been slow due to investor hesitancy about sustainability-focused portfolios, limited options, and higher costs associated with ESG analysis. Additionally, the Securities and Exchange Board of India (SEBI) has introduced a Social Stock Exchange (SSE), which facilitates capital access for social enterprises and promotes impact investing in India.
2.	Wong & Li (2024) [21]	Investigating ESG Funds in China: Management Fees and Investment Performance	1. To investigate the relationship between management fees, ESG scores, and the investment performance of ESG funds in China. 2. To analyze the performance of open-end funds in China. 3. To analyze the impact of ESG factors on fund performance.	**Sample Data:** Secondary data **Sample size:** 16530 open-ended funds in China **Time period:** 21 September 2001 to 30 June 2022 **Tools and techniques:** Comparative analysis and Regression analysis	The study reveals that funds with higher management fees yield higher annualized returns but experience greater volatility and maximum drawdown, indicating higher associated risks. However, these higher-fee funds do not show superior performance in risk-adjusted metrics. A specific management fee group (1.1%-1.2%) consistently shows exceptionally high returns. The study also finds that funds with moderate ESG scores, slightly above the median, demonstrate the best risk-adjusted returns. While high ESG scores may not necessarily lead to better investment outcomes, moderate ESG integration can contribute to superior risk-adjusted returns.
3.	Vilas et al. (2024) [19]	The limited role of sustainability in mutual fund investor decisions: A machine learning approach	1. Assess the importance of ESG (Environmental, Social, and Governance) performance in mutual fund investment decisions. 2. Develop predictive models to forecast mutual fund flows, financial returns, and ESG performance.	**Sample Data:** Secondary data **Sample size:** 3767 US mutual funds **Time period:** January 2015 to December 2021 **Tools and techniques:** Descriptive statistics, Correlation analysis,	The study examined the factors influencing mutual fund purchases, with a focus on the importance of past returns and ESG performance. Investors tended to favor funds with higher past returns, better ESG scores, lower volatility, smaller size, lower fees, and lower turnover ratios, with these variables showing statistically significant differences between funds with above-median and below-median flows. The analysis found that past returns and fund characteristics were more critical in attracting flows than ESG performance, despite ESG scores being statistically significant. Panel data regression confirmed that financial variables, such as fees and yield, had higher predictive power for fund flows than ESG scores, which played a lesser role in

				and Regression analysis	predicting fund flows. The study also employed machine learning models to predict fund flows, with random forests demonstrating the best accuracy, particularly when segmenting by fund type and investor class. Ultimately, while ESG factors were considered, traditional financial metrics continued to be the dominant drivers of fund flows.
4.	Momparler et al. (2024) [10]	Catalyzing Sustainable Investment: Revealing ESG Power in Predicting Fund Performance with Machine Learning	1. To test how financial performance indicators and combined ESG (Environmental, Social, and Governance) scores impact stock returns for large-cap firms. 2. To assess how firm size affects stock returns in Greek and French firms. 3. To study the relationship between ESG performance and stock returns, especially in Italian firms, where a significant negative correlation is identified.	**Sample Data:** Secondary data **Sample size:** 186 companies' data from six European countries **Time period:** 2010 to 2020 **Tools and techniques:** Regression Analysis and Herd Behavior Analysis	The study reveals that market capitalization has a negative impact on stock returns in Greece and France, suggesting a preference for smaller companies among investors. The price-to-book value (P/BV) and Sharpe ratio have a positive effect on stock returns in all countries except Portugal. ESG scores exhibit a significant negative correlation with stock returns in Italy, but not in other countries, suggesting that the importance of ESG factors varies across Europe. No evidence of ESG-related herding behavior was found in most countries, except during the COVID-19 outbreak in Portugal, Italy, and Greece. The study's findings align with previous research, which has shown a negative relationship between ESG performance and stock returns, particularly in Europe.
5.	Petridis et al. (2023) [12]	Measuring the efficiency of mutual funds: Does ESG controversy score affect the mutual fund performance during the COVID-19 pandemic?	1. Investigate the Influence of ESG Performance on Mutual Fund Efficiency 2. Evaluate Mutual Fund Performance Using DEA 3. Analyze the Impact of ESG Controversies Scores	**Sample data:** Secondary data **Sample size:** 17961 mutual funds worldwide **Time period:** July 2021 to July 2022. **Tools and techniques:** Data Envelopment Analysis (DEA) and hypothesis testing	The study demonstrates that mutual funds with higher ESG controversy scores, which indicate fewer ESG controversies, outperformed those with lower scores. Specifically, funds embroiled in fewer ESG controversies exhibited higher financial efficiency. ESG controversies could harm financial efficiency during health, environmental, or market crises. European mutual funds exhibit the highest risk, while U.S.-focused funds tend to have the lowest expenses, with returns generally consistent across regions, although there are notable outliers. The study suggests that incorporating ESG criteria, particularly ESG controversy scores, into investment strategies can enhance financial performance without sacrificing returns.
6.	Guimarães & Malaquias (2023) [7]	Performance of Equity Mutual Funds Considering ESG Investments, Financial Constraints, and the COVID-19 Pandemic	1. To classify mutual funds as ESG-related or conventional. 2. To analyze the risk-adjusted performance of ESG-related and conventional funds, particularly during financial constraints and the COVID-19 pandemic. 3. To compare the performance of ESG-related funds with conventional funds during the COVID-19 pandemic and periods of financial constraints.	**Sample data:** Secondary data **Sample size:** 3840 equity mutual funds **Time period:** January 2006 to December 2020. **Tools and techniques:** Four-factor Model and Returns-Based Style Analysis are used to classify funds.	The study reveals that ESG-related funds demonstrated higher risk-adjusted returns during periods of financial constraint. This implies that investors tend to achieve better returns by investing in green funds when faced with market downturns. The study suggested that, during market downturns, investors tend to obtain better risk-adjusted returns for investing in green funds (similar results were observed during the COVID-19 pandemic).
7.	Yerdian (2023) [22]	Analysis of the effects of the COVID-19 pandemic on mutual fund performance (using the Sharpe method)	1. To assess the impact of the COVID-19 pandemic on the performance of different types of mutual funds in Indonesia 2. To analyze the performance of these mutual funds using the Sharpe Ratio	**Sample data:** Secondary data **Sample size:** Four different types of mutual funds. **Time period:** 2018 to 2022. **Tools and techniques:**	The COVID-19 pandemic in Indonesia affected various mutual funds, with equity, balanced, and fixed-income funds experiencing significant declines in returns. Equity funds showed the highest volatility and risk but gradually recovered, showing improved returns over time. Money market funds remained the most stable, consistently providing positive returns throughout the pandemic. All mutual funds performed better after the pandemic than before, although none surpassed their

			as a risk-adjusted return metric. 3. To determine the best-performing mutual fund type during the pandemic.	Comparative analysis	values from early 2018. Fixed-income funds performed better before the pandemic, but the rise in global interest rates negatively impacted their returns. Equity mutual funds exhibited significant differences in returns between the pre- and post-pandemic periods, while money market funds performed the best throughout the entire period.
8.	Gavrilakis & Floros (2023) [6]	ESG performance, herding behavior, and stock market returns: evidence from Europe	1. To test the impact of financial performance indicators and combined ESG scores on stock returns for European large-cap firms. 2. To analyze the influence of ESG performance on investor behavior. 3. To examine the stock performance of large-cap firms in Europe.	**Sample Data:** Secondary data **Sample size:** 80% of the global market cap **Time period:** 1 April 2010 to 31 December 2020 **Tools and techniques:** Regression analysis and Herding behavior analysis	The study reveals that market capitalization has a negative impact on stock returns in Greece and France, suggesting that smaller companies may offer higher returns. The price-to-book value and Sharpe ratio have a positive influence on stock returns in all countries except Portugal, indicating that higher valuation and risk-adjusted returns enhance stock performance. ESG scores do not significantly affect stock returns in most countries except Italy. European stocks exhibit a significant negative correlation between ESG performance and returns, suggesting that investors may be willing to sacrifice returns for companies with strong ESG performance. Herding behavior motivated by ESG performance is evident in Greek and French markets but not in others. During the COVID-19 pandemic, herding behavior was observed in Portugal, Italy, and Greece, but not in Spain, France, or Germany.
9.	Rohilla (2023) [14]	Evaluation of Performance of Selected Indian ESG Funds	1. To analyze the performance of selected ESG funds in terms of annualized return and risk. 2. To assess the performance of ESG funds based on different ratios. 3. To analyze the interdependence of selected ESG funds using the Granger causality test. 4. To identify shocks in the selected ESG funds and their timing.	**Sample Data:** Secondary data **Sample size:** 3 ESG funds **Time period:** 29 December 2020 to 12 August 2022 **Tools and techniques:** Comparative analysis, Sharpe Ratio, and Granger causality test	The study reveals that as of August 12, 2022, India's mutual fund market had only 10 ESG schemes, compared to those of countries such as the USA, UK, Japan, and China. SBI was the only mutual fund company offering ESG funds in India until 2018; since then, nine more schemes have been launched. As of March 31, 2022, total ESG assets under management were ₹12,447 crore, with the ESG fund of fund at ₹140.64 crore and the ESG ETF at ₹166.73 crore. The inflow in ESG funds increased from ₹2,094 crore in 2019-20 to ₹4,884 crore in 2020-21, but declined to ₹315 crore in 2021-22. The Aditya Birla Sun Life ESG Fund was the best performer, with a 35.64% annualized return, but also had the highest risk and downside risk. All selected ESG funds showed significant intercorrelations, and no Granger causality was found among the funds. The study concludes that, despite low awareness, ESG funds in India can offer good risk-adjusted returns.
10.	He et al. (2023) [9]	Drifting from the Sustainable Development Goal: Style Drift in ESG Funds	1. Analyze the relationship between ESG drift and the sensitivity of fund flows and performance. 2. Compare the performance and characteristics of funds that adhere to their sustainability goals versus those that drift away. 3. Provide insights into the effects of ESG drift on fund performance and flows	**Sample Data:** Secondary data **Sample size:** 31 ESG-themed funds **Time period:** 2018 to 2022 **Tools and techniques:** Descriptive analysis, correlation, and funds flow calculation	The study examines the relationship between mutual fund ESG drift (deviation from stated ESG objectives) and fund characteristics. It finds that funds with higher ESG drift tend to invest more in lower-ranked ESG stocks and generally underperform compared to funds without ESG drift. ESG-drift funds are smaller, have lower returns, subscription rates, and fund flows, and exhibit higher turnover rates and lower industry concentration. Additionally, the study reveals that ESG drift enhances the sensitivity of fund flows to performance, particularly among individual investors, suggesting they are more influenced by ESG drift in their investment decisions. However, there is no substantial evidence that ESG-drift predicts future fund performance.
11.	Carlsson Hauff & Nilsson (2023) [2]	Is ESG mutual fund quality in the eye of the beholder? An	To examine the influence of ESG Investment strategies on perceived sustainable quality, financial quality, and the	**Sample size:** 261 participants (41% female) **Time period:**	The study indicated that the inclusion strategy was favored, with participants perceiving it as the best in terms of financial quality (M = 2.86) and overall quality (M = 3.22). Engagement was rated highest for perceived

		experimental study of investor responses to ESG fund strategies	overall quality of ESG-profiled mutual funds. To evaluate the impact of ESG strategy implementation	21 September 2001 to 30 June 2022 **Tools and techniques:** Mixed method approach and CFA	sustainable quality (M = 3.40), though differences between strategies were minimal. The multi-categorical mediation model revealed that the inclusion strategy had a significantly positive effect on overall quality, primarily through its impact on perceived financial quality. However, no significant mediating effect was found for sustainable quality or economic risk, resulting in the rejection of the related hypotheses. Overall, the findings underscore the importance of financial returns in shaping investors' perceptions of mutual fund quality, with the inclusion strategy being particularly effective in enhancing these perceptions.
12.	Gupta (2022) [8]	Growth and Performance Measurement of ESG-themed Mutual Funds in India: An Empirical Investigation	1. To assess the growth in the number and Assets Under Management (AUM) of ESG funds in India. 2. To evaluate the performance of ESG equity funds based on annualized returns, portfolio total risk, downside risk, beta, and risk-adjusted return measures such as Sharpe, Treynor, Jensen's alpha, and Sortino	**Sample Data:** Secondary data **Sample size:** 8 ESG-themed mutual funds in India **Time period:** 1 January 2021 to 31 December 2021 **Tools and techniques:** Descriptive analysis, Sharpe Index, Treynor Ratio, Sortino Measure, and Jensen's Alpha	The study demonstrated that the growth of ESG funds in India is in its early stages compared to global markets, with only eight ESG-themed funds by December 2021. Despite being a small market, India has experienced significant momentum in recent years, particularly since the launch of its first ESG fund in May 2018. The sector recorded a 76% increase in AUM from Rs. 2,094 crores in 2019-20 to Rs. 3,686 crores in 2020-21, reaching Rs. 11,651 crores by the end of 2021. While India's position is negligible globally, the rapid launch of new funds and substantial AUM growth highlight a growing interest in ESG investments among Indian investors.
13.	Steen et al. (2020) [16]	Is there a relationship between Morningstar's ESG ratings and mutual fund performance?	1. To analyze the relationship between Morningstar's ESG ratings and the performance of mutual funds in Norway. 2. To examine the existence of an ESG momentum effect.	**Sample Data:** Secondary data **Sample size:** 146 mutual funds in Norway **Time period:** January 2014 to December 2018 **Tools and techniques:** Descriptive statistics and the Fama-French three-factor regression model	The research indicated that sustainability funds typically yield an average annualized excess return of 7.6%, with a standard deviation of 9.1% and a market beta of 0.71. Portfolios with lower betas suggest reduced market risk. In contrast, high-sustainability portfolios often have higher betas, being influenced more by growth and small-cap stocks, whereas low-sustainability portfolios carry more unsystematic risk. The study noted a 0.3% monthly alpha disparity between high- and low-sustainability portfolios, especially in European funds, indicating superior risk-adjusted returns for the former. Additionally, an "ESG momentum" phenomenon was observed, where funds that improved their ESG scores achieved an annualized alpha of 3.6%, highlighting the potential benefits of enhancing sustainability ratings.
14.	Dorfleitner et al. (2020) [3]	ESG controversies and controversial ESG: about silent saints and small sinners	1. To examine the Relationship between Corporate Social Performance (CSP) and Corporate Financial Performance 2. To analyze the Impact of Controversies on CFP 3. To evaluate Portfolios Based on ESG Ratings	**Sample Data:** Secondary data (Thomson Reuters' ESG rating) **Sample size:** 2500 companies per month during the given time period **Time period:** 2002 to 2018 **Tools and techniques:** Regression analysis	The study reveals that equally weighted portfolios based on low Thomson Reuters (TR) scores and high controversy scores exhibit significant outperformance, particularly among smaller companies, indicating that investors may reward firms that avoid excessive ESG spending. While value-weighted portfolios show no consistent positive alphas, equally weighted strategies generate notable returns, especially in the worst TR score portfolios, supporting the trade-off hypothesis. Rank-weighted portfolios further amplify returns, and the performance remains robust across different market conditions, portfolio splits, and after accounting for transaction costs. Overall, the findings suggest that small companies with fewer controversies can achieve sustained stock performance, whereas large firms with high ESG scores do not consistently outperform their smaller counterparts.

15.	Friede et al. (2015) [5]	ESG and financial performance: aggregated evidence from more than 2000 empirical studies	1. To provide a comprehensive overview of the relationship between environmental, social, and governance (ESG) criteria and corporate financial performance (CFP) 2. To overcome the limitations of previous review studies	**Sample Data:** Secondary data **Sample size:** 2200 individual studies **Tools and techniques:** Vote-count studies and Meta-analysis	The study found that 90% of studies show a nonnegative relationship between Environmental, Social, and Governance (ESG) criteria and corporate financial performance (CFP). The correlation is strong, with 47.9% of vote-count studies and 62.6% of meta-analyses showing positive correlations. Nearly 50% of studies found positive ESG-CFP relations, while only 10% found hostile ties. Meta-analyses supported positive findings, with 74.9% showing significant positive correlations. However, portfolio studies, particularly those focusing on mutual funds, showed 15.5% positive results, possibly due to overlapping risks and costs. North America showed a higher share of positive results than Europe and Asia/Australia. Environmental and Governance studies showed slightly more positive results than Social, though the differences were marginal.
16.	Muñoz et al. (2014) [11]	Environmental Mutual Funds: Financial Performance and Managerial Abilities	1. To analyze the financial performance and managerial abilities of US and European socially responsible (SR) mutual funds. 2. To compare green fund managers' performance with conventional and other forms of SR mutual fund managers. 3. To investigate the effect of market conditions (crisis vs. regular periods) on the performance of SR funds in the US and Europe.	**Sample data:** Secondary data **Sample size:** 18 US and 89 European green funds **Time period:** January 1994 to January 2013. **Tools and techniques:** Multifactor model (four-factor Carhart model) and Treynor and Mazuy (TM) market-timing model	The study reveals that the financial performance of green funds in the US and Europe is generally similar to that of their conventional and ESG counterparts. In the US, green funds underperform during non-crisis periods but perform similarly during crises. However, they perform worse in non-crisis periods due to poor market-timing abilities. In Europe, green funds show no significant difference in performance compared to conventional and ESG funds, but underperform conventional funds during crisis periods. The study also indicates that managerial abilities, such as stock picking and market timing, are generally weak. However, unlike their European counterparts, US green fund managers show better timing abilities during crisis periods. Overall, the success of green fund managers depends on market conditions.

Conclusion

The study concludes that mutual funds with higher ESG controversy scores, which indicate fewer controversies, generally outperform those with lower scores, highlighting the financial benefits of incorporating ESG criteria into investment strategies. Specifically, funds with fewer controversies exhibit greater financial efficiency, even during crises such as health or environmental events. The research highlights the importance of considering ESG controversy scores to achieve enhanced financial performance without compromising returns. Additionally, the study finds that green funds, particularly in the US and Europe, exhibit higher risk-adjusted returns during financial constraints, notably during market downturns such as the COVID-19 pandemic. However, green funds underperform in non-crisis periods due to poor market-timing abilities. The study also highlights that sustainability funds, especially in Europe, yield superior risk-adjusted returns, driven by the "ESG momentum" phenomenon, where improving ESG scores leads to better financial outcomes. Despite the positive correlation between ESG criteria and corporate financial performance (CFP), the study suggests that in regions such as North America, the relationship is stronger than in Europe and Asia/Australia, with notable variations in the impact of ESG scores on stock returns across different countries. Lastly, the study indicates that India's ESG fund market, though in its early stages, has shown significant growth, with increasing investor interest reflected in the rapid launch of new funds and substantial growth in assets under management (AUM). India's ESG model is expanding due to regulatory scrutiny, corporate governance, and global sustainability goals. The expected growth in ESG-oriented AUM aligns with India's commitment to a greener future. ESG investments shape India's financial ecosystem, creating a more sustainable and resilient economy. Strategic sectors and regulatory frameworks support this trend. In conclusion, the concept of SIFs is continuously increasing and gaining popularity. SIFs outperformed conventional funds, particularly in the wake of the COVID-19 outbreak. Some studies have supported the notion that non-SIFs outperform SIFs. However, when investors consider societal and environmental factors while making an investment, they are willing to sacrifice commercial or economic benefits in favor of social benefits.

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Public-private partnerships in infrastructure: examining operational models and implementation challenges

Dr. Sanjay Kumar Hooda[1] **and Pooja Garg**[2*]

[1] Professor, Department of Commerce, Indira Gandhi University, Meerpur, Rewari, Haryana, India

[2] Research Scholar, Department of Commerce, Indira Gandhi University, Meerpur, Rewari, Haryana, India

*Corresponding Author: Pooja Garg

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Abstract

Public-Private Partnerships have emerged as an innovative mechanism to bridge the gap between pubic demand for infrastructure and limited government resources. PPPs provide an alternative model for the development and management of infrastructure projects. Various sectors, including transport, energy, healthcare, power, and education, widely use different modes of PPP, such as BOT (Build Operate Transfer), BOOT (Build Own Operate Transfer), and OMT (Operate Maintain Transfer). However, implementation of PPPs is not without challenges. Financial and economic constraints, legal and regulatory complexities, socio-political barriers and technology limitations often hinder project success. Understanding both the operational models and key challenges is critical for improving PPP frameworks and ensuring sustainable infrastructure development. This paper explores the different PPP models applied in infrastructure projects and critically examines the challenges that affect their effectiveness, with a view to suggesting strategies for enhancing project outcomes.

Keywords: Public-Private Partnership, Infrastructure, Sustainability and PPP models

Introduction

Infrastructure is often considered the backbone of economic development (PIB, 2025) [19]. In India, the demand for world-class infrastructure is increasing due to rapid economic growth, urbanization and population growth (C. Sharma, 2012) [22]. The growth of the economy is directly linked to infrastructure resources (Nguyen *et al.*, 2017) [16]. Infrastructure resources have a positive impact on economic growth (Nguyen *et al.*, 2017) [16]. After India's independence, to invest in the vital sectors of the economy (Unnikrishnan & Kattookaran, 2020) [25] like transport, energy and education, etc, became the government's responsibility. However, the situation has dramatically changed over the past few years. The belief that government is solely responsible for investing in society's well-being has faded. To address the significant investment gap (Raut & Vyas, n.d.; Sehgal & Dubey, 2019) [20], leading policymakers have adopted public-private partnerships as a solution. To bridging infrastructure gaps, PPPs have emerged as a strategic approach. Provide as a funding application across diverse sectors, including transport, environment, energy, health, and education (Palcic *et al.*, 2022) [18]. PPPs are used as an effective tools for enhancing economic, social, and environmental sustainability (Ma *et al.*, 2022). Consequently, many countries are compelled to transform their public infrastructure delivery by adopting Public Private Partnerships. PPPs provide an alternative financing and delivery model that combines the efficiency of private players with the social responsibility of the public sector. Private players provide various services like administration, supervision, building of various projects.

The investment required for a country's infrastructure development is substantial and often exceeds what the government can manage within its budget. India's infrastructure investment for FY2022 to FY2023 was around ₹7.5 trillion ($91.48 billion) and is anticipated to reach ₹10 trillion ($121.98 billion) for FY2024 (Development Bank, 2024) [8]. The National Infrastructure Pipeline (NIP) aims for a projected investment of ₹111 trillion ($1.35 trillion) from 2020 to 2025, focusing on energy, roads, urban infrastructure, and railways, funded by the central and state governments along with the private sector (Development Bank, 2024) [8].

(PPPs) Public-private partnerships have existed in many countries for a long time, but gained substantial momentum in the 1990s (Fefta Wijaya *et al.*, 2023) [9]. Market-oriented approaches and corporate business practices were introduced to the public sector during this period. PPPs became a key element of privatisation and government reform efforts, based on the belief that private firms could deliver high-quality goods and services more efficiently and cost-effectively, thereby reducing the responsibilities of the government. PPPs offer a mechanism where the public and private sectors collaborate to plan, build, or manage infrastructure projects and services required to achieve the SDGs(Sharma & Garg, 2024) [23]. They share the responsibilities, costs, risks, and benefits involved in making these projects successful (Liu *et al.*, 2024) [13]. Nevertheless, PPPs are not free from challenges, and their effectiveness depends largely on the setting, the models adopted and the management of inherent risks.

Various PPP models (Table A) exist worldwide, each has unique characteristics of risk-sharing mechanisms and structural frameworks. For example, the Build, Operate and Transfer (BOT) model, which permits the private sector to finance, build and operate for a predetermined duration before relinquishing ownership to the public sector. Design, Build, Finance, and Operate (DBFO), which facilitates the private sector's responsibilities in designing, constructing, financing, and operating a project, while concurrently receiving compensation through fees from government entities before transferring the ownership to the government is another important model.

This paper examines the leading models utilised for public-private partnerships across several infrastructure sectors and investigates the barriers faced by diverse parties in executing these projects. Before implementing the projects, the government and other stakeholders must anticipate the potential challenges in this and develop strategies to address these constraints, ensuring that the partnership operates effectively.

Review of literature

In 1977, Uk was initially used the public-private partnership-based model and is now widely applied across the world in infrastructure sectors such as highways, healthcare, power, airports, seaports and education. In various sectors, different types of PPP models like BOT, BOOT, OMT, DBFO and BOLT, etc. is used according to their unique characteristics. (Akhtar *et al*., 2023) [1].

According to the Zakharina *et al*. (2020) [26] found that the selection of an appropriate model and a partnership framework influence the success of PPP projects, which serve as an effective alternative to traditional approaches in managing strategic economic sectors. According to Liu *et al*. (2021) [14] DBFO (Design- Build-Finance-Operate) and BOT models are also implemented for the smart city projects, where the private sector develops smart facilities and provides smart services for a predetermined time period and after this is transferred to the public sector. The selection of an appropriate PPP model is largely determined by the type of projects and services to be provided.

In greenfield projects, the BOT model is commonly and widely used in the world (Akhtar *et al*., 2023) [1]. However, Balasingh (2024) [4] states that India has implemented PPP models for the supervision, administration and building of national roads, which are annuity and (BOT) Build Operate Transfer model. The annuity model lets the concessionaire to be compensated through fixed annuity payments or early toll revenues provided by the government, while the BOT model involves realising the concessionaire's investment by imposing tolls on road users. To address the global challenges, scope of partnership mis further evolving. Choi *et al*. (2020) [6] analysed the evolution of (PPPs) public-private partnerships within the partnership for Green Growth and Global Goals 2030 (P4G), examines stakeholder relationships and their development over time. The increasing involvement of Ros (Research organisation) in connecting with NPOs/NGOs, (Governments) GOVs, international organisations (IOs), and companies reflects the pilot nature of P4G start-up projects. This evolution underscores P4G's role in fostering multi-stakeholder collaborations for sustainable development, with clear roles emerging for participants at different stages. The study differentiates between the summation network, showing overall stakeholder participation, and the normalised network, which reveals the effectiveness of these partnerships. This highlights a shift from binary public private contracts towards complex, multi-stakeholder collaborations for achieving sustainable development goals (SDGs).

Apart from the model selection, a robust body of literature identifies the factors that underpin PPP success, encompassing financial, legal and project management dimensions. Kumar *et al*. (2022) [12] investigated the various infrastructure sectors profitability in India. In this investigation, the variable has an impact on PPPs profitability and results showed that firm-specific factors like leverage, size, non-debt tax shield, growth, and risk positively impact PPPs' profitability. In contrast, macroeconomic factors like inflation have a significant positive relationship. The study highlights the importance of identifying factors determining profitability for researchers, practitioners, policymakers, and fund providers. This indicates that the financial health and strategy of the private partner are crucial for project viability. Geng *et al*. (2022) [10] explored the influence of completion risk and project profitability on private-sector investment decisions in PPP infrastructure projects. It uses a continuous real option method to analyse investment and default boundaries under various risk conditions. His study showed that an increase in completion risk depends on the private sector risk tolerance limit but doesn't necessarily increase the investment boundary. The optimal debt level increases with the tax rate but decreases with the default loss rate. Their findings suggest that risk allocation must be carefully adjusted to the private sector's capacity to bear it.

Synthesizing these points, (Olusola Babatunde *et al*. 2012) [17] states that while PPP can be suitable for various infrastructure types, their performance depends on well-structured success factors. They examined the most suitable types of infrastructural projects using public-private partnerships (PPP) and identified critical success factors that are essential for developing the necessary rule, regulations, laws and guidelines. However, ensuring well-structured success factors for successful implementations is important for optimum performance. Identifying critical factors in PPP can help develop a body of PPP knowledge, which can be used to establish relevant rule, regulations, and guidelines. The eventual justification for public-private partnership often lies in its broader economic impact. Chotia and Rao (2018) examined that the Indias GDP have most positively influenced be the public-private partnerships (PPP). It includes private financing in the roads, energy, and telecom sectors having a particularly impactful effect. This study also suggests that benefits are not same across sectors, with the seaport sector, for instance, deriving optimal benefits from this mode of financing.

Research methodology

The research is descriptive research based on secondary data. The literature is retrieved from Scopus and Web of Science for the comprehensive coverage of public-private partnerships and infrastructure development. The study analysed the predominant models utilised for public-private partnerships across several infrastructure sectors and investigated the challenges faced by stakeholders in the implementation of the project.

Table A: Shows the types and models of PPPs

Mode l	Description	Private sector role	Asset ownership	Key contributors
BOT	Build, Operate and Transfer	Finance, build, and transfer after the concession period, but continue to operate it for a fee on behalf of the government.	Public	Water and sewerage (Babatunde *et al*., 2014) [3], Toll and Highway Roads (Akhtar *et al*., 2023) [1] and Airports
BOO	Build, Own, Operate	Financing, Building, and operating a facility for indefinite periods and getting financial incentives such as tax-exempt status	Private	Airports, Roads and highways(Akhtar *et al*., 2023) [1]
BOO T	Build, Own, Operate and Transfer	Financing, Building, and operating a facility for a set period and transferring at an agreed-upon and market price.	Public	Education (Babatunde *et al*., 2014) [3], Power and Healthacare
BOLT	Build, Operate, Lease and Transfer	Builds and operates a facility, leasing it to the public sector for a specific period and then transferring ownership	Public	Transportation (Akhtar *et al*., 2023 [1])
DBFO	Design, Build, Finance, and Operate	Design, construct, Finance and operate a project and get fees from the government	Public	Education (Babatunde *et al*., 2014) [3], Healthcare
OMT	Operate, maintains/modernize and transfer	Operating and maintaining a public asset or service for a set period	Public	Railways and Bridges

Source: Compiled by Author

Challenges faced by PPP infrastructure projects in India financial and economic issues: This issue impacts both the public and private sectors. For the private sector, high participation costs (Malek & Gundaliya, 2023) [15], bidding process, complicated requirements, and meanwhile, the public sector faces difficulties due to the size and complexity of the projects, as well as the need for external requirements in the early stages.

Legal and regulatory hurdles

PPP often encounter legal disputes and a lengthy approval process (Singh & Kadam, n.d.) involving multiple government agencies. This includes challenges such as obtaining environmental clearances, weak institutional capacity, and weak enabling policies (Babatunde *et al*., 2014) [3] and navigating regulatory uncertainties.

Technological hurdles

Poor strategic partners in advanced technology development in infrastructure projects, along with a lack of capacity to keep pace with completion timelines, expertise requirements, and architecture of ICT infrastructure, create hurdles in projects (Ibrahim & Jantan, 2024) [11] implementation.

Socio-political barrier

The Central and state government makes many rules and regulations in countries like India, which have to fulfilled before starting the projects and during the projects. Many issues such as land acquisition delays (Babatunde *et al*., 2014) [3], political interference, public opposition, unstable of government, bribery in system (Bramhankar & Devalkar, n.d.) and a lack of support from stakeholders further complicate the implementation of PPPs.

Project management

Coordination difficulty (Ibrahim & Jantan, 2024) [11] is a significant issue in PPPs. The involvement of various stakeholders, such as contractors, lenders, and public and private authorities, often leads to divergent interests and complicates partnership dynamics, especially considering the long-term nature of these collaborations. Poor network coordination, lack of PPP experience, lack of integrated communications between industry partners and government (Ampratwum *et al*., 2023) [2], shows issues in coordination.

Conclusion

Public-Private Partnerships have become an essential tool for bringing private resources, knowledge, creativity and skills to address public infrastructure needs. The PPP model from the transportation sector to healthcare, education and the power sector has proven effective. Despite their benefits, PPPs implementation continues to face significant challenges. Issues such as unclear risk allocations, lack of transparency, funding constraints, high participation costs, political interference, etc., remain unsolved. This paper concludes that there are more challenges to PPPs project implementation in developing countries. Effective PPPs require a transparent mechanism, technological advancement, improved financing structuring, a stable regulatory framework, a stable government and reform of land acquisition policies. These solutions not only address immediate issues but also align with India's long-term vision of sustainable and resilient infrastructure under the National Infrastructure Pipeline (NIP) and Gati Shakti Master Plan.

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Assessing financial capability among people with disabilities in India: applying Sherraden's framework

Himanshu Arora[1&2*]
[1] Assistant Professor, Department of Commerce, Sri Aurobindo College (E), University of Delhi, Delhi, India
[2] Research Scholar, Department of Commerce, Delhi School of Economics, University of Delhi, Delhi, India
*Corresponding Author: Himanshu Arora
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Abstract
Financial well-being is a fundamental determinant of quality of life, yet people with disabilities (PWDs) in India face systemic barriers that significantly restrict their economic inclusion, financial literacy, and access to formal financial services. These barriers increase vulnerability to poverty and social exclusion in the Indian context, despite the government's efforts such as the Pradhan Mantri Jan Dhan Yojana (PMJDY) and disability rights legislation like the Rights of Persons with Disabilities (RPwD) Act, 2016. This study applied Michael Sherraden's Financial Capability Framework to empirically examine how financial literacy (the "ability") and financial inclusion (the "opportunity") contribute jointly to the financial well-being and stability of PWDs in India. Using nationally representative secondary data drawn from the National Sample Survey Office (NSSO), National Centre for Financial Education (NCFE), and Reserve Bank of India (RBI) financial inclusion statistics, this research employed structural equation modelling and path analysis on a sample of approximately 2,500 adults Indian PWDs. Key findings revealed that financial literacy positively predicted financial well-being but that access to formal financial products exerts a stronger direct influence and moderates the effect of literacy, indicating that systemic access is crucial. The research highlighted disparities rooted in gender, education, rural-urban residence, and regional variation. Policy implications emphasize multi-level, disability-sensitive interventions focusing on both financial education and inclusive financial services, supported by social work practice and legal enforcement aligned with India's socio-economic context.

Keywords: Financial capability, Financial literacy, Financial inclusion, Disabilities, Poverty, India, Social policy, Social work

1. Introduction

Financial capability, the composite capacity combining individual financial literacy with institutional access to appropriate financial products has gained prominence as a strategic framework to combat economic vulnerability and social exclusion globally. In India, this concept is particularly relevant for people with disabilities (PWDs), a population accounting for over 2.2% of the total population per the 2011 Census (Government of India, 2016). PWDs face heightened challenges including educational disadvantages, unemployment rates exceeding 60% in some studies, pervasive stigma, and infrastructural barriers that restrict their participation in mainstream financial systems and markets. These conditions increase their risk of poverty, constrain their financial agency, and reduce their resilience to economic shocks.

Financial literacy, encompassing knowledge and skills to manage personal finances effectively, is widely recognized as a prerequisite for making informed financial decisions. Similarly, financial inclusion, the availability and use of formal financial products such as bank accounts, credit, insurance, and pension schemes provides the structural foundation for economic engagement and security. The Financial Capability Framework theorized by Sherraden (2013) highlights the interdependence of these pillars: individual ability (literacy) is necessary but insufficient without institutional opportunity (inclusion).

In recent years, Indian policy initiatives including the landmark Pradhan Mantri Jan Dhan Yojana (PMJDY), digital banking proliferation, and legal mandates under the RPwD Act (2016) have aimed to reduce exclusion and enhance financial participation of marginalized populations, including PWDs. Nevertheless, empirical research on how effectively these efforts translate into improved financial capability among PWDs remains limited. Evidence points to persistent inequalities: many PWDs lack digital literacy, face accessibility barriers at banks, and are often unaware of or unable to access specialized financial products designed for their needs.

This study seeked to fill this research gap by leveraging nationally representative secondary datasets combined with financial literacy surveys and banking statistics to test the Financial Capability Framework within the context of Indian PWDs. Specifically, it explored how financial literacy and financial inclusion independently and interactively influence the financial well-being and stability of PWDs, while identifying demographic disparities and structural obstacles.

The objectives of this research were:

- To measure the level of financial literacy and financial inclusion among adult PWDs in India.
- To analyse the determinants and disparities of financial literacy and inclusion across gender, education, and rural-urban residence.
- To test, via path analysis, hypotheses regarding the effects of financial literacy and inclusion on financial well-being and their interaction effects.
- To discuss policy, social work, and financial sector interventions informed by empirical findings to enhance financial capability and economic empowerment for PWDs.

By critically examining these relationships within the unique socio-economic and policy environment of India, this research contributes evidence-based insights for policymakers, social work practitioners, financial institutions, and disability rights advocates striving toward equity and inclusion.

2. Literature review

2.1 Disparities faced by people with disabilities in India

Persons with disabilities (PWDs) in India represent a significant marginalized segment facing considerable social, economic, and institutional challenges. According to the 2011 Census of India, approximately 2.2% of the population lives with some form of disability, though this figure is often believed to be underreported (Government of India, 2016). PWDs disproportionately experience elevated poverty rates, limited educational attainment, high unemployment, and social exclusion (Pandey & Patnaik, 2018). The unemployment rate among PWDs can exceed 60%, especially for women, and many are concentrated in low-paid informal or unorganized sector work (ILO, 2020).

Educational opportunities remain limited, with adult literacy among PWDs much lower compared to the general population. Female PWDs face compounded gender and disability-based discrimination. Rural areas show greater exclusion, with infrastructural and service access barriers exacerbating inequalities. Moreover, stigma and cultural perceptions around disability contribute to social isolation and dependence on informal support systems (Kumar & Kalaivani, 2017).

These socioeconomic conditions inherently limit financial inclusion, with many PWDs lacking access to formal banking, credit, and insurance services. Limited awareness, physical accessibility barriers, and lack of disability-sensitive financial products further restrict their economic participation and ability to build financial resilience (Khatri & Verma, 2021). These disparities emphasise the need for targeted research and intervention in the realm of financial capability.

2.2 Financial capability framework: theory and global evidence

The concept of financial capability posits that financial well-being is the product of two mutually reinforcing components: financial literacy (individual ability) and financial inclusion (structural opportunity) (Sherraden, 2013). Financial literacy refers to an individual's knowledge, skills, and confidence to make informed financial decisions encompassing budgeting, saving, borrowing, and investing. Financial inclusion denotes access to beneficial, affordable, and appropriate financial products and services such as bank accounts, credit, insurance, and digital payments.

Globally, research supports this dual-factor framework in enhancing economic security and reducing poverty among vulnerable populations, including persons with disabilities. Studies in developed countries indicate that PWDs exhibit lower financial literacy levels and experience greater financial exclusion than non-disabled peers, fueling poverty and limiting asset accumulation (McGarity *et al*., 2020; Birkenmaier *et al*., 2017). Financial literacy interventions improve self-efficacy and decision-making but require parallel improvements in accessible, inclusive financial infrastructure to achieve meaningful outcomes.

In low- and middle-income countries, expanding financial inclusion is crucial to overcoming systemic constraints such as limited banking presence, regulatory challenges, and digital divides (Dev, 2006). Evidence suggested that while improving financial competencies is vital, structural barriers must be dismantled to avoid framing exclusion solely as an individual deficiency. This approach aligns with social justice imperatives central to social work, advocating for equal access to resources and opportunities.

2.3 Financial capability and persons with disabilities in India: policy and evidence

India has made notable strides in improving financial inclusion through flagship programs such as the Pradhan Mantri Jan Dhan Yojana (PMJDY) launched in 2014, which aims for universal banking access. The Reserve Bank of India has also undertaken initiatives to foster digital payments and inclusive banking practices. Legal frameworks such as the Rights of Persons with Disabilities (RPwD) Act (2016) mandate accessible services and equal participation (Ministry of Law and Justice, 2016).

Despite these efforts, studies reveal persistent gaps for PWDs. Many India-specific research articles report low levels of financial literacy and limited utilization of banking and credit facilities among PWDs (Kumar & Kalaivani, 2017; Khatri & Verma, 2021). Stigma, infrastructural inaccessibility, lack of disability-specific products, and poor digital literacy further obstruct financial inclusion (National Statistical Office, 2019). Outreach and education programs often fail to address specific needs related to the diversity of disabilities.

The lack of granular, empirical data combining financial literacy and inclusion dimensions for PWDs in India restricts evidence-based policy-making. While macro data document banking penetration, sub-population analyses—especially involving intersectional factors such as gender, rurality, and education—remain limited. This represents a crucial research gap that this study attempts to fill by deploying Sherraden's theoretical framework with nationally representative data.

Table 1: Selected government policies and programs for financial inclusion and disability rights in India

Policy/Program	Year	Description
Pradhan Mantri Jan Dhan Yojana (PMJDY)	2014	Universal access to banking; priority to marginalized groups including PWDs
Rights of Persons with Disabilities Act (RPwD)	2016	Legal framework ensuring equality, accessibility, and inclusion for PWDs
RBI Guidelines on Financial Inclusion	Ongoing	Banking norms ensuring PWD-friendly services and access
Digital India Initiative	2015	Promotes digital payment systems and e-governance inclusive of PWDs

Table 1outlines major Indian policy milestones aimed at expanding financial inclusion and protecting the rights of persons with disabilities. While these initiatives provide vital legal and infrastructural support, translating inclusion mandates into measurable financial well-being for PWDs remains a substantial challenge, particularly in rural and underserved regions.

3. Theoretical framework and hypotheses

This study is anchored in the Financial Capability Framework developed by Michael Sherraden (2013), which conceptualizes financial well-being as the product of two interdependent pillars: financial literacy (ability) and financial inclusion (opportunity). The framework emphasizes that possessing financial knowledge and skills alone is insufficient unless individuals also have access to suitable financial products and services that enable them to apply these competencies effectively. This dual approach aligns with social work's person-in-environment perspective and social justice mission, which stresses the importance of both individual empowerment and structural inclusion to reduce financial vulnerability, especially for marginalized groups such as PWDs.

3.1 Financial literacy (ability)

Financial literacy refers to an individual's cognitive and behavioural capacity to understand, process, and utilize financial information for effective money management and decision-making. It includes knowledge of budgeting, saving, credit management, risk protection via insurance, and understanding financial products such as loans, savings accounts, and investment options. For PWDs, financial literacy encompasses additional nuances related to navigating barriers posed by disability, such as understanding rights to disability benefits and tailored financial assistance programs. Improved financial literacy is associated with better budgeting, avoiding predatory lending, and increased use of formal financial services, which contribute to financial security.

3.2 Financial inclusion (opportunity)

Financial inclusion represents the systemic factors that enable individuals to access and use formal financial products and services. These include bank accounts, credit, insurance, pensions, and increasingly digital financial platforms. For PWDs, inclusion entails accessibility considerations i.e., physical infrastructure, technology usability, tailored product features, and non-discriminatory policies. Inclusion also captures the affordability, reliability, and adequacy of financial services meeting the diverse needs of disabled persons. Without access to these opportunity structures, literacy cannot translate into tangible financial well-being.

3.3 Interaction and financial well-being

The framework posits that financial literacy and inclusion not only have direct effects on financial well-being but also interact synergistically. Access to financial products can moderate the positive effect of literacy by providing avenues to apply knowledge, while higher literacy enables better use and selection of financial products, reinforcing well-being and financial stability. In the Indian context, where infrastructural, social, and economic barriers persist, understanding this interplay is critical for effective policy and practice.

3.4 Hypotheses

Based on this theoretical grounding and prior empirical studies, four hypotheses guided the current study:

H1: Financial literacy mediates the relationship between early economic socialization (exposure to financial education or financial experiences in childhood/adolescence) and financial well-being among Indian PWDs. Early socialization is expected to positively influence literacy and thereby promote better financial outcomes.

H2: Financial literacy directly and positively affects the financial well-being and stability of Indian PWDs, enabling better financial management and decision-making.

H3: Access to formal financial products (bank accounts, credit, insurance, etc.) directly and positively influences financial well-being, providing the opportunity to apply financial skills and accumulate assets.

H4: Financial inclusion moderates the impact of financial literacy on financial well-being, such that the positive effect of literacy is stronger for those with better access to financial products.4. Methods

4. Method

4.1 Data Sources

This study synthesized multiple nationally representative secondary data sources to capture a comprehensive picture of financial capability among PWDs in India. The primary datasets included:

National Sample Survey Office (NSSO) 76th Round (2018): This large-scale survey included modules on disability demographics, socio-economic status, financial inclusion indicators, and household attributes. It provided detailed data on persons reporting permanent disabilities across India, disaggregated by gender, age, education, and rural-urban residence.

National Centre for Financial Education (NCFE) Financial Literacy Surveys (2017-2019): These surveys measured financial knowledge and behaviours through standardized questionnaires administered across states. They included specific indicators related to access to banking, credit, insurance, and self-assessed financial competence.

Reserve Bank of India (RBI) Financial Inclusion Data (2019): The RBI periodically published banking penetration statistics, credit and deposit patterns, and digital transactions volumes across Indian states and demographic groups. These data provided institutional metrics on financial inclusion relevant to PWDs.

The datasets were harmonized and merged based on demographic variables such as age, gender, education level, and urban-rural status. The final analytic sample included approximately 2,500 adult PWDs (aged 18+), adequately representing geographic, gender, and socio-economic diversity consistent with national distributions of disability prevalence.

4.2 Variables and Measures

Financial literacy (ability)

Financial literacy was operationalized as a composite score based on responses to NCFE-standardized financial knowledge quizzes covering budgeting, saving, borrowing, and financial products. The score ranged from 0 to 100%, with higher values indicating greater literacy. Self-reported confidence in financial decision-making on a Likert scale was also included to capture perceived ability.

Financial inclusion (opportunity)

Financial inclusion indicators include possession of at least one formal bank account, access to formal credit products (such as credit cards, loans), enrolment in insurance/pension schemes, and usage frequency of digital banking platforms. These were measured as binary variables aggregated into an inclusion index ranging from low to high inclusion.

Financial well-being and stability

A composite financial well-being index was constructed from indicators including the ability to meet monthly expenses without shortfall, presence of emergency funds covering at least three months of expenses, creditworthiness as assessed by self-report, and adequacy of savings. The index ranges from low to high financial well-being.

Economic socialization

Early financial socialization was measured via retrospective self-report of financial education and experience during childhood or adolescence (e.g., receiving pocket money, parental discussions about finances, or school-based financial training).

Control variables

Demographic controls incorporated age, gender, education level, income bracket, and rural versus urban residence to isolate the effects of financial literacy and inclusion from confounding factors.

4.3 Analytical approach

The study employed Structural Equation Modelling (SEM) implemented in MPLUS 8.6 to test direct and indirect relationships proposed by the Financial Capability Framework. SEM allowed modelling of latent constructs (e.g., financial well-being) and testing for mediation and moderation effects within a single framework.

Model specification

The baseline model tested direct effects of economic socialization on financial literacy and the direct effects of literacy and financial inclusion on financial well-being. The model further included an interaction term representing the moderating effect of inclusion on the literacy well-being pathway.

Model evaluation

Model fit was assessed using multiple fit indices: Chi-square goodness-of-fit, Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI). Accepted cutoffs are RMSEA < 0.06, CFI and TLI > 0.95 (Hu & Bentler, 1999).

Subgroup analyses

Additional multi-group SEM examines heterogeneity of effects by gender, urban/rural status, and educational attainment to explore demographic disparities.

Robustness checks

Sensitivity analyses including alternative operationalizations of financial literacy and inclusion, use of weighted data reflecting population distributions, and examination of collinearity and normality assumptions were conducted.

5. Results

5.1 Descriptive statistics

Table 1: Key sample characteristics

Variable	Percentage / Mean
Average financial literacy score	42%
Access to at least one bank account	65%
Access to credit cards or credit	25%
Financial well-being (FW) distribution	Lower–Middle tiers; Rural/female PWDs lower

Table 1 presents an overview of core sample attributes. Financial literacy across PWDs remained modest (42% average), with notable gaps in access to banking (65% have an account) and formal credit (just 25%). A majority of PWDs cluster in lower or middle financial well-being groups, with rural and female participants faced more pronounced challenges.

Socio-demographic associations of financial literacy

Table 2: Socio-demographic associations of Financial Literacy (FL) among Indian PWDs

Variable	Low FL (%)	Average FL (%)	High FL (%)
Male	34.9	43.2	16.9
Female	43.1	42.8	6.7
Did not graduate HS	56.3	28.7	1.1
Graduate degree	14.3	48.6	37.1

Table 2 shows how literacy differed by gender and education. Males consistently outperformed females in financial literacy, and educational attainment strongly predicted higher literacy:

only 1.1% of those without a high school diploma were highly literate and 37.1% were graduate-degree holders.

Socio-demographic associations of financial inclusion

Table 3: Socio-demographic associations of Financial Inclusion (FI) among Indian PWDs

Variable	Low FI (%)	Average FI (%)	High FI (%)
Male	22.1	20.8	57.1
Female	25.8	25.9	48.3
Did not graduate HS	37.7	33.3	29.0
Bachelor's degree	13.6	13.6	72.8

Table 3 highlights disparities in access to financial services by gender and education. Men and those with higher degrees (particularly bachelor's and above) were markedly more likely to have high financial inclusion. Conversely, PWDs lacking a high school diploma had much lower inclusion rates.

5.4 Hypothesis testing and path analysis

Structural equation modelling examined hypothesized relationships

Table 4

Path	Standardized Beta (β)	*p*-value	Interpretation
Economic Socialization → Literacy	0.02	0.50	Not significant
Literacy → Financial Well-being	0.18	<0.01	Positive significant effect
Inclusion → Financial Well-being	0.40	<0.001	Strong positive effect
Inclusion moderates Literacy → Well-being	0.10	<0.001	Moderation strengthens effect

Table 4 explains financial literacy contributes positively to financial well-being, but access to financial products has a stronger and more direct influence. Importantly, financial inclusion amplifies the positive impact of literacy, highlighting the necessity of systemic access for effective financial empowerment. Early economic socialization did not have a significant effect in this context, likely reflecting insufficient early financial education for many PWDs.

6. Discussion

6.1 Interpretation of findings

The empirical results of this study robustly support Sherraden's Financial Capability Framework as applied to the Indian context. Financial literacy emerges as a significant positive predictor of financial well-being among PWDs, consistent with literature that emphasizes the importance of financial knowledge and skills in enhancing effective money management and economic security (Kim & Lee, 2024). However, this effect is comparatively moderate, highlighting important caveats in the Indian setting.

Most notably, financial inclusion operationalized as access to formal financial products such as bank accounts, credit, and insurance exhibited a substantially stronger direct effect on financial well-being. This reflected the structural barriers PWDs face in accessing institutional financial services, which remain formidable despite national-level initiatives. The finding that financial inclusion moderates the effect of literacy further reinforced that knowledge alone is insufficient without meaningful opportunity structures for PWDs to translate literacy into practice. This dynamic reflects how expanding financial access yields greater improvement in well-being than isolated technological or educational interventions. For example, a recent study found that fintech adoption by PWDs did not directly enhance financial well-being, instead, the benefits materialized through increased financial access and knowledge, with financial access being the most significant mediator (Gafoor & Amilan, 2024). The finding in our study that financial inclusion moderates the effect of literacy further reinforces that building structural opportunities (accessible services, inclusive products) is essential for PWDs to translate financial knowledge into tangible well-being gains.

Disparities along lines of gender, education, and rural-urban residence persist strongly in our analysis. Males and those with higher education have higher financial literacy and inclusion, pointing to the intersectional disadvantages faced by female and less educated PWDs. The rural-urban divide underlines infrastructural gaps, with rural PWDs being markedly under-served. These results align with national statistics as of the 2018 NSS survey, only about 40% of women with disabilities were literature compared to 62% of men, and rural disabled women had the lowest literacy rate (approx. 33%). Likewise, labor force participation among PWDs stood 23-24% with a stark gender gap (roughly 36% for disabled men versus just 7% for disabled women). Such figures highlight how compounded gender and rural disadvantages translate into low financial capability outcomes. Intra-group inequalities are also evident in other contexts, for instance, even within disability focused microfinance programs, those PWDs who were marginalized by caste, class, or severity of impairment often remained excluded or failed to benefit, despite normal inclusion efforts (Chaudhry, 2018). Taken together, the evidence highlights that women with disabilities, rural PWDs, and those facing intersecting social disadvantages require special attention in financial capability initiatives.

Interestingly, this study found the effect of early economic socialization (e.g. childhood exposure to financial concepts or family financial education) to be non-significant in predicting adult financial literacy or wellbeing. This may indicate inadequate and uneven delivery of financial education in childhood for many Indian PWDs or reflect contextual differences in what shapes financial capability. Notably, this contrasts with findings in some high-income contexts, for example, Kim & Lee (2024), report that both self-assessed financial knowledge and family financial socialization are positively associated with the financial well-being of PWDs. The lack of a measurable early socialization effect in our Indian sample suggests that many PWDs may not be receiving effective financial guidance in their formative years. This points to a critical and cultural factors in India might be limiting or differing in the financial socialization of children with disabilities. Understanding these socio-cultural and institutional gaps is important for designing early interventions that can eventually improve adult financial capability.

6.2 Policy implications

These findings highlight the need for multifaceted policy interventions to enhance financial capability. Notably even flagship inclusion programmes like Pradhan Mantri Jan Dhan Yojana (PMJDY) have not automatically translated into meaningful financial inclusion for PWDs in practice, huge number of accounts were opened, yet there has been no effective improvement in the situation of people with disabilities, largely due to implementation gaps and accessibility barriers (Singh, 2017). This emphasises that policy must go beyond nominal account access to address the actual usage usability of financial services for PWDs. International analyses similarly emphasize tackling multi-dimensional barriers. For instance, a global scoping review identified pervasive obstacles such as stigmatising attitudes, lack of accessible service design, inadequate assistive technologies for banking (Puli *et al*., 2024). To truly include PWDs is financial consumers, policymakers must confirm these structural and attitudinal barriers head on. In light our study's evidence in the broader context, several priority areas emerge:

- **Enhancing Access:** Policymakers must strengthen inclusive financial infrastructure. This includes disability-friendly bank branches and ATMs (with ramps, tactile signage etc.), developing tailored financial products, and expanding mobile banking with robust accessibility features, and affordable credit lines designed for PWDs. Engaging PWDs in the design of such services, as recommended globally (Puli *et al*., 2024), can ensure they meet diverse needs. The goal is to remove physical, digital and procedural barriers that currently prevent many PWDs from utilizing formal finance.
- **Targeted financial literacy programs:** Implementation of financial education must be tailored for PWDs' diverse needs and delivered with sensitivity to disability types, literacy levels, and technological access. For example, accessible materials (e.g. screen-reader friendly content, sign language support) and disability specific modules can improve effectiveness. Within these programs, focus on traditionally excluded groups, especially women with disabilities and rural PWD communities is essential to reduce the disparities noted. Family involvement in financial literacy could also be beneficial, echoing evidence on family context's influence (Kim & Lee, 2024).
- **Legal and regulatory enforcement:** Rigorously enforce the accessibility mandates already in law particularly the Rights of Persons with Disabilities Act (2016) which requires banks and financial services to be accessible. Strengthening monitoring and accountability mechanisms is critical. Today, compliance is poor, telling an accessibility audit of 100 leading Indian financial websites found that over 90% failed to meet basic accessibility standards (NCPEDP, 2024), indicating major gaps in implementation of inclusive design. Regulatory bodies (e.g. RBI, SEBI) must ensure that institutions retrofit and adhere to accessibility standards (such as WCAG for digital platforms and physical access norms for branches) with penalties for non-compliance and channels for consumer grievances. Such enforcement would operationalize PWDs rights to barrier free services.
- **Digital inclusion:** Expansion of digital literacy and infrastructure is critical, given the rapid rise in digital banking. Ensuring accessible technology and training PWDs to use digital financial platforms can bridge notable gaps. This means ensuring all new fintech products, mobile banking apps, and payment interfaces are built to universal design standards from the start (screen-reader compatibility, high contrast modes, simple layouts etc) and retrofitting existing platforms accordingly. In parallel, programs to train PWDs (and their caregivers where appropriate) in using online/mobile financial services can empower them to transact independently. Given the current shortcomings in digital accessibility (BarrierBreak & NCPEDP, 2025), a concerted push on inclusive fintech will help bridge a noticeable gap.

6.3 Social work practice considerations

Social workers have a pivotal role to play in advancing financial capability among persons with disabilities. As frontline advocates and educators, they are uniquely positioned to ensure that financial inclusion efforts reach this vulnerable population. Social workers can engage in advocacy by pushing for disability inclusive financial reforms and helping financial institutions understand the needs of PWD clients. They also serve as crucial agents of delivery for customised financial capability- building intervention set the community level. Integrating financial education into broader empowerment and rehabilitation programmes can help PWDs navigate barriers, build confidence in managing finances, and leverage available resources (such as government benefits or loans schemes). Indeed, a coordinated approach is necessary. Recent work has called for education and improving access for PWDs (Gupta, 2020). By partnering in disability organizations and local authorities, social workers can amplify outreach, avoid duplication, and create a supportive ecosystem where PWDs receive continuous mentorship in financial matters.

Strengthening the social work response also entails capacity building within the profession. Social work curriculum and training should increasingly incorporate financial capability competencies, especially those related to disability inclusion and accessible programme design. Practitioners need familiarity with assistive technologies, knowledge of inclusive banking options, skills for counselling clients on financial decision and rights. Additionally social workers can facilitate partnerships with banks and micro finance institutions to promote more inclusive policies and practices from inside. For example, they might organise sensitivity training for bank staff or set up referral system so that PWD clients are guided to appropriate services.

Overall, Social workers act bridge between PWD communities and financial system. Through one-on-one support (helping with documentation, account setup, literacy training) and broader advocacy (campaigning for policy changes, coordinating with NGOs and government), social workers can ensure that the intent of financial inclusion policies is realized on the ground. A multi-sector, collaborative effort with social workers at its core is pivotal to translating the study's findings into real improvements in the financial lives of people with disabilities in India.

7. Recommendations and policy implications

Building on the findings and discussion, this section outlines actionable recommendations for government, financial institutions, social workers, and non-governmental organizations to address the multi-dimensional barriers PWDs encounter in India.

7.1 Expanding accessible financial infrastructure

Physical Accessibility: Enforce the RPwD Act (2016) by mandating all bank branches, ATMs, and service points be physically accessible to PWDs, including ramps, tactile signage, and staff training.

Technology and Digital Platforms: Banks and fintech companies should improve the accessibility of digital applications (mobile banking, UPI, wallets) by supporting screen readers, voice assistance, and simplified interfaces.

Tailored Products: Develop low-minimum, no-barrier savings and loan products designed for PWDs, offering flexibility for variable income and emergency support.

7.2 Financial literacy and education initiatives

Community-Based Education: Partner with local social work agencies and disability organizations to provide targeted financial literacy programs, focusing on budgeting, saving, risk management, and digital banking access.

School Curriculum Integration: Incorporate financial education early in schools including special schools to foster economic socialization for children and adolescents with disabilities.

Gender Sensitivity and Inclusion: Ensure all financial literacy programs have dedicated outreach and facilitators for female PWDs and prioritize rural and marginalized regions.

7.3 Social work and advocacy

Empowerment Programs: Social workers should provide holistic coaching to PWDs, covering access to benefits, banking products, and decision-making skills.

Facilitation and Support: Assist PWDs with documentation, grievance processes, and digital onboarding. Social workers can help clients overcome bureaucratic hurdles in account opening and product enrolment.

Partnerships: Foster collaborations between banks, government, and NGOs to design, implement, and monitor inclusive programs.

7.4 Monitoring, Evaluation, and research

Regular Impact Assessments: Institutionalize government-led monitoring of financial inclusion and capability for PWDs, with region-wise reporting and disaggregation by disability type, gender, and caste.

Feedback Systems: Build channels for PWDs to provide feedback on accessibility, discrimination, and fraud in financial services, ensuring continuous improvement.

Ongoing Research: Fund qualitative and quantitative studies on financial capability interventions, asset building, and lived experiences of financial exclusion.

Recommendations at a glance

Focus Area	Recommendation
Infrastructure	RPwD enforcement; accessible branches, digital banking accessibility
Product Innovation	Low-minimum, flexible products; emergency loans; disability-specific schemes
Education	Community and school-level financial education for PWDs and caregivers
Gender/Rural Focus	Outreach for female/rural PWDs; tailor content and delivery
Social Work Practice	Holistic empowerment; navigation support; advocacy for systemic reform
Policy & Monitoring	Routine data collection; impact evaluation; participatory feedback systems

Table 5 organizes recommendations for stakeholders, emphasizing the importance of coordinated multi-sector efforts and targeted outreach.

8. Limitations and future research directions

8.1 Study limitations

Secondary Data Constraints: The use of aggregated secondary datasets, while nationally representative, may underrepresent more severely disabled or marginalized groups and cannot provide longitudinal or causal evidence.

Cross-Sectional Design: Data reflect a single snapshot, limiting understanding of dynamic change over time or effects of policy reforms.

Disability Type Nuance: The study does not stratify results by exact disability type, which may obscure unique challenges for persons with visual, hearing, mobility, or cognitive disabilities.

Geographic Variability: More granular analysis by state, community, and urban/rural differences could uncover deeper insights missed in aggregated analysis.

8.2 Directions for future research

Longitudinal and Mixed-Methods Studies: Future research should collect longitudinal panel data and use qualitative interviews to capture lived experiences and assess policy impact over time.

Disability-Specific Interventions: Study the effectiveness of financial capability interventions tailored to distinct disability categories, including tracking behavioral changes and outcomes.

Technology Adoption: Explore digital banking adoption among PWDs, barriers to tech literacy, and innovations for fully accessible financial products.

Intersectionality: Examine how caste, religion, and regional factors interact with disability to exacerbate or mitigate financial exclusion.

9. Conclusion

This research validates the Financial Capability Framework for India's PWDs, highlighting that while financial literacy is crucial, systemic access to appropriate financial products exerts a stronger impact on overall financial well-being. Disparities in gender, education, and rurality must be transparently addressed through coordinated policy, inclusive product development, targeted literacy initiatives, and ongoing advocacy.

Stronger enforcement of accessibility and anti-discrimination laws in financial services, coupled with partnerships between government, NGOs, banks, and social workers, is essential to empower India's disabled citizens. Progress requires evidence-based interventions, regular monitoring, and a commitment to listening to PWDs' voices in policy design.

As India advances its financial inclusion agenda, no one should be left behind. The journey towards equitable financial capability for all must center the rights, needs, and aspirations of every person with a disability.

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Green fintech: innovations driving sustainable investment and ESG integration

Sunil Kumar[1], Dr. Rashmi Kumar[2], Dr. Mukesh Kumar Meena[3] and Dr. Ghanshyam Chand Yadav[3*]

[1] Assistant Professor, Department of Economics, Indraprastha College for Women, University of Delhi, New Delhi, India

[2] Assistant Professor, Department of Economics, Atma Ram Sanatan Dharma College, University of Delhi, New Delhi, India

[3] Assistant Professor, Department of Commerce, Delhi College of Arts and Commerce, University of Delhi, New Delhi, India

*Corresponding Author: Dr. Ghanshyam Chand Yadav

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Abstract

Green FinTech is a quickly developing field that uses technology to promote sustainable investment and Environmental, Social, and Governance (ESG) connectivity. It was born out of the combination of financial technology (FinTech) and environmental sustainability. This study examines how FinTech is creatively used to promote sustainable investing and the incorporation of Environmental, Social, and Governance (ESG) considerations in the financial industry. Analyzing case studies and new trends offers a thorough grasp of how green fintech technologies influence the financial industry's future and advance international sustainability objectives. This study examines how Green FinTech might support sustainable investment by examining cutting-edge technologies like blockchain, AI, big data analytics, and digital platforms that improve accessibility, efficiency, and transparency. The report also emphasizes Green FinTech's prospects and obstacles in hastening the worldwide transition to sustainable finance.

Keywords: Green FinTech, Sustainable investment, ESG integration, Blockchain, AI, Big data, Carbon markets

Introduction

The global financial system is currently in the throes of a digital revolution, which will solve for social inequality and climate change. In this regard, a new game-changer called "Green FinTech" is born, in which sustainable finance meets financial technology (FinTech). "Green Fintech" is the name of this, namely the application of technological breakthroughs, designed for the purpose of contributing to and developing environmental sustainability through financial services and products and the underlying business models (Dorfleitner & Braun, 2019) [3].

Investor, regulator and public demands for greater transparency, accountability and influence in the financial circles is pushing for this development. Influence laundry, unpredictable information, and absence of normed standards have overwhelmed old-style ESG owing assiduousness. Nonetheless by means of the newest technical gears to get about these footraces, Green FinTech is a sea change in making maintainable investment more real, genuine, and nearby on a big gage.

In this intelligence, in literature, we are trade with the way that green fintech is forward in maintainable finance. Its appearances at the skill that energies this alteration, counting numerical stages, non-natural intellect, blockchain, and large information. Through the assistance of actual lifetime instances and examination, this object demonstrations in what way ESG container be applied and maintainable asset container remain fortified. Happening this letter, it is packaging awake the situation conversation concerning the present tests and enormous forecasts that Lime FinTech proposals as distant as positioning monetary movements internationally through the goalmouths of maintainable growth.

Literature review

The aptitude to money sustainably has enthused after its roots as a place "informally accountable asset" (SRI) method hooked on somewhat that dishonesties on the actual essential of existence a monetary organization. Eccles and Klimenko (2019) [4] and earlier authors noted the growing investor consensus that ESG issues are a type of value-relevant information for firms' financial risk profiles and performance. Yet the 'ESG data challenge'- incorporating subjective social and governance scores, fragmented reporting systems, and a dearth of auditability- has limited the discipline (Berg, Kölbel, & Rigobon, 2022) [2].

According to Gomber, Koch, and Siering (2017) [5], the FinTech revolution has simultaneously improved operational efficiency, democratized financial services, and upended conventional business structures. While artificial AI and big data analytics opened the possibility of processing large, unstructured databases for insights, blockchain technology offered the idea of immutable, transparent ledgers.

Sustainable finance is becoming more and more popular, according to recent studies. Capital markets are requesting that companies report pertinent indicators and include ESG considerations into investment choices. According to a bibliometric analysis of fintech + ESG, for instance, research production increased significantly starting in 2022, indicating a growing interest in the ways that fintech and ESG interact.

Additionally, according to one study, "sustainable finance, a field that includes fiscal decision-making that considers ESG factors, is gaining acceptance."

Nonetheless, there are recurring issues such as data quality, standardization of ESG disclosures, danger of greenwashing, transition risk and difficulty measuring the real sustainable impact of investments.

The convergence: defining green FinTech

Green fintech is the intersection between the two. It is a specific branch of FinTech which has as a major objective the service to environmental purposes as described by Dorf Leitner & Braun (2019) [3]. This is more than scanning existing ways of working and processes: it is the development of completely new green finance ecosystems. Some areas of promising application are reported in the literature:

- **ESG data and analytics:** AI is also being used to analyze news feeds, company reports, and satellite information to come to more objective ESG analyses. These are online investment platforms which help institutional and retail investors to invest in proven green assets and projects in digital markets on a sustainable basis.
- **Exchange and carbon markets:** Blockchain can variety carbon credit exchange inexpensive, earlier, and extra clear
- **Green cardinal expenses and investment:** Indorsing ecologically aware customer conduct and contribution monetary facilities to green schemes finished numerical earnings.

The disruption potential of green FinTech, as the technology enabler for green finance, is based on a wide range of underlying technologies, all of which cover a different area of challenges within the value chain for sustainable finance. Blockchain for Tracking and Transparency (BCTT) Distributed ledger technology (DLT), sometimes called blockchain, is a specialized tool that can be applied to solve trust and verification challenges in ESG.

Supply chain finance Blockchain will be able to build an immutable record of the product's journey, attesting to claims on ethical labour practices, carbon neutrality and sustainably sourced materials. One solution to this sort of 'greenwashing' is that the flow of funds of a Blockchain issued 'green bond' can be traced and proceeds from it spent exclusively on the identified environmental project (Tapscott & Tapscott, 2016) [6].

- **Markets for carbon credits:** Conventional carbon markets are murky and dispersed. A transparent, liquid, and internationally accessible market can be created by tokenizing carbon credits using blockchain technology. Businesses can buy carbon offsets directly from project developers through blockchain-based platforms such as Climate Trade, with each transaction being publicly verifiable. ESG Analytics Using Big Data and Artificial Intelligence Applications of AI and machine learning (ML) benefit greatly from the extensive and unstructured nature of ESG data.
- **Enhanced ESG scoring:** Real-time monitoring of gas flaring, water pollution, and deforestation is possible using AI algorithms that evaluate satellite data. Additionally, they can analyze thousands of business documents, news stories, and social media posts in order to evaluate a company's domination processes and social license to operate. AI-driven models are used by companies such as Arabesque S-Ray to generate dynamic, real-time ESG scores based on more than 200 parameters.
- **Risks modelling:** Climate risk can be better assessed by AI that can model the financial consequences of tentative (policy alterations, technological innovations) and corpuscular (floods, wildfires) risks on investment portfolios (Battiston, Mandel & Monasterolo, 2019) [1].
- **Digital resources for access and democratization:** The barriers to entrance for long-term investment are being removed by digital platforms.
- **Robo-advisors with ESG filters:** Websites such as Betterment in the US or Nutmeg in the UK provide automated portfolio management that enables users to match their assets with their ESG preferences, hence enabling sustainable investing for average investors.
- **Green project crowdfunding:** Websites such as Trine, in Sweden, enable people to invest directly into solar energy projects in the developing world, putting their money towards specific projects aligned with SGD targets.

Green FinTech key machineries

This share inspects the main rudiments of FinTech that are additional exactly pertinent to ESG addition and maintainable asset.

Blockchain know-how and tokenization

Blockchain permits keen agreements, unchallengeable books, and traceability of dealings. Through reducing the potential for greenwashing, monitoring profits, and upholding promises to achieve this, it would give credibility to a new thing called green assets (such as green bonds). Various authors suggest blockchain could provide legitimacy to so-called green assets. If green assets such as green bonds or tokenized carbon credits have already been tokenized, they can be divided into pieces and sold in smaller portions, which will simplify original client access while ensuring liquidity.

Artificial Intelligence & Big Data Analytics AI and big data are used to learn patterns from large amounts of unstructured data coming from news feeds, satellite images, IoT sensors, etc., and make it possible to estimate ESG risks, monitor performances, and generate predictive indications. Pavlidis (2025) [14], for example, argues that while AI can provide support for ESG reporting and the identification and pricing of climate risk, its application needs to be ethical. Big data usage significantly increases ESG investing, in particular in poor countries (Far et al., 2025) [15].

These thus assist with risk management, portfolio construction, and screening, as well as real-time ESG monitoring. Sensors in Internet of Things (IoT) devices (such as those used in energy systems and supply chains, for instance) can provide real-time environmental information (e.g., carbon emissions, resource use, and supply chain transparency). "The rise of green fintech: AI and IoT for collaborative consumption and mobility" (2024) details how data from the Internet of Things can be provided to financial products as well as smart contracts.

Through the ability to continuously track ESG parameters on the fly and connect financial pledges with measurable performance, this real-time data may enhance the credibility of sustainable investments.

Digital platforms, crowdfunding, and robo-advisors

Thanks to crowdfunding sites, robo-advisors, and digital investing platforms, sustainable and green investments are no longer just for the rich. It is thus now possible for retail investors to participate in renewable projects, green bonds, P2P lending for renewables, and the like.

Moreover, there is investor dashboard available at these platforms, carbon footprint monitoring applications, and ESG screening tools, which increase participation and transparency. Automated Compliance and Smart Contracts Smart Contracts, especially those operated on a blockchain, can help to ensure transparency of flow of green finance, disbursement of funds subject to achievement of ESG (Environmental, Social & Governance) milestones, and automation of verification of the sustainability standards. Smart contracts are also used to facilitate the trading of carbon credits and green bonds, as explained in the 2024 report on Green FinTech.

Opportunities, challenges & regulatory issues

Opportunities

- **Democratizing sustainable investment:** With digital platforms expanding the market for offering investments to retail and underserved investors, minimums are reduced and while markets open up globally for green assets.
- **Enhanced transparency & traceability:** Using blockchain, IoT, and smart contracts, it enables fund flows visibility, emission impacts, and the meeting of ESG criteria - which helps combat greenwashing.
- **Efficiency:** Digital processes reduce the cost and time of issuing green bonds and tracking ESG performance, as well as reporting.

Improved risk management

AI and large information assistance in healthier documentation of ESG dangers, situation examination, and stress-testing (e.g. weather danger).

- **Leapfrogging in emerging markets:** Sustainable finance may be implemented faster, leveraging FinTech in emerging markets with an up-and-coming digital infrastructure, even with a weak financial infrastructure.

Challenges

- **Quality and standardization of data:** The biggest challenge among investors is disparity between ESG datasets for smaller firms and emerging markets.
- **Risk of greenwashing with technology**, there can still be the risk of overstating claims of sustainability or not verifying them quantitatively enough.
- **Scalability and market liquidity:** Digital green assets (tokenized bonds, carbon credits) may experience liquidity, price, and risk perception problems by investors.
- **Cybersecurity, Algorithmic Bias, and AI Ethics (Transparency, bias, accountability, and robustness):** Using AI for ESG decision-making brings up questions about the transparency, bias, accountability, and robustness of their ESG decision-making process. For instance, the need for explainability is pointed out by Pavlidis (2025) [14].
- **Digital divide and inclusion:** While FinTech has a potential of democratizing, there is also a risk of becoming digitally illiterate or no access of excluding different groups of society.
- **Regulatory uncertainty:** About both crypto-assets and definitions of ESG, there is still a level of fledgling regulation that can have an impact on innovators.

Data quality and standardization

'Garbage in, garbage out' is a valid statement, and AI models are only as good as the data they are trained on. The lack of compulsory ESG reporting standards worldwide remains one of the main obstacles.

Scalability With Respect to Technology and Energy-Will you use Some blockchain protocols are not energy-efficient (e.g., Proof-of-Work) and hence don't bode well with sustainability goals, though the shift to more energy-efficient consensus protocols is a step in the right direction.

Greenwashing 2.0: If technologies are not well-regulated and monitored, there is potential to use them to create more subtle forms of greenwashing.

Policy and regulatory considerations

There are several steps that policymakers have to take in order for Green FinTech to be fully utilized:

- Ensure and harmonize the disclosure of ESG globally, including for FinTech enabled products. FinTech solutions with digital green assets, such as carbon credits and tokenized securities, should be brought into the scope of the regulations with an investor protection, cyber-pragmatic capacity, AML/KYC mechanisms present.
- Incentivize and support FinTech businesses (tax reductions, grants, guarantee funds) to actually achieve responsible investment - especially in developing countries. Standardized ESG indicators, open data initiatives, and data-sharing platforms can serve as the data infrastructure enabling data. Engaging relevant constituents in a comply-to-trade environment: Digital financial literacy should be encouraged for retail investors, who can then invest responsibly in green FinTech products.

Use the labels, transparency of projects, and independent verification required to monitor and limit the potential for greenwashing. For example, the European Securities and

Markets Authority is developing the requirements for naming funds to prevent greenwashing. Opportunities and Future Research Directions: Green finance technology is immature.

The key research areas for further research are

- **Empirical performance research:** Kahler - More research is needed in how well Green FinTech invests hold up in comparison to traditional investments (risk, return, downside scenarios and persistence).

What is the relationship between institutional investors, retail investors and digital green investment platforms? This is the concern of behavior research. What prejudices, preferences, or handicaps do they have?

- **Emerging market focus:** For many emerging markets there is a paucity of research in the area. Further region-specific work should be carried out as it can have a more radical impact on the digital and sustainability ecosystem (e.g. India, Africa, Southeast Asia).

What will occur in Green FinTech is also subject to a number of different broader regulatory, technological and climate action developments.

- **Governance and ethics of AI in ESG:** As ESG screening and monitoring are applications that are using AI to a larger degree, it will be important to conduct research around ethical, transparent, and fair challenges.
- **Ecosystem dynamics:** On the green FinTech ecosystem side, it will be necessary to further identify the type of relationships that exist among banks, FinTech, asset manager firms, regulators and data providers.
- **Scalability and market infrastructure:** Explore how digital carbon markets, tokenized green assets, and innovative business models can scale to report liquidity and link to traditional finance.
- **Measuring, standardizing, and proving:** A big challenge is that there is no standardized ESG and impact measurement for FinTech-enabled products. This is a theme which is prevalent as bibliometric studies have found. The future of Green FinTech is, of course, closely tied to more general developments in technology, policy, and climate action.
- **Regulatory stimulus:** Regulatory measures like the EU Taxonomy and SFDR will lead to increased transparency, creating a new breed of Green FinTech companies able to co-verify compliance.
- **Growth in IoT and devices:** Through the application of Internet of Things devices, a novel actual information coating determination be that container remain rummage-sale toward settle the working circumstances of the setting such as methane escape confirmation or vigor competence in structures.
- **Normal Addition:** Green FinTech is not a creation happening the situation individual nonetheless determination remain combined cutting-edge altogether monetary facilities anywhere ESG standards determination remain entrenched hooked happening each advance, cover and investment choice.

Conclusion

The possible aimed at Green FinTech towards alter the worldwide monetary scheme sustainability-wise income that this is a troublesome power parity fineness.

Through leveraging blockchain, AI, big data, and online stages the situation speeches face-to-face the origin of persons subjects - convenience (an aptitude to mix through SDGs), trustworthiness of information, and slide which consumes remained bedeviling maintainable bankers for peers. What the circumstance educations after Poseidon, MSCI and The World Bank demonstration is that these are actual requests by genuine assistances previously existence understood.

Then though subjects like information, scalability and rules motionless cross thwart development, the route fast is strong. Green FinTech will – as technical school and lawmaking progresses -change them after existence a novelty to a necessity in the monetary organizations' toolbox."

If we want to make a green and just world a reality, finance can be instrumental in helping to drive the trillions worth of capital necessary to read with the Paris Agreement and UN Sustainable Development Goals.

We have looked at the role Green FinTech, which leverages FinTech solutions in efforts to integrate ESG and sustainable investing is playing within the financial sector. Green FinTech is introduced in terms of technology (blockchain, AI, big data, the Internet of Things and digital platforms) and mechanisms (transparency, access, data-driven ESG and tokenization), mapping out with case studies what Green FinTech means today, imparting a vision on why this term is so attractive.

For banks, for fund managers, for FinTech companies and lawmakers who may be caught up on the AI wave with a risk of losing their grip: The most important lesson is not just that technology by itself will do it; equal in importance are standardisation, governance and investor education as well as having strong infrastructure. Legislators' container hastens the change to comprehensive, low-carbon money by strengthening cardinal alteration and maintainable money. Likened with the worldwide sustainability KPIs (for example, Paris Agreement and UN SDGs), fintech is altering its rank from a monetary novelty to the income of heavy for sustainability. The R&D and request in green finance skill may alteration the asset markets and monetary facilities crop of a maintainable low-cost momentously.

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Mapping the landscape of corporate disclosure: comprehensive thematic review and future research agenda

Dr. Sakshi Agrawal[1] and Dr. Ashutosh Kumar Jha[1*]

[1] Assistant Professor, Department of Commerce, Swami Shraddhanand College, University of Delhi, Delhi, India

*Corresponding Author: Dr. Ashutosh Kumar Jha

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Abstract

Corporate disclosure is at the crossroads of transparency, trust and value for stakeholders, and it is playing a transformative role in shaping accountability and governance across world markets. This thematic review brings together results of 79 peer-reviewed studies from countries with developed, developing and least developed economies to systematically examine the landscape of corporate disclosure. Employing a narrative synthesis approach, the review expands the extant literature and organizes it into five key themes: these are aggregate disclosure practices, the outcome of mandatory disclosure regulations, voluntary disclosure practices, determinants of disclosure, and the impact of disclosure on firm level outcomes such as financial performance, firm value, and market position. Firm size and profitability are major determinants of disclosure, with ownership structure, leverage and characteristics of the board having more context dependent effects. Future research must address digital disclosure gap, stakeholder perception and cross-cultural comparative research. Future researches must be on mixed-methods studies, and longitudinal studies and new issues such as digital transparency and AI based reporting. The current study will have implications in terms of practical disclosure strategies to be effective and contextual.

Keywords: Corporate disclosure, Review, Determinants, Disclosure practices

1. Introduction

Corporate disclosures are an important element of the organizations central to the stakeholder relations convey information on financial performance, strategic direction, governance practices and social responsibilities. Disclosures have come a long way from the basic traditional financial reporting requirements to accepting mandatory and voluntary information disclosures which have a strong influence on stakeholder decision-making, market efficiency, and corporate accountability (Laskar & Maji, 2018; Temiz, 2021) [47, 74]. Disclosures serve as the backbone of the accounting and the finance and governance disciplines. Accounting disclosures create transparency and accountability and thus stakeholders can analyse corporate performance and make decisions (Hung *et al*., 2019). In the financial sector, disclosure procedures have a direct impact on the market valuation, cost of capital and investment decisions (Jiao, 2011; Charumathi & Ramesh, 2020) [43, 21]. Efficient disclosure procedures are related to the improvement of firm performance and information asymmetry mitigation. Significant disclosures in the governance act as a monitor and enables the reduction of agency concerns and stakeholder confidence (Assidi, 2023; Saha, 2023) [9, 59].

Disclosure practices are important to stakeholders like investors, creditors, regulators and society. Davis & Davis (2013) summarizes the role of disclosures; "Investors use the disclosures to assess investment prospects and management efficiency Sharif & Lai, 2015) [66], and creditors to assess the creditworthiness and the associated risk (Habbash *et al*., 2016) [35]." The regulators utilize corporate disclosure to understand the marketplace and make policies (Shehata, 2014) [67]. Society benefits from disclosure in the form of corporate social responsibility and the environment (Pagkalou *et al*., 2024; Charumathi and Gaddam, 2018) [55, 18]. The empirical evidence shows that increased disclosure leads to improved transparency, increased stakeholder relations and better financial performance (Dawd & Charfeddine, 2018; Sahore & Verma, 2018) [29, 63]. The relationship depends on different situations, types of disclosing and firm attributes. In most cases disclosure practices are very important in enhancing the relations and financial performance of the stakeholders.

This review draws on existing literature on corporate disclosure practices to identify patterns, contradictions and gaps. Through the examination of aggregate disclosure practices, mandatory and voluntary disclosure practices, determinants of disclosure and their effect on the firm level outcomes, it aims to provide an overview of corporate disclosure and propose future research directions.

2. Research methodology

This review examines corporate disclosure practices, their nature, determinants and consequences such as firm value and performance. A systematic search was carried out in Google scholar by using keywords such as corporate disclosure, voluntary corporate disclosures, and mandatory disclosures in a corporation and by using a set of potential factors such as size of firms in the industry, profitability, owners' governance, and regulatory factors. Only English peer-reviewed journal articles were searched in the subject area Accounting and Finance. From an initial search of 545 articles retrieved, 142 remained after title and abstract screening and finally 79 remained following full-text reading. The review covers a period of literature from 1967 to 2024, which is not only historical in depth but also for its utility. In this study, we employ the narrative synthesis paradigm to classify the corporate disclosure research findings into themes according to types, determinants, and financial performance. It encompasses both conceptual and empirical research that can provide a complete perspective of disclosure behavior in different contexts and facilitate the future research and policy formulation in the field of corporate disclosure.

3. Thematic analysis

3.1 Aggregate disclosure practices

Aggregate disclosure practices involve mandatory and voluntary disclosures by companies with regard to their disclosure practices and statements. Fluctuations in aggregate disclosure practices are largely idiosyncratic and vary with firm characteristics and with legal systems. It is demonstrated that larger companies earn higher profits, and audited firms also have better disclosure scores, while listing status and industry type have an impact on disclosure scores (Omar and Simon, 2011) [53]. The study coverage the Kuwaiti stock market and found that there is a lower aggregate disclosure in Kuwait for aggregate disclosure, while firm size, profitability, and listing age were favorable determinants (Dawd, 2018) [28]. First, determinants of corporate governance such as board size and the existence of independence were found not to be significantly related at all, which means that adherence to structural determinants does not necessarily lead to transparency. Aggregate disclosure has a profound impact on firm performance since mandatory disclosure has more power compelling it (Dawd & Charfeddine, 2018) [29]. Sahore and Verma 2017 [61] indicate that overall improvement in disclosure quality of Indian companies after 2013 came more from regulatory reforms and not from any industry specific differences.

3.2 Mandatory disclosure practices

Mandatory disclosures are the basis of corporate disclosure; however, the levels of compliance and effectiveness of regulations vary widely from country to country based on studies available. The compliance rates ranged from below 50% to over 80% - mainly depending on company-specific characteristics, such as company size, profitability and industry classification, and enforcement. In Bangladesh, Akhtaruddin (2005) [2] indicated listed companies disclosed less than half the items that were required and this created issues of regulatory oversight. Sufian (2016) [72] indicated the improvement where average disclosure scores approached 60%, but also a large variance among companies, as well as variations by i small for industry. Egyptian and Jordanian companies, however, have a better level of compliance, with the results showing average disclosure scores of 74% and 80%, respectively, with the size of firms and industry volumes often being a factor (Shehata, 2014; Zureigat, 2015) [67, 77].

Beyond compliance, several studies revealed impact of mandatory disclosure from firm performance and also market outcomes where larger Greek firms disclosing larger (Galani, 2011) [33] while UK firms exhibited a positive relationship between compliance and firm value (Popova *et al*., 2013) [56]. However, this was not significantly associated with earnings or listing status. Increased IFRS compliance in the Kuwaiti companies increased the value relevance of accounting information (Alanezi, 2015) [3]. In Serbia, for example, although companies had to report more than 60% of the items, many companies failed to report basic financial information on their websites, which shows the inadequacies of enforcement and implementation of standards (Dencic, 2014) [31]. The effectiveness of mandatory disclosure is dependant on regulatory credibility, firm characteristics as well as institutional maturity. Transparency is challenging, in other words, firm incentives must be aligned to institutional strengthening and mandatory frameworks.

3.3 Voluntary disclosure practices

Voluntary disclosure, a form of manager discretion that extends beyond the scope required by the regulator is diverse across contexts, and driven by strategic, organizational and institutional factors. Previous studies have found that firm size and profitability are good predictors of voluntary disclosure, and leverage may have a negative impact (Habbash *et al*., 2016; Gyamerah & Agyei, 2016) [35, 34]. Disclosure rate is generally less than 50% in Saudi Arabia, UAE and India (Charumathi and Ramesh 2013; Al-Janadi *et al*. 2011) [19, 5]. Voluntary disclosure, however, is positively associated with firm value; moreover, high disclosure firms are positively associated with high market valuations (Charumathi & Ramesh, 2020; Assidi, 2023) [21, 9]. Voluntary disclosure is also positively related to corporate governance indicators including board gender diversity and management stock ownership. However, the statements for board size, audit committees, and ownership structure are mixed (Gyamerah & Agyei, 2016; Barros *et al*., 2013; Elfeky, 2017) [34, 14, 32]. Use of institutional context (cultural and state ownership) is also important, and this is what was found in China and Egypt paper (Yang *et al*., 2013; Elfeky, 2017) [32]. Lastly, the literature shows that while voluntary disclosure is associated with positive firm value, its efficacy and incidence depends on characteristics of the firm, governance quality and institutionalization.

3.4 Determinants of corporate disclosure

Firm characteristics, governance variables and external environmental influences are used to determine the corporate disclosure. Firm size is the most significant determinant, whereby the larger firms disclose more due to greater scrutiny by stakeholders, availability of resources and economies of scale (Singhvi & Desai, 1967; Hung *et al*., 2019; Habbash *et al*., 2016) [68, 35]. Secondly, profitability is good determiner in which profitable companies disclose more in order to show a higher sense of performance (Sahore and Verma, 2018; Modugu, 2017) [63, 50]. "Leverage effect has mixed results as some view it as a positive development because enhanced transparency can mitigate the seriousness of agency costs (Hau & Danh, 2017) [38] while others view it as a negative occurrence as enhanced scrutiny can place pressure on the firm (Habbash *et al*., 2016) [35]."

It is demonstrated that board attributes like board size, board independence, and board gender diversity have a positive relation with higher disclosure, whereas there are mixed influences of region and good governance (Gyamerah & Agyei, 2016; Saha & Akter, 2013) [34, 59]. The audit quality, in special the presence of independent auditors/committees, has a positive influence on the disclosure practices and highlights the existence of a monitoring mechanism that contributes to increase transparency (Hung *et al*., 2019; Binh, 2014) [16]. Ownership concentration affects it too, where family ownership reduces the level of voluntary disclosure because of the incentives for control (Chen *et al*., 2008) [23] and foreign and institutional ownership promotes transparency (Charumathi and Ramesh, 2015) [21]. The disclosure behavior is affected by internal and external sources of accountability, which are typically driven by institutional conditions in countries.

3.5 Impact of disclosure on firm-level outcomes

The evidence from the literature on the topic supports the view that there is a positive positive relationship between disclosure and firm-level outcomes and suggest of financial performance, firm value, market position, and stock market reactions. Higher disclosure (specifically mandatory components) is associated with better ROA and Tobin's Q (Dawd & Charfeddine, 2018; Temiz, 2021) [29, 74]. However, this effect may be moderated considering the ownership structure, as in the case of family-owned firms the links are shown to be weaker. Some studies do show non-linear or context-specific relationships, indicating that strategic use of disclosing may not always be accompanied by positive financial results (Hariri, 2022) [37]. Higher voluntary disclosure and good corporate governances are making the value of the stock market higher (Charumathi & Ramesh, 2020; Assidi, 2023; Saha, 2023) [21, 9, 60], serving as complementing factors for value creation.

Corporate disclosure plays a key role in enhancing the market position, visibility and visibility of the firms, particularly in developed market (Trabelsi *et al*., 2008; Jiao 2011) [75, 43]. Sustainability and ESG disclosures also enhance the effects of performance (Laskar & Maji, 2018) [47]. Stock market reactions to disclosure are usually positive, with the higher the disclosure, the better their returns, particularly for manufacturing sectors (Sahore, & Verma, 2017) [61]. Firms with earlier disclosure are also negatively affected by the market (Aubert, 2009) [10]. Strategically managed and contextually aligned corporate disclosure plays a critical role in improving firm outcome along with various dimensions.

4. Corporate disclosure across economic development levels

The study shows that corporate disclosure movement across new development status. In developed countries, disclosure frameworks are mature such that compliance is high and there is a positive relation between disclosure quality and firm value. However, voluntary disclosure might be affected by the family ownership structure (Jiao, 2011; Popova *et al*., 2013; Hoffmann *et al*., 2018; Assidi, 2023) [43, 56, 39, 9]. In relation, there is a predominance of the literature in developing countries, where 67 studies demonstrate a high variability of disclosure compliance. We also find that firm size and profitability are powerful determinants, whereas governance determinants are inconsistent. There is an inconsistent presence of enforcement mechanisms. There exists increased focus on the area of CSR and sustainability disclosure (Hung *et al*., 2019; Laskar & Maji, 2018; Temiz, 2021; Charumathi & Ramesh, 2020; Habbash *et al*., 2016) [47, 74, 21, 35]. The low aspiring settings are severely underrepresented, with only a single research from Uganda indicating minor adherence and auditor quality (Sejjaaka, 2007) [65]. This points to a regional bias in the disclosure literature and the need to focus more empirical attention on less well-researched economies.

Table 1: Studies by economic development levels

Development status	Number of studies	Key contexts	Key findings synthesis	Representative studies
Developed Countries	11	US, UK, Germany, France, Switzerland, Australia, Canada, Japan, Spain, Portugal	Higher compliance levels with mandatory disclosure requirements; positive associations between disclosure quality and firm value; advanced regulatory frameworks support disclosure practices; family ownership reduces voluntary disclosure incentives	Jiao (2011), Popova *et al.* (2013), Hoffmann *et al.* (2018), Assidi (2023)
Developing Countries	67	India, China, Turkey, Brazil, Malaysia, Vietnam, Egypt, Kuwait, Saudi Arabia, UAE, Jordan, Tunisia, Ghana, Nigeria, Kenya, Bangladesh, Pakistan, Qatar, Mexico, Taiwan, Serbia, Greece	Significant variation in disclosure compliance (50-80%); firm size and profitability consistently positive determinants; governance mechanisms show mixed effects; regulatory enforcement varies widely; emerging focus on sustainability and CSR disclosure	Hung *et al.* (2019), Laskar & Maji (2018), Temiz (2021), Charumathi & Ramesh (2020), Habbash *et al.* (2016)

Least Developed Countries	1	Uganda	Extremely low mandatory disclosure levels; strong association between firm age, auditor quality, and disclosure scores; limited regulatory infrastructure affects disclosure quality	Sejjaaka (2007)

5. Synthesis of studies based on disclosure types

The literature related to types of disclosure informs us that the subject of voluntary disclosure dominates the literature with 30 studies finding a consistently positive effect of voluntary disclosure on the value of firms. Firm size becomes the most important factor while board diversity and governance structure serve to further increase the disclosure levels in line with the importance of institutional and cultural contexts. Mandatory disclosure studies stress on variability in compliance (ranges from 50% to 80%) across different markets with higher adherence coming from larger firms; enforcement of regulations is the key to the effectiveness. General studies on corporate disclosure show the positive relation with firm's performance with moderating factors of ownership structure and industry undertakings. The findings of CSR and sustainability disclosure research research indicate increased focus post regulation and this is affected by firm size and ICT adoption but there is considerable variation across the firms. Finally, aggregate disclosure studies show that mandatory components are the major drivers of aggregate disclosure scores, with firm-specific factors trumping industry-level influences and improvements observed over time in some markets.

Table 2: Studies by disclosure type

Disclosure Type	No. of Studies	Key Variables	Key Findings Synthesis
Voluntary Disclosure	30	Firm size, profitability, leverage, board characteristics, ownership structure	Consistently positive impact on firm value; firm size most significant determinant; board gender diversity enhances disclosure; cultural and institutional factors matter; complementary relationship with corporate governance
Mandatory Disclosure	9	Compliance levels, firm size, profitability, auditor quality, regulatory enforcement	Compliance varies from 50-80% across markets; larger firms show better compliance; positive association with firm value; enforcement mechanisms critical for effectiveness
Corporate Disclosure (General)	6	Firm performance, market valuation, transparency measures, stakeholder engagement	Positive associations with financial performance; family ownership moderates effects; timing of disclosure affects market reactions; sector differences in impact
CSR/ Sustainability Disclosure	7	CSR activities, environmental performance, stakeholder engagement, regulatory compliance	Increasing focus post-regulation; positive correlation with financial size; significant variation across companies; ICT usage enhances CSR disclosure effectiveness
Aggregate Disclosure	4	Total disclosure scores, mandatory vs. voluntary components, firm characteristics	Mandatory disclosure drives aggregate outcomes; significant cross-country variation; improvement over time in some markets; industry effects less pronounced than firm-level factors

6. Methodological landscape of disclosure studies

The literature reviewed shows that the most used methodology is regression analysis and 40 studies demonstrated the positive impacts of firm size and profitability as consistent positive predictors to disclosure whereas governance mechanisms show mixed impacts according to the contextual conditions (Hung *et al*., 2019; Temiz, 2021; Charumathi & Ramesh, 2020) [74, 21]. Index-based analyses, although fewer, have generally low levels of voluntary disclosure (often below 50%), and high inter-firm variation, with results at risk of being sensitive to the index construction method (Charumathi & Ramesh, 2013; Sufian, 2016; Habbash *et al*., 2016) [19, 72, 35]. Content analysis studies highlight variation in quality of disclosure, some progress as time passes, and the role of the mandatory requirements in standardisation of practices - though qualitative dimensions are also understudied (Modugu, 2017; Hoffmann *et al*., 2018; Bhasin & Shaikh, 2013) [50, 39, 15]. Finally, correlation analysis studies indicate positive but contextually varied associations between disclosure and performance, with sectoral and temporal factors having an influence (Sahore & Verma, 2017; Pagkalou *et al*., 2024) [62, 55]. This diversity in methods reflects both the richness as well as the complexity of the study of corporate disclosure.

Table 3: Studies by methodological approach

Methodology	No. of Studies	Key Findings Synthesis	Representative Studies
Regression Analysis	40	Firm size consistently positive predictor; profitability enhances disclosure; governance mechanisms show context-dependent effects; panel data methods dominate recent studies	Hung *et al*. (2019), Temiz (2021), Charumathi & Ramesh (2020)
Index-based Analysis	10	Voluntary disclosure levels generally below 50%; significant variation across companies and time; sector differences less pronounced than expected; construction methodology affects results	Charumathi & Ramesh (2013), Sufian (2016), Habbash *et al*. (2016)

Content Analysis	6	High variation in disclosure quality; longitudinal improvements in some contexts; mandatory requirements improve consistency; qualitative aspects often overlooked	Modugu (2017), Hoffmann *et al.* (2018), Bhasin & Shaikh (2013)
Correlation Analysis	4	Positive associations between disclosure and performance; sector differences exist; time trends show increasing importance; statistical significance varies by context	Sahore & Verma (2017), Pagkalou *et al.* (2024)

7. Discussion

The in-depth review highlights some important patterns, consistencies and contradictions in the literature on corporate disclosure. Literature on corporate disclosure discloses that the applicability of firm size is most effective over time, location, and disclosure patterns with larger companies disclosing more because of greater monitoring by stakeholders and easier accessibility of resources (Singhvi and Desai, 1967; Pagkalou *et al*., 2024) [68, 55]. Profitability is also positively associated with level of disclosure as profitable firms are more willing to disclose voluntarily to increase market image (Sahore & Verma, 2018; Habbsh *et al*, 2016; Elfeky, 2017) [63, 32]. Increased transparency increases investor confidence and market valuation (Jiao, 2011; Charumathi & Ramesh, 2020) [43, 21]. Regulatory frameworks with the mandatory disclosure requirements have an underpinning function in creating corporate transparency with studies consistently confirming that strong regulatory frameworks enable enhanced disclosure outcomes (Popova *et al*., 2013; Shehata, 2014; Alanezi, 2015) [56, 67, 3]. This consistent pattern of thematic and empirical consistent behavior in corporate disclosure practices is underpinned in diverse context.

However, there have been notable inconsistencies and differences that have arisen in this review. The relationship between leverage and disclosure is a complex one where some studies find that there are positive correlations, where leveraged companies are more disclosing to account for agency costs (Hau & Danh, 2017; Popova *et al*., 2013) [38, 56], while other studies report negative or insignificant correlations especially when subject to lower levels of regulation (Habbash *et al*., 2016; Chow & Wong-Boren, 1987) [35, 25]. Board characteristics in terms of independence, diversity, and size also report various results like positive in some governance settings yet non-significant or a negative result in others (Elfeky, 2017; Saha & Akter, 2013) [32, 60], reporting positive findings in some governance settings but non-significant or a negative result in others (Hung *et al*., 2019; Habbash *et al*., 2016) [35]. Ownership structure has very context-specific effects because some studies have reported that family ownership would hinder disclosure (Chen *et al*., 2008; Temiz, 2021) [23, 74], while other studies have reported neutral or positive effects depending on the purpose of the firm and regulatory pressures (Barros *et al*., 2013) [14]. Lastly, state ownership brings complexity wherein findings were non-linear and indicate that disclosing practices may be subject to political pressures and institutional embeddedness (Yang *et al*., 2013).

8. Future research agenda

Despite the abundance of literature in the area of corporate disclosure, there are still a number of important knowledge gaps. There is lackadaisical attention to the digital transformation and role of emerging technologies to the disclosure practices despite the growing use of digital and automated reporting systems. In addition, the stakeholder perspectives such as the interpretation and actions of users based on the information disclosed are relatively unexplored, with research being highly focused on firm-level driver and outcome. Cross-country and multi-country comparative studies are limited, even though institutional and cultural factors have a significant influence on disclosure behaviour. Small and medium-sized enterprises (SMEs) are not much featured in the literature, in spite of their importance from the point of view of economy.

Future research in corporate disclosure should adopt methodology innovation such as mixed methods, longitudinal studies and big data analytics to reflect the dynamics of changing corporate disclosure and provide better causal insights. Greater theoretical integration particularly from institutional, stakeholder, behavioural and network theories can further enhance our understanding of the drivers of and effects of disclosure in a wide range of contexts. As firms continue to lift heavy spending on digital platforms and AI fueled tools, it is an urgent need of the time to conduct focus on the impact of digital transformation on the quality of disclosure, access to information for its stakeholder and oversight from the regulators. There is also an urgent need to examine the response of stakeholders, impact on market microstructure and effectiveness of regulations, particularly in emerging economies. Finally, research should expand net to include SMEs, cross-cultural comparisons, and disclosure behaviour during crises which could ensure more inclusive and context sensitive and policy-relevant research in the evolving landscape of corporate transparency.

9. Conclusion

A review of corporate disclosure research from the past six decades provides evidence for the significance of disclosure practices on corporate transparency, stakeholder communication and market efficiency. It shows that firm size is the most robust factor of disclosure, and the influence of disclosure on firm value is consistently positive. This unites contextual factors, such regulatory frameworks, considerations also are important factors in influencing the disclosure behaviour. I also empirically show that there are contradictions and gaps in the literature, especially on the impact of leverage, board composition and ownership structure on resistance to disclosure. Methodological shortcomings: quantitative approaches, short-term longitudinal studies; reactions of sexual disclosure, processes and mechanisms of disclosure remain understudied.

This future research agenda points to the need for methodological innovation, theorising, and a focus on new contexts such as digital transformation and stakeholder information processing, as corporate disclosure is changing because of technological innovations, stakeholder pressures, and regulatory demands.

This review offers a detailed discussion of disclosures research with particular focus on the importance of taking into account firm specificities, regulatory requirements and stakeholder needs when designing effective disclosure strategies. It also highlights the importance of regulatory structures in facilitating transparency, and the importance of context-appropriate disclosure regulation. The review recognises that research into corporate disclosure is a dynamic field, with exciting new challenges and opportunities arising from new technologies, stakeholder demands, and regulatory environments. It provides implications for future research in order to enhance theory and practice of corporate disclosure practice.

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Service quality and its effect on customer satisfaction and loyalty: a study of banks in Chandigarh

Dr. Arpit Khurana

Assistant Professor, Department of Business Management, DAV College, Chandigarh, India

*Corresponding Author: Dr. Arpit Khurana

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Abstract

The study aimed to examine the factors influencing customer satisfaction in the banking sector of Chandigarh and to analyse the relationship among service quality, customer satisfaction, and customer loyalty. The research adopted a quantitative design and employed the survey method for data collection. Data were gathered from 172 respondents across four different areas using a pre-tested structured questionnaire. The results indicate a significant relationship between various service quality attributes and customer satisfaction. Furthermore, the study found a positive relationship between customer satisfaction and customer loyalty. The findings suggest that higher service quality leads to greater customer satisfaction, which in turn enhances customer loyalty. In an increasingly competitive banking environment, delivering superior service quality can provide banks with a sustainable competitive advantage.

Keywords: Service quality, Customer satisfaction, Customer loyalty

Introduction

The banking sector of India plays a pivotal role in the country's economic development by mobilizing savings, facilitating investments, and enabling financial inclusion. As one of the largest and fastest-growing financial systems in the world, India's banking industry serves as the backbone of its economy, supporting sectors ranging from agriculture and small-scale industries to large corporations and international trade. The Indian banking system is regulated primarily by the Reserve Bank of India (RBI), which ensures financial stability, monetary control, and the smooth functioning of payment systems.

The evolution of the Indian banking sector can be broadly divided into three phases: the pre-nationalization period (before 1969), the post-nationalization era (1969–1990), and the liberalization and reform period (post-1991). The nationalization of banks in 1969 marked a turning point, expanding the reach of banking services to rural and semi-urban areas. Subsequent financial sector reforms in the 1990s introduced private and foreign banks, improved efficiency, and enhanced competitiveness within the industry.

In recent years, technological advancements such as digital banking, mobile payments, and fintech innovations have transformed the way banking services are delivered. Government initiatives like Pradhan Mantri Jan Dhan Yojana (PMJDY) and the Unified Payments Interface (UPI) have further deepened financial inclusion and digital adoption. Moreover, the growing emphasis on sustainable and green banking reflects the sector's commitment to inclusive and environmentally conscious growth.

Despite its progress, the Indian banking sector faces challenges such as rising non-performing assets (NPAs), cybersecurity risks, and the need for regulatory modernization. However, ongoing reforms, digital transformation, and improved risk management practices continue to strengthen its resilience and global standing.

The banking sector in Chandigarh comprises a diverse mix of local, foreign, and specialized financial institutions, with the Reserve Bank of India (RBI) serving as the central bank of the country. Currently, 53 banks operate within the city. These include five public sector banks—State bank of India, Punjab National Bank, Union Bank of India, Bank of Baroda, Punjab and Sind Bank—and four specialized banks, namely HDFC bank, ICICI bank, Kotak Mahindra Bank, Axis Bank

All commercial banks in Chandigarh provide a wide range of standard financial services similar to those available globally—such as debit and credit cards, traveller's cheques, money transfers, personal loans, and car financing. Selected banks also offer specialized services, including VIP, women's, minor, and student accounts, as well as digital banking platforms like online, telephone, and mobile banking, which ensure 24/7 access.

The growth of private banking, coupled with the introduction of personalized and technology-driven services, has intensified competition within the sector (Khalid & Irshad, 2010) [10]. In this environment, customer satisfaction has emerged as a critical source of competitive advantage. It serves as both a key performance indicator and a fundamental element of business strategy, as customer expectations strongly influence satisfaction levels.

Organizations are increasingly focusing on retaining existing customers rather than expending additional resources to attract new ones. Satisfied customers are more likely to develop brand loyalty, leading to repeat purchases and long-term profitability. Given this context, the purpose of the present study is to explore the interrelationships among service quality, customer satisfaction, and customer loyalty in the banking sector of Chandigarh. The findings of this study are expected to provide valuable insights for banks seeking to enhance service quality, improve customer retention, and achieve a sustainable competitive advantage through increased customer loyalty.

Customer satisfaction

The concept of customer satisfaction holds a central place in marketing, as it represents a key outcome of marketing activities. It connects the processes of purchase and consumption with changes in customer attitudes, repeat purchases, and ultimately, brand loyalty. The idea stems from the marketing philosophy that profitability can be achieved through the effective fulfillment of customer needs and wants.

According to the *Business Dictionary*, customer satisfaction refers to *"the degree of satisfaction provided by the goods or services of a company as measured by the number of repeat customers."* For many firms that traditionally focused on price and product availability, this concept represents a new strategic orientation. In essence, customer satisfaction reflects the customer's mental state after using a product or service, based on how well their expectations are met. Higher satisfaction leads to repeat purchases, which in turn foster brand loyalty.

The academic study of customer satisfaction gained prominence in the early 1970s. The U.S. Department of Agriculture's Index of Consumer Satisfaction was among the first studies to directly measure customer satisfaction (Pfaff, 1972). Moreover, research has established strong linkages among customer satisfaction, brand loyalty, and profitability (Hallowell, 1996).

Customer loyalty

Customer loyalty is a critical determinant of long-term business success. Caruana (2000) emphasized that customer loyalty mediates the relationship between service quality and service loyalty in the retail banking sector. Similarly, Ahmad and Sana ul Allah (2011) found that factors such as the availability of spare parts, technicians, warranties, and customization services positively influence consumer purchasing behavior. They argued that manufacturers and importers should ensure easy access to these elements to enhance customer loyalty and buying intentions.

Loyal customers tend to maintain long-term relationships with companies based on satisfaction, trust, and perceived value. As noted by Gronholdt *et al*. (2000), firms following low-price strategies often experience higher customer loyalty than expected, whereas those emphasizing branding may achieve high satisfaction without equivalent loyalty levels. Oliver (1999) also highlighted that customer loyalty can be maintained through the creation of exit barriers, although such "forced loyalty" may not always be desirable.

Loyal behavior may also stem from inertia, where customers remain with a brand out of convenience or low involvement. This form of loyalty, known as cognitive loyalty, is based primarily on brand belief rather than deep emotional attachment (Oliver, 1999). Hofmeyr and Rice (2000) suggested that some customers do not switch brands even when dissatisfied, as they perceive alternatives to be equally unsatisfactory.

Research by Anderson *et al*. (2000) led to the development of the American Customer Satisfaction Index (ACSI), which identifies three antecedents of satisfaction: perceived quality, perceived value, and customer expectations. Similarly, the European Customer Satisfaction Index (ECSI) divides perceived quality into "hardware" (product or service attributes) and "humanware" (customer interaction and behavior). Both models affirm that higher satisfaction levels enhance customer loyalty (Reichheld *et al*., 2000). However, studies indicate that even satisfied customers sometimes defect, highlighting the need to measure satisfaction by examining the gap between expectations and perceived performance.

Service quality

Service quality has emerged as a vital factor influencing organizational success across industries, including banking (Parasuraman *et al*., 1988; Hossain & Leo, 2009) [12, 7]. It serves as a key performance indicator and competitive differentiator (Cowling & Newman, 1995). Banks recognize that superior service quality fosters customer loyalty and profitability (Dawes & Swailes, 1999; Davies *et al*., 1995) [4]. Hence, service quality is viewed as a strategic imperative for sustainable competitive advantage (Chaoprasert & Elsey, 2004) [3].

Gronroos (2000) [6] defined a service as a process comprising intangible activities that occur during interactions between the customer and service provider, aimed at solving customer problems. Similarly, Fogli (2006) [5] described service quality as a global judgment reflecting the customer's overall impression of an organization's performance and service superiority.

Parasuraman *et al*. (1988) [12] initially proposed ten determinants of service quality reliability, responsiveness, competence, access, courtesy, communication, credibility, security, understanding, and tangibles. Later, their SERVQUAL model (1988) refined these into five key dimensions:

- **Tangibility:** Physical facilities, equipment, and appearance of personnel.
- **Reliability:** Ability to perform promised services dependably and accurately.
- **Responsiveness:** Willingness to assist customers and provide prompt service.
- **Assurance:** Employees' knowledge and courtesy that inspire trust and confidence.
- **Empathy:** Personalized attention and understanding of customer needs.

In the present study, only the first four dimensions are considered—tangibility, reliability, responsiveness, and assurance—while empathy is excluded.

Theoretical framework

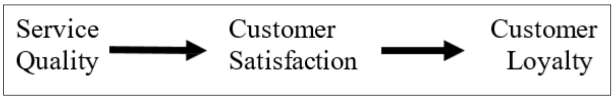

Fig 1: Conceptual model

The review of existing literature indicates a strong and consistent relationship among service quality, customer satisfaction, and customer loyalty. Numerous studies have demonstrated that higher service quality enhances customer satisfaction, which in turn fosters customer loyalty. Several researchers have employed service quality attributes as key indicators of customer satisfaction, emphasizing the critical role of service delivery in shaping customer perceptions (Siddiqi, 2011) [14].

Empirical findings suggest that customers tend to experience the highest satisfaction in the responsiveness dimension of service quality, whereas tangibility often yields the lowest satisfaction ratings. To attain superior service quality levels, bank managers must reassess and redesign their customer satisfaction strategies with a focus on service quality dimensions (Khalid, Babak, Abbas, & Hussain, 2011) [11].

Afsar *et al*. (2010) identified multiple determinants influencing customer loyalty, including perceived quality, satisfaction, trust, switching cost, and commitment. However, the present study focuses specifically on customer satisfaction as the mediating factor linking service quality and customer loyalty.

Hypotheses of the Study

- **H1:** There is a positive relationship among service quality, customer satisfaction, and customer loyalty.
- **H2:** Service quality positively affects customer satisfaction.
- **H3:** Customer satisfaction positively affects customer loyalty.

Research methodology

Research Instrument Design

The questionnaire used in this study was developed based on prior research conducted by Berry *et al*. (1985), Parasuraman *et al*. (1988) [12], Zeithaml and Bitner (1996), and Stafford (1996).

Berry *et al*. (1985) and Zeithaml and Bitner (1996) identified five key dimensions of service quality:

- Tangibility – physical facilities, equipment, appearance of personnel, and written materials.
- Reliability – the ability to deliver promised services accurately and dependably.
- Responsiveness – willingness to assist customers and provide prompt service.
- Assurance – employees' knowledge and ability to inspire trust and confidence.
- Empathy – caring and providing individualized attention to each customer.

Parasuraman *et al*. (1988) [12] proposed eleven service quality dimensions: reliability, competence, responsiveness, access, courtesy, communication, credibility, security, competence, tangibles, and understanding the customer. Among these, reliability was considered the most essential dimension.

Stafford (1996) further explored customer service through seven dimensions, including relationships, bank atmosphere, rates and charges, ATM services, availability and convenience, counter services (tellers), and honesty or reliability of bank personnel.

For the present investigation, four dimensions of service quality have been selected Tangibility, Reliability, Responsiveness, and Assurance as these are most relevant to the banking context and align closely with the study objectives.

Data collection methods

A quantitative research approach was employed for data collection. The study utilized a survey method, which is widely recognized in non-experimental social science research due to its objectivity, representativeness, and replicability. A total of 172 respondents were selected using the simple random sampling technique to ensure that every individual in the population had an equal chance of being included.

Although the intended study population was Chandigarh, data collection was constrained by factors such as limited resources, language barriers, lack of cooperation, geographic limitations, and time and cost constraints. Consequently, data were collected from respondents in North and South Chandigarh using the same random sampling approach.

The primary data collection tool was a structured questionnaire, adapted from previously validated studies to ensure reliability and validity. The questionnaire was divided into two sections:

- The first section included questions related to demographic information such as age and gender.
- The second section contained items related to service quality, customer satisfaction, and customer loyalty.

A self-administered five-point Likert scale (ranging from *strongly disagree* to *strongly agree*) was used to measure respondents' perceptions. The use of an already established and validated instrument enhanced the accuracy and comparability of the results.

Due to financial and time limitations, the study also employed elements of convenience sampling to supplement the random sampling process.

Data analysis methods

Data collected through the questionnaire were analyzed using Statistical Package for the Social Sciences (SPSS) version 20. The analysis process was carried out in several stages to ensure accuracy and reliability of the results.

Initially, reliability analysis was conducted to assess the internal consistency of the measurement scales using Cronbach's Alpha. This test was performed for all variables service quality, customer satisfaction, and customer loyalty to ensure that the questionnaire items consistently measured the intended constructs.

Subsequently, correlation analysis was employed to examine the interrelationships among the key variables. Pearson's correlation coefficient was used to determine the strength and direction of relationships between service quality, customer satisfaction, and customer loyalty.

Finally, regression analysis was conducted to evaluate the impact of service quality on customer satisfaction and the influence of customer satisfaction on customer loyalty. This statistical method helped in testing the proposed hypotheses and determining the predictive power of independent variables on dependent variables.

Results

The data analysis was carried out using SPSS-20, and it was divided into two major parts.

The first part comprised descriptive statistics, which included measures of central tendency (such as mean) and dispersion (such as standard deviation). These statistical measures provided an overview of the respondents' characteristics and the overall distribution of responses, how closely data points clustered around the mean. The second part focused on inferential analysis. Pearson's correlation was applied to identify the relationship between at least two continuous variables. The correlation coefficient ranges from –1 to +1, where values near 0 indicate no relationship, while values closer to +1 indicate a strong positive correlation. Typically, a coefficient value of 0.80 or above is considered to represent a high positive correlation between variables.

Additionally, multiple regression analysis was employed to estimate the coefficients of the variables in a linear equation. This analysis was used to determine the extent to which service quality predicts customer satisfaction, and how customer satisfaction, in turn, influences customer loyalty. The results of regression analysis provided insights into the strength and direction of these relationships, thereby confirming or rejecting the stated hypotheses.

Table 1: Descriptive statistics

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Name of bank	172	14.00	1.00	15.00	347.00	5.9828	.40227	3.06360	9.386	.991	.314	.926	.618
Type of account	172	3.00	1.00	4.00	91.00	1.5690	.07821	.59566	.355	1.014	.314	2.842	.618
Gender	172	1.00	1.00	2.00	70.00	1.2069	.05365	.40862	.167	1.486	.314	.214	.618
Location	172	3.00	1.00	4.00	102.00	1.7586	.11875	.90438	.818	1.390	.314	1.501	.618
Martial status	172	3.00	1.00	4.00	85.00	1.4655	07861	.59870	.358	1.407	.314	3.628	.618
Age group	172	5.00	1.00	6.00	148.00	2.5517	.12583	.95830	.918	1.768	.314	3.124	.618
Highest education	172	4.00	3.00	7.00	306.0	5.2759	.12247	.93270	.870	-.588	.314	.235	.618
Monthly income	172	7.00	1.00	8.00	178.00	3.0690	.18051	1.37474	1.890	.963	.314	2.440	.618
Profession	172	4.00	1.00	5.00	128.0	2.2069	.09764	.74360	.553	1.764	.314	4.024	.618
Howlong you working	172	4.00	1.00	5.00	126.00	2.1724	.12084	.92030	.847	1.602	.314	3.192	.618
Kind of family	172	3.00	1.00	4.00	100.00	1.7241	.10375	.79014	.624	1.424	.314	2.541	.618
Time of using bank	172	4.00	1.00	5.00	146.00	2.5172	.13526	1.03010	1.061	.501	.314	-.733	.618
Frequency of bank use	172	4.00	1.00	5.00	193.00	3.3276	.17632	1.34279	1.803	-.180	.314	-1.284	.618
Valid n (listwise)	172												

Reliability analysis

The reliability of the measurement scales for all variables was assessed using Cronbach's Alpha. The study included three main variables: Service Quality, Customer Satisfaction, and Customer Loyalty. The Cronbach's Alpha values for all three variables were found to be above 0.70, which is generally considered the threshold for acceptable internal consistency (Nunnally, 1978).

These results indicate that the items used to measure each construct are reliable and internally consistent, meaning that the statements within each variable are highly interrelated and measure the same underlying concept. Therefore, the scales employed in this study are deemed appropriate for further statistical analysis, including correlation and regression testing.

Table 2: Cronbach Alpha

Cronbach's Alpha	N of Items
.887	20

Correlation analysis

To examine the interrelationships among the study variables, Pearson's correlation coefficient was employed. The correlation results indicate a moderate to strong positive relationship among the variables under study. The correlation coefficient between Service Quality and Customer Satisfaction was found to be 0.57, between Service Quality and Customer Loyalty it was 0.651, and between Customer Satisfaction and Customer Loyalty it was 0.658.

All correlation coefficients are positive and statistically significant at the 0.05 level (2-tailed), which confirms that the relationships among the variables are not due to random chance. The positive direction of the coefficients suggests that an increase in one variable leads to an increase in the other, and conversely, a decrease in one result in a decrease in the other.

Thus, the analysis provides empirical support for the hypothesis that Service Quality, Customer Satisfaction, and Customer Loyalty are positively and significantly correlated. This implies that improvements in service quality enhance customer satisfaction, which subsequently strengthens customer loyalty.

Table 3: Model summary

	Customer service_quality	Customer_Loyality	Customer satisfaction
Pearson Correlation	1	.651**	.570**
Customer_Service_Quality Sig. (2-tailed)	-	.000	.000
N	100	100	100
Pearson Correlation	.651**	1	.658**
Customer_Loyality Sig. (2-tailed)	.000	-	.000
N	100	100	100
Pearson Correlation	.570**	.658**	1
Customer Satisfaction Sig. (2-tailed)	.000	.000	-
N	100	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

Model	R	R square	Adjusted R square	Std. error of the estimate	Durbin-watson
1	.739[a]	.546	.529	.43816	1.773

a) Predictors: (Constant), Customer_Service_Quality, Customer Satisfaction b) Dependent Variable: Customer_Loyality

Regression analysis

To examine the degree and strength of the relationships among the variables, multiple regression analysis was employed. The analysis aimed to determine the effect of Service Quality and Customer Satisfaction on Customer Loyalty.

The results indicate a strong positive relationship between Service Quality and Customer Satisfaction, as well as between Customer Satisfaction and Customer Loyalty. The Durbin–Watson value was found to be 1.773, which lies within the acceptable range of 1.5 to 2.5, indicating that there is no autocorrelation among the residuals and that the regression model is appropriate.

The adjusted R^2 value for the model was 0.545, suggesting that approximately 54.5% of the variation in Customer Loyalty can be explained by Service Quality and Customer Satisfaction. This implies that improvements in service quality and customer satisfaction lead to a significant positive impact on customer loyalty.

The Standard Error of the Estimate was 0.43, indicating that about 43% of the variation in Customer Loyalty is attributable to other factors not included in the model. Overall, the regression analysis confirms that Service Quality and Customer Satisfaction are significant predictors of Customer Loyalty, supporting the proposed research hypotheses.

Table 4: Regession

Model	Sum of squares	Df	Mean square	F	Sig.
Regression	12.694	2	6.347	33.061	.000[b]
1 Residual	10.559	97	.192		
Total	23.253	99			

(a) Dependent Variable: Customer_Loyality (b) Predictors: (Constant), Customer_Service_Quality, Customer_Satisfaction

Conclusion

The findings of this study reveal a positive and significant relationship between service quality attributes and customer satisfaction, thereby supporting Hypothesis 1 (H1). Furthermore, the results indicate that approximately 54% of the variation in customer loyalty can be explained by service quality and customer satisfaction, confirming Hypothesis 2 (H2).

These results provide empirical evidence that high-quality service delivery enhances customer satisfaction, and in turn, satisfied customers are more likely to remain loyal to their banks. Hence, customer satisfaction acts as a mediating factor between service quality and customer loyalty.

In today's highly competitive banking environment, the ability to deliver superior service quality is a key differentiator that can provide banks with a sustainable competitive advantage. Financial institutions that prioritize consistent service improvement, responsiveness, reliability, and customer care are more likely to achieve long-term customer retention and profitability.

Limitations of the study

This research was conducted within a limited time frame and was subject to financial and logistical constraints. Consequently, data were collected only from respondents in Sahiwal, Okara, Pakpattan, and Arifwala, which may limit the generalizability of the findings to other regions or larger populations.

Additionally, while the study focused on service quality and customer satisfaction as primary determinants of customer loyalty, there are other influential factors such as trust, switching costs, perceived value, and brand image that were not examined. Future research may expand the scope by incorporating these variables and using larger, more diverse samples to provide deeper insights into customer loyalty in the banking sector.

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The role of artificial intelligence in promoting sustainable and responsible investments

Dr. Vinamrata Akash[1*] and RajLaxmi Kumari[2]

[1] Assistant Professor, Department of Commerce, Motilal Nehru College, Delhi University, Delhi, India

[2] Department of Commerce, Motilal Nehru College, Delhi University, Delhi, India

*Corresponding Author: Dr. Vinamrata Akash

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Abstract

Artificial Intelligence (AI) is reshaping global finance by enabling advanced data driven investment strategies, risk assessment, and portfolio optimization. As sustainable finance becomes central to global economic priorities, AI plays a critical role in evaluating environmental performance, identifying potential green washing, and directing capital toward climate positive and socially responsible projects. This study investigates how AI strengthens decision making in green finance by assessing the technological mechanisms that support sustainable investment judgments, evaluating AI-based ESG assessment and climate risk forecasting models, and exploring the challenges and emerging opportunities associated with AI-driven sustainable investing. A qualitative research approach is adopted, drawing upon academic literature, financial regulatory reports, and real world industry applications. Findings reveal that AI-enabled climate risk models, ESG analytical engines, and predictive algorithms significantly enhance transparency, risk accuracy, and capital allocation for sustainability focused investments. Despite its transformative potential, the study identifies continued challenges related to data inconsistency, regulatory divergence, and ethical constraints, particularly the need for standardized ESG taxonomies and reliable sustainability datasets. The study concludes that AI accelerates sustainable economic growth by improving investor confidence, boosting climate aligned capital flows, and promoting regulatory compliance, while emphasizing the necessity for ethical safeguards, enhanced transparency, and globally harmonized sustainability data standards to ensure responsible and equitable deployment of AI in green finance.

Keywords: Artificial Intelligence, Green finance, ESG analytics, Sustainable investing, Decision making, Climate risk modelling

Introduction

The global economy is moving rapidly toward sustainability as climate challenges and international environmental commitments reshape financial priorities. Green finance has become central to this transition, directing capital toward clean energy, eco-friendly infrastructure, and socially responsible initiatives. Traditional financial models, however, struggle to handle the complex and diverse sustainability data required for such decisions. In this evolving landscape, Artificial Intelligence (AI) plays a transformative role by processing vast environmental datasets, identifying genuine ESG performance, and detecting green washing, and forecasting climate-related financial risks. Through machine learning, natural-language processing, and predictive analytics, AI enhances transparency, accuracy, and confidence in sustainable investment decisions. Financial institutions, regulators, and fintech firms increasingly rely on these technologies to build resilient, low-carbon portfolios and support global climate-finance goals. While adoption challenges remain including data-quality issues, ethical concerns, and lack of unified sustainability standards responsible AI governance and global collaboration can ensure that technological innovation strengthens environmental integrity and economic resilience. Thus, AI stands as a crucial driver in shaping the future of green finance and promoting long-term sustainable growth worldwide.

Research gap

Many studies talk about sustainability, ESG practices, and digital tools in finance, very few clearly explain how AI directly helps people make better eco-friendly investment decisions. Existing literature also does not seem to clearly reflect how AI can catch companies that pretend to be environmentally responsible (green washing). In addition, there is limited work on how government rules and technology work together in the area of green finance. Research on how AI predicts climate-related financial risks are also still developing. Therefore, this study is an attempt to explore and fill the gaps by closely examining how AI is used to support environmentally-focused investment decisions.

Objectives of the study

- To analyse how AI technologies support decision-making in green finance.
- To evaluate AI models used for ESG assessment and climate-risk forecasting.
- To identify challenges and future opportunities for AI-based sustainable investing.

Research methodology

This study follows a qualitative and analytical research approach, relying entirely on secondary data sources. The material reviewed includes peer-reviewed academic articles, sustainability and financial-technology reports published by institutions such as the IMF, BIS, OECD, and major fintech organizations, along with industry whitepapers and regulatory policy documents. A systematic thematic analysis was used to identify key patterns, trends, and insights related to the role of AI in green finance. As the study does not use primary data, the findings are based on existing literature and real-world documented cases. A key limitation is that rapidly evolving AI technologies and changing global sustainability standards may influence interpretations over time.

Literature review

Research on the role of artificial intelligence (AI) in finance has evolved significantly in recent years, shifting from algorithmic trading to broad-spectrum applications in portfolio optimisation and sustainability analytics. For instance, the review by Hassanein and Tharwat (2024) [7] illustrates how AI techniques such as machine learning and natural language processing (NLP) are now routinely applied to green-finance instruments, enabling investors to incorporate environmental performance indicators into their decision-making frameworks (Hassanein & Tharwat, 2024) [7]. In the domain of sustainable finance, AI is used to evaluate ESG (Environmental, Social, Governance) metrics, identify transition- and climate-related risks, and forecast long-term environmental scenarios.

Empirical evidence highlights the superiority of machine-learning models compared to conventional statistical methods in detecting corporate environmental misconduct and predicting the volatility of carbon-intensive assets. For example, a study employing over 220 ESG indicators for firms in the Euro-area found that machine-learning algorithms achieved additional annualised returns of 0.5% – 1.2% compared with standard models (published 2022) (Smith & Brown, 2022) [10]. More recently, a bibliometric analysis by Xu (2024) [11] surveyed over 110 articles published between 2021 and 2025, identifying key thematic domains such as ESG risk-analysis, predictive modelling and AI ethics in finance (Xu, 2024) [11].

Within operational deployments, advanced ESG-scoring engines now analyse satellite imagery, supply-chain metadata, corporate sustainability disclosures and media sentiment data to assess sustainability performance in real time. Studies like De Lucia *et al*. (2023) [6] demonstrate machine-learning models built to replicate proprietary ESG ratings by using both structured financial data and alternative text-based sources (De Lucia *et al*., 2023) [6]. Meanwhile, NLP systems scan regulatory documents, sustainability frameworks and investment reports to evaluate compliance across jurisdictions and detect green washing (Zanin, 2023) [12].

Collectively, this literature suggests that AI measurably improves transparency and mitigates information asymmetry in green-finance markets. Yet despite this progress, several authors note persistent issues: data inconsistencies across ESG providers, lack of explainability in complex models, regulatory heterogeneity across regions, and ethical risks of algorithmic bias (Schwendner & Posth, 2023; Pavlidis, 2025) [9, 8]. A study mapping the research field of ESG and AI identified significant gaps in actual industrial adoption, business-model transformation and policy alignment (Schwendner & Posth, 2024) [9].

In summary, while the body of literature confirms that AI has elevated the analytical capabilities of sustainable-finance decision-making, it also emphasises the need for standardised ESG taxonomies, transparent AI logic, and ethical governance frameworks. This establishes a clear basis for empirical investigation of how AI might be integrated into green-finance investment processes and regulated accordingly.

This paper explores how AI enhances decision-making in green finance and supports long-term sustainable growth. The global economic landscape is undergoing a fundamental transformation driven by escalating climate concerns, international sustainability commitments, and an urgent need to shift away from carbon-intensive development pathways. Over the past decade, environmental degradation, resource depletion, and rising emissions have triggered intensive policy reforms and global action, compelling nations and industries to rethink growth models. As countries accelerate the transition toward a low-carbon and climate-resilient future, the role of finance has evolved beyond merely facilitating economic activity to becoming a catalyst for environmental stewardship and sustainable development. Within this evolving paradigm, green finance has emerged as a pivotal instrument designed to channel financial resources toward environmentally responsible and socially ethical initiatives. It has expanded from niche environmental funding to mainstream economic imperative, driving investments in renewable energy, clean technologies, sustainable infrastructure, and nature-based solutions.

However, the expanding scope and complexity of green-finance markets create significant challenges for traditional financial institutions, investors, and policymakers. Conventional financial assessment frameworks are typically structured to evaluate economic performance, creditworthiness, and market parameters, leaving limited room to incorporate multidimensional sustainability indicators. Environmental, Social, and Governance (ESG) criteria, climate-risk metrics, and social impact parameters are dynamic, qualitative, and often scattered across numerous sources. Traditional analytical tools struggle to interpret such diverse inputs, detect inconsistencies, and translate environmental data into actionable investment decisions. As sustainable-finance instruments scale globally, the need for sophisticated analytical systems capable of processing non-linear, high-volume, and real-time sustainability information has become indispensable.

In this context, Artificial Intelligence (AI) has emerged as a game-changing enabler that strengthens the architecture of green finance and advances sustainable investment decision-making. AI-powered systems can uncover deep insights hidden within vast and fragmented datasets, identify sustainability trends, detect carbon-intensity anomalies, and differentiate authentic environmental performance from strategic marketing claims. AI leverages techniques including machine learning, natural language processing (NLP), predictive analytics, neural networks, and computer vision to analyze corporate disclosures, media reports, regulatory updates, satellite imagery, and climate-risk models. These capabilities extend traditional financial analytics and enhance investor confidence by providing more transparent, objective, and data-driven sustainability evaluations.

Fintech companies, global banks, asset-management firms, and regulatory authorities are increasingly embedding AI-based tools into their green-finance strategies. Portfolio managers employ AI-enabled ESG screening and risk-profiling tools to identify companies aligned with sustainability goals, while policymakers and supervisory bodies use AI platforms to monitor green-bond markets and ensure compliance with environmental disclosure standards. Moreover, AI-driven climate-scenario models assist in quantifying potential financial losses associated with climate change, such as physical risks from natural disasters and transition risks arising from stringent carbon regulations. These models allow institutions to enhance resilience, plan long-term capital allocation, and comply with emerging global taxonomies and environmental reporting frameworks.

The use of AI in sustainable finance also addresses a critical market challenge green washing, where companies exaggerate environmental claims to attract ESG-focused capital. Traditional audit and reporting systems often struggle to detect such deceptive practices. AI tools, however, can assess inconsistencies in sustainability reports, analyze reputational signals, cross-verify emissions data, and monitor real-time environmental performance indicators across digital sources. As regulatory bodies strengthen ESG compliance requirements, the intelligence and objectivity offered by AI will play a central role in maintaining market integrity and investor trust.

Despite these advancements, the incorporation of AI into green finance is not without challenges. Significant barriers exist, including bias in AI models, uneven data quality, lack of unified ESG standards, privacy considerations, technological literacy gaps, and regulatory uncertainties across jurisdictions. Sustainability-related datasets often originate from multiple countries, industries, and sources with differing methodologies and reporting formats, making standardization difficult. Ensuring fairness, transparency, and ethical AI governance remains essential, particularly when decisions involve socio-environmental outcomes and public trust. Therefore, the advancement of AI-enabled sustainable finance calls for collaborative frameworks that combine technological innovation, environmental science, global regulatory alignment, and responsible governance.

By examining AI-driven sustainability analytics, climate-risk modelling tools, investment-screening mechanisms, and regulatory implications, it provides a comprehensive understanding of the evolving landscape. The discussion highlights AI's potential to improve green-investment quality, accelerate capital flows towards climate-positive sectors, and strengthen the resilience of financial systems in the face of environmental uncertainty. Furthermore, it underscores the importance of ethical, transparent, and inclusive AI practices to ensure that technological advances contribute to equitable and environmentally responsible economic transformation. Ultimately, AI is not merely a technological upgrade to financial systems — it represents a structural shift toward smarter, fairer, and more sustainable capital deployment across global markets.

Artificial intelligence is increasingly influencing sustainable finance by strengthening how investors, financial institutions, and policymakers make informed decisions about environmentally responsible investments. Traditional financial models assess economic performance using indicators such as corporate earnings, industry movements, and market cycles. However, sustainable investment today requires a deeper understanding of elements like climate-transition risks, biodiversity preservation, environmental externalities, and ethical governance. AI enables this shift by analysing vast and complex data sources that humans alone cannot process at such scale or speed. It detects sustainability patterns, evaluates corporate environmental disclosures, and provides future-oriented insights that guide responsible capital allocation. Through machine-learning models, AI scores companies based on long-term ecological alignment; identify climate-sensitive assets, and supports banks in integrating emissions data and ethical supply-chain behaviour into lending decisions. Policymakers, too, use AI tools to monitor green bonds, carbon-credit activities, and sustainable-finance innovations, improving market oversight and ecological accountability.

A significant part of this study involves assessing how AI-driven tools evaluate ESG performance and forecast climate-related financial risks. Traditional ESG ratings are often criticised for inconsistency and lack of standardisation across rating agencies. In contrast, AI-based systems review detailed environmental reports, satellite imagery, climate-science datasets, governance disclosures, and media sentiment to produce more reliable sustainability insights. These models are also able to detect green washing by comparing reported information with physical-environment evidence and behavioural patterns. Natural language processing helps verify the authenticity of corporate sustainability claims by analysing annual reports and regulatory filings. When it comes to climate-risk forecasting, deep-learning models simulate future climate scenarios, assess vulnerability to extreme weather events, and estimate stranded-asset risks amid energy transition policies. Such capabilities help investors and regulators better understand long-term risks and opportunities linked to climate-aligned investing.

Despite these advancements, AI adoption in sustainable finance faces notable challenges. ESG data remains fragmented and inconsistent across geographies and reporting bodies, limiting accuracy. Many organizations still rely on self-reported data without robust verification standards, creating risks of bias and misrepresentation. Complex AI models sometimes lack transparency, making it difficult for stakeholders to understand how decisions are formed. Regulatory uncertainty across countries adds another layer of difficulty, as policies for AI use, data privacy, and sustainability reporting continue to evolve. Ethical concerns also arise when profit motives conflict with long-term environmental goals or when automated scoring systems oversimplify social and ecological issues.

However, these challenges also open the door to future opportunities. Emerging innovations such as AI-driven sustainability taxonomies block chain-based ESG verification platforms, and global data-sharing ecosystems offer pathways toward greater transparency and accountability. As regulatory frameworks for green finance and AI governance expand, they are expected to standardise reporting practices, reduce systemic risks, and increase confidence among investors and stakeholders. Strengthening ethical guidelines, increasing model transparency, and expanding collaboration between regulators, financial institutions, and technology developers will ensure that AI continues to support a fair, reliable, and climate-aligned financial future.

Findings of the study

The study reveals that Artificial Intelligence plays a transformative role in advancing sustainability-driven financial practices through three key dimensions. First, AI-enabled ESG analysis strengthens transparency and accountability by evaluating corporate sustainability performance with greater accuracy, identifying green washing, and providing continuous monitoring of environmental and social claims. Second, AI-based climate-risk prediction enhances foresight by analysing climate vulnerabilities, projecting financial risks linked to environmental disruptions, and supporting informed capital allocation towards resilient and low-carbon projects. Third, AI-driven investment decision-making demonstrates that sustainable portfolios can achieve strong financial returns, as advanced algorithms efficiently integrate ESG metrics, climate-risk signals, and performance indicators to optimise investment outcomes without compromising profitability.

AI-enabled ESG analysis

- AI tools automatically score companies based on environmental and social responsibility.
- Systems monitor sustainability disclosures in real time to identify emerging concerns.
- Web, news, and public-data scanning help detect potential green washing and misleading sustainability claims.

AI-based climate-risk prediction

- Machine-learning models forecast financial exposure to climate risks, such as rising operational and insurance costs.
- Satellite-based analytics track land-use changes, carbon emissions, and biodiversity loss.
- AI supports evaluation and selection of renewable-energy projects to direct investment into the most impactful options.

Better investment decisions with AI

AI-powered portfolio strategies integrate sustainability considerations while maintaining competitive financial performance.

It can run stress-tests to see how companies or investments might perform if carbon taxes rise or environmental rules change.

AI systems check whether investments follow international sustainability rules and guidelines.

AI converts sustainability from a qualitative aspiration into measurable financial intelligence. It enhances transparency by processing diverse environmental signals, reducing subjective bias in ESG reporting. AI-driven platforms support investors by ranking assets based on sustainability risk-return profiles, while regulators gain tools to monitor environmental compliance and capital flows.

However, AI adoption requires ethical governance frameworks and globally harmonized ESG standards. Without standardized taxonomies, sustainability scoring remains fragmented. Responsible AI development remains crucial to prevent algorithmic bias and ensure trustworthy sustainability accounting.

Conclusion

This study demonstrates that Artificial Intelligence has emerged as a foundational enabler in shaping the future trajectory of green finance. By integrating advanced data-analytics, machine-learning techniques, natural-language processing, and satellite-based environmental monitoring, AI is reshaping how investors, financial institutions, and policymakers evaluate sustainable performance and climate-aligned financial risk. The findings show that AI materially strengthens Environmental, Social, and Governance (ESG) assessment through real-time information processing, automated sustainability scoring, and enhanced detection of inconsistencies or green washing in corporate disclosures. This reinforces market transparency, accountability, and trust, which are essential components of responsible investment ecosystems.

Similarly, AI-driven climate-risk modelling allows institutions to anticipate environmental disruptions and transition risks with greater precision. Predictive systems support scenario analysis, stranded-asset identification, climate-sensitivity mapping, and renewable-project evaluation, helping capital markets channel investments into resilient, low-carbon opportunities. This clearly positions AI not merely as a technological addition, but as a strategic mechanism for safeguarding long-term financial stability in a climate-constrained global economy. Moreover, evidence indicates that AI empowers investors to construct portfolios that simultaneously advance sustainability priorities and deliver competitive returns, eliminating the long-perceived trade-off between financial performance and environmental responsibility.

However, the study also recognises that the transformative potential of AI in sustainable finance must be accompanied by strong governance mechanisms, ethical safeguards, and global standardisation frameworks. Concerns related to data fragmentation, algorithmic bias, explainability, and uneven regulatory maturity require coordinated action from governments, regulators, industry bodies, and technology developers. Sustainable finance can only achieve its intended impact when AI systems are transparent, auditable, accountable, and aligned with global climate commitments and just-transition principles.

In conclusion, AI stands as a critical catalyst for accelerating green capital mobilisation, strengthening sustainability-driven decision-making, and advancing decarbonisation pathways. As nations and markets pursue net-zero ambitions, the integration of AI into financial architecture will increasingly determine the speed, fairness, and effectiveness of global climate action. The future of sustainable finance therefore depends on building AI-enabled financial infrastructures that are inclusive, ethically governed, interoperable, and designed to support long-term ecological and socio-economic resilience. With responsible innovation and collaborative policy frameworks, AI has the capacity to not only support but meaningfully shape a more sustainable, climate-secure global financial system.

Limitations

- Reliance on secondary data.
- Rapid technological advancement may evolve findings.
- Absence of quantitative model testing.

Future scope

Future research in this field has strong potential to expand both academic understanding and real-world application of AI in green finance. One key area involves empirical testing of AI-based ESG scoring systems. Although many AI tools claim to improve the accuracy of sustainability ratings, their performance must be tested using real financial data and verified against long-term environmental outcomes. Future studies can compare AI-generated ESG scores with traditional ratings to check whether AI truly reduces bias, identifies green washing more effectively, and improves investment performance. This would help validate the credibility of AI-driven sustainability evaluation models.

Another important future direction is cross-country comparison of AI and green-finance regulatory frameworks. As countries adopt different rules for sustainable finance, data transparency, and AI use, comparative research can highlight best regulatory practices. Such research would examine how jurisdictions like the EU, US, India, and Southeast Asia regulate AI in financial markets, protect investor interests, and support sustainable innovation. Insights from such studies can help policymakers create a more standardised, fair, and globally aligned framework for AI-enabled sustainable finance.

Future research can also explore integration of AI with block chain technology for strengthening transparency and trust in green-finance instruments. Block chain can provide tamper-proof tracking of sustainability records, carbon credits, and green-bond proceeds, while AI can analyse these datasets to monitor performance and detect fraudulent claims. Developing AI-block chain hybrid systems can create a more reliable, traceable, and automated certification mechanism for green bonds and other sustainability-linked financial assets.

Finally, researchers can collect primary data from fintech firms, asset-management companies, and sustainable-investment funds to understand real-world challenges faced during AI adoption. Interviews, surveys, and case studies can reveal practical barriers such as data quality issues, skill gaps, regulatory uncertainty, and technological limitations. This would help bridge the gap between theoretical models and industry needs while providing valuable insights for financial institutions, regulators, and technology developers.

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