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MESSAGE FROM THE EDITOR-IN-CHIEF

It gives me immense pleasure to present the latest release of the International Journal of Applied Management Research (IJAMR), Vol. 12, Issue 1 (2026), a flagship publication of the Department of Management, North-Eastern Hill University (NEHU).

At IJAMR, our core mission has always been to foster academic excellence and contribute meaningfully to the global discourse on management sciences. To ensure the highest academic integrity, the journal strictly adheres to a rigorous double-blind peer-review process. This uncompromising evaluation framework guarantees that only the most rigorous, innovative, and impactful research finds a place in our pages, thereby maintaining the high standards our readers and contributors expect.

We are profoundly grateful to the university's leadership for their unwavering support, guidance, and encouragement, which have been pivotal in sustaining the journal's vision. We owe a great debt of gratitude to our esteemed reviewers. Their meticulous evaluation, constructive comments, and invaluable feedback have not only significantly elevated the quality of the published papers but have also served as an excellent source of learning and mentorship for our contributing scholars. A sincere thanks to the authors who chose IJAMR as the vehicle for their research. I offer my most respectful thanks to our Managing Editor, IJAMR for his tireless and exemplary efforts. Following a challenging two-year hiatus in publication, his dedicated leadership has been instrumental in streamlining our editorial operations, allowing the journal to regain its momentum for high-quality academic publishing.

As we look to the future, we warmly welcome researchers, academicians, and practitioners from across the globe to submit their original, high-quality research papers, case studies, and conceptual articles for our forthcoming issues. Together, let us continue to push the boundaries of management research.

With warm regards,

Prof. J. U. Ahmed

Head, Department of Management, NEHU, Tura Campus
& Editor-in-Chief
International Journal of Applied Management Research (IJAMR),
Department of Management, North-Eastern Hill University (NEHU)

FROM THE DESK OF THE MANAGING EDITOR

Dear Readers, Researchers, and Colleagues,

It is with immense pride, gratitude, and a profound sense of accomplishment that we present to you Volume 12, Number 1 (2026) of the International Journal of Applied Management Research (IJAMR).

This particular issue marks a watershed moment in our journal's journey. Just three years ago, IJAMR stood at a difficult crossroads, emerging from a period of unforeseen discontinuation. Reviving a scholarly journal after a hiatus is a monumental task—it requires rebuilding trust, restoring operational infrastructure, and reigniting the academic community's interest. Today, looking at the rigorous, high-quality research gracing these pages, I can confidently say that the revival phase is behind us; IJAMR is officially entering an era of renewal and growth.

The resurrection and streamlining of our publication process over the last three years are the direct results of the unwavering dedication of Team IJAMR. The editorial board and research scholars of the Department of Management have worked tirelessly behind the scenes. They have meticulously overhauled our submission pipelines, enforced strict adherence to publishing ethics, and maintained an uncompromising stance on academic quality. Their silent, everyday labour is the bedrock upon which this volume stands.

An academic journal is only as strong as its peer-review ecosystem. We owe a deep debt of gratitude to our esteemed reviewers. Their holistic, constructive, and rigorous evaluations have not only safeguarded the integrity of the journal but have also elevated the scholarship of the contributing authors.

Furthermore, this revival would have remained a distant dream without the institutional backbone provided by North-Eastern Hill University. We extend our heartfelt thanks to the academic Heads and leadership of NEHU. Their constant motivation, structural support, and belief in the vision of the Department of Management have been our ultimate driving force.

While we celebrate how far we have come in the last three years, our gaze is fixed firmly on the horizon. Our next collective objective is to elevate IJAMR beyond regional boundaries and position it as a publication of global repute and acceptance.

To achieve this, we are actively working toward stringent international benchmarks and prestigious indexations/accreditations. We are committed to fostering a diverse, global pool of contributors and tackling contemporary, frontier challenges in applied management research.

As you leaf through the articles of Vol. 12, No. 1, we invite you to join us in this next chapter—as readers, critics, and contributors. Thank you for your continued trust in IJAMR.

Warm regards,

Dr Amit Kundu

Associate Professor, Department of Management, NEHU, Tura Campus
& Managing Editor
International Journal of Applied Management Research (IJAMR),
Department of Management, North-Eastern Hill University (NEHU)

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Study on the Predictors of Job Satisfaction of Academics in the Central Universities of North-East India

Monu Singh¹ & Abhigyan Bhattacharjee²

Abstract

In recent years, the Indian government has made education a top priority, especially higher education, by setting up new Central universities in areas that lack sufficient access. This initiative aims to reduce regional disparities and provide opportunities for socially disadvantaged communities. To support this effort, academics are being recruited and placed throughout the country. It is essential for these academicians to find satisfaction in various aspects of their lives, including social, economic, personal/family, and institutional factors. This study focuses on the job satisfaction of 478 academicians from 9 central universities in North Eastern India, representing 30% of a total of 1589 from fields such as Science, Humanities, and Social Science, across all ranks (Assistant Professor 1, 2, 3, Associate Professor, and Professors). The research investigates how different factors related to job satisfaction impact the overall satisfaction of academics. Additionally, it explores the relationships between predictors of job satisfaction. In this study, the researcher employed stepwise regression analysis, treating job satisfaction as the dependent variable. Correlation analysis was utilized to assess the relationships between independent variables related to job satisfaction. The data was processed using SPSS 20.0. The findings indicate that personal, social, economic, and professional factors have a strong influence on job satisfaction. All four independent variables showed significant and positive correlations with academic job satisfaction. The results suggest that the job satisfaction of academics is affected not only by their professional roles but also by their social, family, and personal circumstances. When an academic is content in their family and social life, it positively reflects on their work satisfaction.

Keywords: *Job satisfaction, academicians, North-east, India, Social, Professional, Personal and Economic independent variable.*

Article History

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Introduction

The notion of a “job-satisfaction” was developed from the field of Industrial Psychology. Researchers in work and organizational psychology have devoted considerable effort to studying job satisfaction. It is believed to demonstrate the current feelings and thoughts of a person toward his or her work environment and its features (Weiss & Cropanzano, 1996). It also serves to enhance the economic position of an organization (Aronson et al. 2005). Even today, there continues to be much interest from scholars regarding job satisfaction. This is one of the elements in the workplace that requires monitoring with respect to the well-being of the organization. In fact, understanding the level of happiness of employees is one of the primary goals of an organization (Aronson et al. 2005). It has received attention from those concerned with the quality of work-life, as well as the efficiency of the organizations (Maghrabi, 1999).

Satisfaction, as noted by Wu et al. (1996), stems from various provided social needs, such as food, health, safety, and other task-related needs. Principal indicators of satisfaction include remuneration, employment, institutional pride, and affiliation with regional customs and traditions. Other indicators of satisfaction may include work-life balance, salary, working conditions, and level of supervision.

Employees who are satisfied with their jobs tend to have a positive outlook towards their work. In contrast, dissatisfied employees exhibit negative attitudes. Such a shift in attitude is a reflection of how complicated and intertwined different cognitive processes, behaviors, emotions, inclinations, and even one’s general work style are.

India is virtually bifurcated into five regions: North, East, South, West and, Central. The North-East region consists of eight states which are Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, and Sikkim. As of 2020, there are a total of 54 Central Universities in India, nine of which are in these eight North-Eastern states. The first Central University in North East India was established in 1973, and it is called North-Eastern Hill University.

Literature Review

Few review studies on job satisfaction exist, and those gaps enhance understanding of a multifaceted issue that can further guide our research objectives.

Shamina (2014) has taken an attempt to find the connection between job satisfaction and professional commitment focusing on higher education context. This investigation was based on primary data collected from 250 teachers working at self-financing colleges affiliated to Bharathiar University, Coimbatore. The author adopted stepwise

multiple regression analysis and treated professional commitment as the dependent variable. Various facets of job satisfaction served as independent variables.

These included supervision and professional advancement opportunities, compensation, the nature of the work, and interpersonal relations with other staff members. The findings indicated that different dimensions of job satisfaction greatly impacted the level of commitment the professors in higher education showed towards their profession. In particular, supervision, salary, and work activities were found to be the dominant predictors of commitment to profession and were found to greatly impact the dedication of academic staff. As reported in this study, there was a relatively high level of satisfaction with all aspects of the job. The researcher also pointed out that low satisfaction with the overall job and professional commitment may result in reduced teaching quality, high attrition rates among teachers, and the stagnation of students' growth and development.

Khan and colleagues (2015) conducted an investigation to analyze the impact of some demographic characteristics on job satisfaction of district executive officers in Pakistan. They obtained primary data from a sample of 205 district executive officers in the local government of Pakistan's North West Frontier Province (NWFP). This study focused on five demographic characteristics: Age, gender, length of service, designation, educational qualification, and area of department. The study identified several elements of job satisfaction having impact which included work environment, salary, promotion, relationships with colleagues, and supervision. These elements were classified as independent variables. The dependent variables measured were work involvement, absenteeism, organizational commitment, and employee turnover.

The conclusion drawn from the findings is that salary satisfaction is contingent on the gender and level of education of the employee. In addition, the educational level, length of service, gender, and departmental classification of the employee determine the attitude the employee has towards his or her work.

Out of the entire sample studied, the perception of satisfaction with regards to supervision was neutral. There is a strong correlation between education and promotion regarding the satisfaction level of one's job. On the other hand, demographic parameters did not affect the construct of working environment and co-worker relationships. There is evidence of the impact of demographic variables such as gender, educational level, and department on work involvement and organizational commitment. Moreover, the study found that there is a strong relation between demographic parameters and the rates of absenteeism and staff turnover among district executive officers of local government in Pakistan. Thus, demographic

characteristics tend to influence the shaping of job satisfaction. In addition, demographic elements also affect the positive outcomes of job involvement and commitment, as well as the negative outcomes of absenteeism and employee attrition.

Bhattacharjee and Singh (2016) collected data from 478 academics working in nine central universities of Northeast India across three disciplines and ranks to analyze their perceptions. The researchers focused on four independent variables which included economic, social, personal, family, and institutional factors alongside other dependent variables.

This study aimed to explore the relationship between four independent variables. For this purpose, correlation analysis and stepwise regression analysis were applied. The findings revealed that all four independent variables, including social, personal/family, economic, and professional factors, positively correlated and significantly impacted job satisfaction among academics. It was also observed that the social and personal factors were more influential in determining job satisfaction compared to the institutional and economic factors.

The primary focus of Singh & Bhattacharjee (2020) was conducting an empirical study with a self-designed questionnaire. The objective of the research was to assess how relevant Herzberg's theory is in the academic domain and to study the differences in job satisfaction levels of academicians based on their place of origin, especially between the Northeastern states and the rest of the country. The sample comprised 30% of the total populations which was 478 academicians from Central Universities in North East India. The researchers conducted multiple regression analysis, stepwise regression analysis, and t-tests. The researchers conclude that the two-factor theory by Herzberg can be validly used when assessing academic job satisfaction.

Ravichandran and Bhardwaj (2021), In their empirical study on the relationship between job satisfaction and performance of academic staff in publicly-funded Tamil Nadu Province, India, Ravichandran and Bhardwaj collected primary data from a population survey of 201 faculty through a structured questionnaire. Five variables were examined as independent variables and reflected dimensions of job satisfaction (monetary benefits, job support, job content, interpersonal relations, and work conditions). Academic performance, as evidenced through three dependent performance variables (research publications, professional development activities, and research advising), provided an overall perspective of academic performance; however, job support and work conditions did not provide any significant effect on the performance variables. Overall, the findings create strong positive correlations between job satisfaction and academic performance, leading to evidence that job

satisfaction has a stronger and more positive impact on academic performance than other common characteristics of academic position (i.e., equal or similar wages).

Arachie et al.'s (2021) research on job crafting and job embeddedness amongst Nigerian academic staff was extensive using a large sample size and quantitative analysis. The results showed that all forms of job crafting (task, relational and cognitive) positively affected academics' feelings of fit with their department, social connections, and perceived sacrifice leading to greater retention. This study provided evidence of the proactive role academics play in designing their working lives to increase satisfaction and enhance their commitment to the institution.

Ashraf's work from 2021, which continues to be cited in the literature beyond 2021, showed that demographic factors indirectly affected organizational commitment through compensation and job satisfaction levels. Building on this, Iddrisu (2023) reported that there is a positive correlation between factors positively influencing motivation and retention of staff and job performance at public universities in Ghana, but the correlation was weak. The study highlighted the importance of institutional culture as an important contextual variable influencing satisfaction and retention outcomes.

Mgaiwa (2023), who investigated job satisfaction among university academic staff in Tanzania and found that there were generally moderate levels of job satisfaction, conducted the last study relevant in this area of research. There were also significantly different levels of job satisfaction within the sample; these variables include rank and age which imply that consideration of stage of career is vital in explaining academic well-being and retention decisions.

Atiku and Ganiyu (2024) studied how professors felt about flexibility in their work during crises at institutions of higher education. Their quantitative, descriptive study showed that there was a positive relationship between people's jobs in colleges or universities and their willingness to accept flexible work arrangements (e.g., changing hours and/or compressed workweeks). There were also gender differences in acceptance, indicating that flexibility in work policy needs to be designed with gender equity in mind. Overall, flexibility is a very important factor for job satisfaction and job retention at modern colleges and universities.

An integrative literature review examining academic staff satisfaction and retention undertaken by Mather and Bam in 2025 found four major themes that impact academic staff through synthesis of 21 studies across 13 nations: (1) talent management and employee performance; (2) motivation of staff, retention strategies

for employees and satisfaction of employees; (3) organisational factors and organisational climate; and (4) working environment and wellbeing of employees. The most commonly cited sub-themes included organisational climate, work life balance and leadership support, indicating they are of increasing importance in higher education research.

Moreover, it can be seen from the research that there is a very wide gap in the satisfaction levels of motivator and hygiene factors of job satisfaction according to the place of the residence of the academicians. Academics originating from the North-East region reported greater satisfaction with both motivator and hygiene factors than their counterparts from other regions.

As stated above, the focus of the study is:

1. To estimate the impact of various predictors of job satisfaction on overall job satisfaction among the academic staff.
2. To measure the relationship among the predictors of job satisfaction.

Research Methodology

This analysis is based on the primary data collected specifically for this purpose. The participants of the study were university teachers working at the central universities in North-east India. The sample consisted of 478 respondents which made up 30 percent of the academic staff in these institutions. The researcher designed a questionnaire with closed-ended questions tailored to primary data collection which employed a five-point Likert scale. The academicians were asked to provide their opinions on a number of extrinsic social, personal/family, economic, and professional factors that could affect their job satisfaction. For this study, the researcher applied stepwise regression analysis using independent variables as predictors and job satisfaction as the dependent variable. Furthermore, correlation analysis was performed to determine the interdependencies of the various independent factors associated with job satisfaction. Data analysis was carried out using SPSS version 20.0. The following hypotheses were addressed in the research:

Null Hypothesis (H_{01}): There is no correlation between social factor and job satisfaction.

Null Hypothesis (H_{02}): There is no correlation between personal/family factor and job satisfaction.

Null Hypothesis (H_{03}): There is no relationship between economic factor and job satisfaction.

Null Hypothesis (H_{04}): There is no relationship between professional factor and job satisfaction.

The components of the equation are put in a regression sample as follows:

$$JS_i = \beta_0 + \beta_1 \text{Social}_i + \beta_2 \text{Personal}_i + \beta_3 \text{Economic}_i + \beta_4 \text{Professional}_i + \varepsilon_i$$

Where JS represents Job Satisfaction (the dependent variable) and Social, Personal, Economic, and Professional serve as the independent control variables.

Data Analysis and Interpretation:

This section deals with the results of descriptive analysis of the data collected using self-designed questionnaire. Results from Stepwise Regression Analysis is included below:

The regression model used to determine the quantitative relationship of dependent variable and independent variables is:

Table 1: Results of Regression Analysis

Model	Variables Entered	Method
1	Social	Forward (Criterion: Probability-of-F-to-enter <= .050)
2	Personal	Forward (Criterion: Probability-of-F-to-enter <= .050)
3	Economic	Forward (Criterion: Probability-of-F-to-enter <= .050)
4	Professional	Forward (Criterion: Probability-of-F-to-enter <= .050)

Table 2: Results of Regression Analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.662 ^a	0.439	0.438	1.005	0.439	372.034	1	476	0
2	.861 ^b	0.742	0.741	0.682	0.303	558.421	1	475	0
3	.899 ^c	0.809	0.808	0.588	0.067	165.864	1	474	0
4	.924 ^d	0.853	0.852	0.516	0.044	141.653	1	473	0

a. Predictors: (Constant), Social

b. Predictors: (Constant), Social, Personal

c. Predictors: (Constant), Social, Personal, Economic

d. Predictors: (Constant), Social, Personal, Economic and Professional

Through tables 1 and 2, it can be noted that from a stepwise regression model, four significant models have emerged that explains the relationships between the independent and dependent variables in the present study. Regression model one illustrates the relation that exists between social independent variable and job satisfaction. For this model, R and R-square is 0.662 and 0.439 respectively. The value of r-square will change as more independent variables are added into the regression model. The second regression model added incorporates the two independent variables which are: personal/family associated social factor. The r-square value changes from 0.439 to 0.741 when personal/family independent variable is introduced, meaning that the social factor associated with job satisfaction becomes much more strongly associated when the personal/family factor is included in the regression model. Regression model 3 shows that there is change in the r-square by 0.741 to 0.808 if one further independent variable which is economic factor is added to the regression model.

Hence, there is a significant shift in the relationship of dependent and independent variables. Moreover, also with regression model 4, we see that R-square value also changes when one more independent variable professional factor is added into the regression model. R-square value improves from 0.808 to 0.852 with addition of professional factor to the model. Hence, the last model appears to be the most crucial model in estimating the relationship between the independent variable of job satisfaction and job satisfaction of academic staff since R-square was 0.852. It can be claimed based on the R-square value that out of the total 85% variation in the dependent variable, 85% is due to independent variable while 15% is due to some other random unidentified independent variable. Therefore, four independent variables which are social, personal, economic and professional were found significant in the regression model explaining job satisfaction among the academicians.

Table 3: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	375.702	1	375.702	372.034	0
	Residual	480.693	476	1.01		
	Total	856.395	477			
2	Regression	635.45	2	317.725	683.063	0
	Residual	220.945	475	0.465		
	Total	856.395	477			
3	Regression	692.723	3	230.908	668.715	0

	Residual	163.672	474	0.345		
	Total	856.395	477			
4	Regression	730.443	4	182.611	685.774	0
	Residual	125.952	473	0.266		
	Total	856.395	477			

The value of F in the results of the ANOVA of all four models simultaneously executed by the stepwise regression model are shown in Table 3. In the first regression model the value of F is 372.034 and is significant at 1 percent level of significance. Also in the second, third, and fourth models the value of F is significant at 1 percent level of significance. Thus, the null hypothesis which stated that there is no correlation between job satisfaction and social, personal, economic, and professional independent variables is most likely going to be accepted. Therefore, it could be concluded that the job satisfaction of academic members is affected by the social, personal/family, economic and professional independent variables. There is strong evidence that the relationship between the dependent and independent variables formulated within the context of the research was valid.

Table 4: Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t-value	Sig
1	(Constant)	-1.572	0.24		-6.56	0
	Social	1.328	0.069	0.662	19.288	0
2	(Constant)	-5.778	0.241		-23.965	0
	Social	1.248	0.047	0.622	26.632	0
	Personal	1.535	0.065	0.552	23.631	0
3	(Constant)	-6.71	0.22		-30.504	0
	Social	1.009	0.044	0.503	22.702	0
	Personal	1.327	0.058	0.477	22.788	0
	Economic	0.767	0.06	0.297	12.879	0
4	(Constant)	-8.121	0.227		-35.833	0
	Social	0.92	0.04	0.459	23.166	0
	Personal	1.229	0.052	0.442	23.731	0
	Economic	0.73	0.052	0.282	13.93	0
	Professional	0.558	0.047	0.22	11.902	0

The four regression models' outcomes are depicted in Table 4. The first regression model includes social factors of unstandardized coefficients social factors of 1.328 and beta value of 0.662. Some other independent value may decrease if other variables are added in the regression model. The unstandardized coefficients and beta values minimum are on professional factors. In all the four regression models, the t-values are significant for every independent variable. In this study, all four independent examined

variables were significant and bound effectively captures job satisfaction among academic professionals. Null hypothesis 1 which states that there isn't a social independent variable – job satisfaction relationship among academia was rejected; it was possible to substantiate that positive social independent variable – job satisfaction relationship existed with respect to academic professionals using p-value as justification.

Social independent variable satisfaction level of academicians is the strongest predictor of their overall job satisfaction. So, wider the range of reflected satisfaction leads to increased job satisfaction.

This study did not accept Null Hypothesis 2. Therefore, it can reasonably be claimed based on the p value that 'social independent variable' affects an academicians' job satisfaction. It is plausible to assume that a person who enjoys his family and personal life is happier towards his work and job.

The higher the family/personal independent variable satisfaction level is, the more a person is likely to experience job satisfaction. It can be argued that Null Hypothesis 3, which stated that there is no correlation between the economic independent variable and job satisfaction among academic staff, has been disproven in this study. Economically defined variables dominate the job satisfaction level. As stated before, a competent academic is highly satisfied with his job if he is adequately compensated, sponsored for his research and career development, and offered child education and other benefits. The satisfaction in these areas contributes to high job satisfaction among academics. It is found that Null Hypothesis 4, which claimed no relationship between other professional independent variable and job satisfaction of academicians, has been accepted above the time of the study.

A notable and significant positive correlation was found to exist between the professional independent variable and job satisfaction. Therefore, it can be concluded that an increase in satisfaction related to the professional independent variable will lead to greater levels of job satisfaction among academicians.

From the study, it was evident that all the four independent variables—social independent variable, personal/family independent variable, economic independent variable, and professional independent variable—were positively and significantly correlated with the job satisfaction. This study additionally highlights that social factors contribute the most towards job satisfaction among academicians, followed closely by personal/family independent factors. In contrast, among professional factors, the contribution to job satisfaction is minimal.

All four independent variables are summarized in the correlation matrix provided in Table 5, which has been designed for this study.

Table 5: Correlation Matrix

	Social	Personal	Economic	Professional
Social	1			
Personal	0.073	1		
Economic	.420**	.281**	1	
Professional	.240**	.193**	.195**	1
**. Correlation is significant at the 0.01 level (2-tailed).				

As presented in Table 5, the social factor is positively significant with the economic and professional independent variable, while the relationship between social factor and personal/family factor remains positive but insignificant. It was noted in the correlation analysis that the personal/family factor is also positive with the economic and professional independent variable. The economic factor shows positive and significant results with the professional independent variable. It can, therefore, be concluded that all four independent variables are intercorrelated and mutually supportive. From the analysis, it can be concluded that job satisfaction is majorly influenced by the social, personal/family, economic, and professional independent variables.

All four independent variables indicate strong significance toward job satisfaction among academicians. It confirms the hypothesis that job satisfaction is not determined solely by work. Instead, social and personal factors strongly influence one's perception of job satisfaction. A satisfied individual in family and social life will likely feel content at the workplace.

Limitations:

The research is confined to North-East India but can be relevant in other parts of the country.

This data sample of 478 constitutes a fraction of the larger population of academics in India. Given the amount of population, it may still be of some use globally, but from standpoint of focusing on just India, it is of little use. The research is primary in nature and thus faces concerns regarding bias and subjective patterns of evaluation.

Strategic Plan: This research is relevant from the standpoint of managerial level, academicians and other researchers focusing on the university. The working

satisfaction of the academy is highly influential especially because their teaching has great impact on the future of the students. It is important that they provide quality guidance, which greatly depends on their satisfaction. Thus, as is evident from the findings, there is a need to enhance the satisfaction levels of academicians. This study shows that professional and economic factors as independent variables have a dominant influence on the work satisfaction of the educators. Hence, the institution needs to focus on to provide financial remuneration and encourage career advancement for the educators.

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Plant-Based Dairy Milk Alternatives in India: A Comprehensive Review of Market Opportunities, Consumer Acceptance Drivers and Market Barriers

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Abstract

This review critically examines the emerging role of plant-based dairy milk alternatives in India within the context of health, sustainability, and ethical consumption. The study aims to evaluate their nutritional potential, consumer acceptance patterns, market dynamics, and market opportunities for integration into the Indian food system. Methodologically, the review synthesizes evidence from peer-reviewed scientific literature, industry reports, and secondary data sources, including consumer insights drawn from the GFI India Report (2024), to identify key drivers and barriers influencing adoption.

The findings indicates that health consciousness, lactose intolerance, ease of digestion, and ethical concerns are primary motivators for plant-based milk consumption, while high cost, limited availability, taste expectations, and cultural attachment to dairy constrain wider adoption. Nutritional comparisons suggest that fortification and processing innovations can address existing gaps in macronutrients and micronutrients when compared with bovine milk, with soy and oat milk emerging as particularly strong alternatives. Market analysis demonstrates robust growth potential in India, particularly across metropolitan areas, supported by increasing product diversity, expanding distribution channels, and evolving consumer preferences. However, patterns of dual consumption where consumers continue to use plant-based milk as well as animal-derived milk underscore the need for positioning plant-based options as complementary rather than exclusive substitutes.

The study concludes that policy support through clear regulatory frameworks, competitive pricing strategies, multi-channel distribution, and targeted consumer education are essential to overcome adoption barriers. However, the review is limited by its reliance on secondary data and industry reports, which may involve inherent biases and data constraints. Future research should focus on primary empirical studies and longitudinal analyses to better understand evolving consumption patterns and validate market projections.

Keywords: *Plant-based milk, dairy milk alternatives, consumer acceptance, market barriers, sustainability*

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Introduction

Owing to its high concentration of essential nutrients such as calcium, phosphorus, vitamin D, and other important minerals, milk has long been recognized as a key component of human nutrition (FAO, 2013; Pereira, 2014). Milk is widely recognized as a complete and nutritionally balanced food and serves as the foundation for a range of dairy products consumed globally. Despite its nutritional value, traditional dairy milk poses certain challenges. The consumption of dairy products is constrained for a significant segment of the global population due to the prevalence of lactose intolerance and adverse reactions to milk proteins, thereby restricting its consumption (Silva et al., 2020). Increasing environmental concerns associated with dairy production which includes greenhouse gas emissions, intensive water consumption, and degradation of land resources, have further encouraged consumers to explore more sustainable alternatives (Pointke et al., 2022; Hossain et al., 2025; Cloutier et al., 2025).

In response to these shifting dynamics, plant-based milk (PBM) alternatives, such as soy, cashew, oat, millet, almond, and rice milk have gained increasing global prominence. These alternatives are devoid of lactose, free from cholesterol, and generally perceived as healthier and more environmentally sustainable options (Vanga & Raghavan, 2018; Tachie et al., 2023). The production of plant-based milk is associated with substantially lower greenhouse gas emissions compared to conventional dairy systems. In addition, it requires reduced land resources and involves lower levels of water consumption. (Mäkinen et al., 2016; Berardy, 2022). Additionally, the rise of veganism, growing health consciousness, and innovation in product quality have contributed to a surge in PBM adoption across diverse consumer groups (Haas et al., 2019; Sethi et al., 2016). However, the acceptance and market penetration of plant-based milk products remain uneven.

In India, dairy consumption is closely embedded in food habits, cultural practices, and economic structures. Against this backdrop, the move toward plant-based milk alternatives gives rise to a multifaceted scenario, encompassing significant opportunities while also facing notable challenges. While the rising awareness of health, sustainability, and ethical consumption is creating fertile ground for adoption, factors such as price sensitivity, taste and texture expectations, limited availability, and regulatory clarity continue to act as barriers. Understanding the interplay of these drivers and constraints is critical to shaping strategies for market growth, consumer education, and policy support. This review investigates the growth trajectory and consumer acceptance of plant-based dairy milk alternatives in India, evaluates their nutritional composition in comparison with conventional cow's milk, and examines

key market barriers, including pricing, sensory attributes, availability, and regulatory frameworks. It also highlighted strategic opportunities along with insights on key crop producers, brands, and regional trends in the plant-based milk sector in India.

Methodology

The present study utilizes a structured narrative review framework to systematically integrate and analyze existing knowledge on plant-based dairy milk alternatives in India. The review integrates evidence from academic literature and industry-based sources to provide a comprehensive understanding of nutritional characteristics, market trends, and consumer behavior.

The identification of pertinent literature was carried out through a systematic exploration of widely recognized academic databases, such as Scopus, Science Direct, and Google Scholar. The search strategy incorporated combinations of keywords including “plant-based milk,” “dairy milk alternatives,” “plant-based milk India,” and “consumer behaviour towards plant-based milk”. The search was limited to publications in English primarily encompassed studies published between 2013 and 2025 to ensure coverage of recent developments in the field. The identification of relevant studies was carried out in accordance with established inclusion and exclusion criteria. Eligible sources included peer-reviewed journal articles, review papers, and credible industry reports that addressed nutritional characteristics, market dynamics, or consumer behavior related to plant-based milk alternatives. Publications that were not aligned with the research objectives, not available in full text, or focused on unrelated product categories were excluded. Duplicate and redundant information across sources was also carefully filtered during the review process.

The selected literature was analysed using a thematic approach. Key findings were categorized into major domains, including nutritional comparison with bovine milk, market status and growth trends, regional production potential, consumer acceptance drivers, and barriers to adoption in the Indian context. This approach enabled the integration of diverse perspectives into a coherent analytical framework.

Despite its comprehensive scope, this review is subject to certain limitations. The analysis relies predominantly on secondary data sources, including industry reports, which may involve variations in data collection methods and potential biases. Additionally, the absence of primary empirical data limits the ability to validate findings across different consumer segments and regional contexts within India.

Overview of plant-based dairy milk alternatives

Plant-based dairy milk alternatives are beverages derived through the processing and extraction of various plant sources, including nuts, legumes, cereals, pseudo-cereals, and oilseeds. Typically, these plant-derived materials undergo aqueous extraction, followed by homogenization, to yield a liquid product that mimics the visual and textural properties of conventional cow's milk. The particle size in these beverages generally ranges between 5 to 20 μm , contributing to their smooth, milk-like consistency (Yaman, 2024). Such alternatives are often enriched with key micronutrients, such as vitamin B12 and calcium, in order to approximate the nutritional composition of traditional dairy products. The consumption of these alternatives is driven by multiple factors, including evolving dietary preferences, ethical considerations, lactose intolerance, and growing environmental awareness. The flavor, viscosity, and nutritional composition of these products vary depending on the plant source and processing techniques employed. Common examples include soy milk, millet milk, oat milk, rice milk, cashew milk, almond milk, and coconut milk, each offering distinct sensory and nutritional characteristics. Many varieties are available in sweetened, unsweetened, flavored, and plain forms to cater to different consumer preferences and culinary uses (Walther et. al, 2022).

Table 1: Classification of Plant-based dairy milk alternatives based on plant sources

Categories of plant-based milk	Examples
Cereal and pseudo cereal based milk	Oat milk, rice milk, corn milk, spelt milk, quinoa milk, amaranth milk
Legume based milk	Soy milk, peanut milk, cowpea milk, lupin milk
Nut based milk	Coconut milk, almond milk, walnut milk, hazelnut milk, pistachio milk
Seed based milk	Flax milk, sunflower milk, hemp milk

Source: Velangi et al., 2022; Sethi et al., 2024

In the absence of a standardized classification framework, plant-based dairy milk alternatives are generally categorized according to their botanical sources. These include: (1) grain-based milks such as oat, millet, corn, rice, and spelt; (2) legume-based milks such as soy, cowpea, peanut, and lupin; (3) nut-based milks including almond, hazelnut, coconut, pistachio, and walnut; (4) seed-based milks such as sesame, flax, hemp, and sunflower; and (5) pseudo-cereal-based milks like quinoa, amaranth and teff (Sethi *et al.*, 2024). Such a classification offers a structured approach to understanding the diversity of plant-based dairy milk alternatives currently present in the market. Within the grain-based category, millet-based milk has recently gained attention as a nutrient-rich and climate-resilient option, further broadening the variety

of products in this segment. Table 2 presents average nutritional values obtained from the United States Department of Agriculture's Food Data Central database (USDA, 2023), offering a comparative assessment of the compositional characteristics of different plant-based milk alternatives relative to cow's milk. Although actual nutrient levels may vary by brand and formulation, these averages provide a useful benchmark for comparison.

Table 2: Nutritional Comparison of Cow's Milk and Selected Plant-Based Dairy Alternatives

Type of milk	Carbohydrate (g/100g)	Protein (g/100g)	Fat (g/100g)	Energy (Kcal)	Ca (mg/100g)	K (mg/100g)	P (mg/100g)	Na (mg/100g)
Cow' milk	4.4	3.4	3.6	265	120	157	96	42
Soya milk	4.64-4.92	3.82-3.98	3.10-4.30	51.50-52.50	4.00-5.40	141.00-215.00	49.00-62.60	2.20-12.0
Almond milk	4.30-4.70	2.50-1.90	3.20-3.60	55.00-55.90	13.05-13.15	65.03-65.00	75.03-75.33	6.38-6.60
Coconut milk	3.75-9.41	0.59-2.00	4.12-6.00	50.00-92.00	176.00-178.10	631.00-639.02	240.00-256.35	36.00-38.36
Rice milk	9.41-12.70	0.28-1.26	0.97-1.11	47.00-112.00	118.00-121.35	26.34-27.00	55.91-56.86	39.20-40.59
Oat milk	27.30-50.01	9.70-17.30	5.20-12.40	576.60-607.10	84.30-85.60	669.00-671.00	672.30-816.32	3.11-3.21
Peanut milk	21.51-16.10	25.80-26.37	47.22-49.20	462.80-567.00	54.00-92.00	501.00-658.00	76.00-358.00	-
Hemp milk	2.50-20.00	0.83-4.00	1.25-3.00	19.00-21.06	12.03-20.30	110.00-126.00	54.84-63.98	85.69-140.01

Source: Paul et al., 2019; Walsh & Gunn, 2020; USDA, 2023

Table 2 provides a summary of the nutritional attributes of bovine milk alongside selected plant-based dairy alternatives, highlighting both their compositional differences and their emerging role as potential substitutes for conventional dairy products. Among plant-based alternatives, soy milk shows the closest similarity in terms of protein content when compared with cow's milk, while also providing added benefits, as it does not contain lactose and is likewise free from cholesterol, making it suitable for individuals with specific dietary restrictions or health-related concerns. Almond milk, though comparatively lower in protein, is valued for its low caloric density and ease of digestibility, attributes that make it highly suitable for weight management and allergen-sensitive consumers. Coconut milk is notable for its elevated fat content and rich mineral profile, especially calcium and potassium, which contribute to its functionality both as a nutrient source and as a versatile ingredient in

culinary preparations. Rice milk, characterized by its high carbohydrate content and hypoallergenic nature, offers a digestible alternative for individuals with multiple food sensitivities, thereby broadening consumer inclusivity. Oat milk demonstrates a nutrient-dense composition, with relatively high levels of protein, carbohydrates, and essential minerals such as potassium and phosphorus, positioning it as a functional beverage with enhanced satiety potential. Peanut milk provides exceptional levels of protein and energy, reflecting its role as a nutrient-rich and cost-effective substitute, particularly in contexts such as India where groundnut cultivation is abundant. Hemp milk, while variable across formulations, contributes moderate levels of protein, essential fatty acids, and minerals, aligning well with current consumer preferences for functional and “superfood” beverages. Collectively, these plant-based dairy milk alternatives offer unique nutritional benefits tailored to diverse consumer needs, and their integration into diets not only supports health and dietary inclusivity but also contributes to sustainability goals by providing viable options beyond conventional dairy (Vanga & Raghavan, 2018; Paul *et al.*, 2019; Walsh & Gunn; USDA, 2023; Venter de Villiers *et al.*, 2024).

Status of Plant-based dairy market in India

An economic forecast by the Good Food Institute India and Deloitte projects significant growth for India’s plant-based food sector by 2030, both in domestic consumption and export potential. The analysis, based on varying consumer adoption scenarios, evaluates three primary categories: plant-based dairy, meat, and eggs. Domestically, the plant-based dairy segment is expected to be the largest, with a projected market value ranging from \$623 million to \$1.4 billion (₹4,827 crore to ₹10,625 crore) (GFI, 2022). Plant-based milk exports are expected to reach between \$59 million and \$244 million (₹459 crore to ₹1,889 crore). These findings highlight India’s strong potential not only as a domestic growth market but also as a competitive global supplier in plant-based dairy (GFI India, 2022).

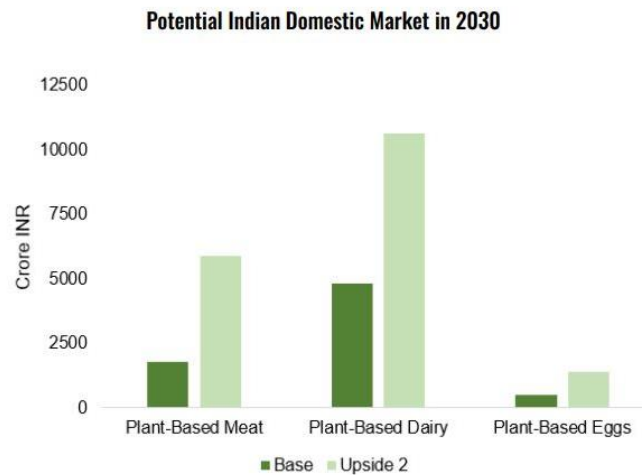


Figure 1: Potential Indian Domestic Market (2022-2030)

Source: GFI India, 2022

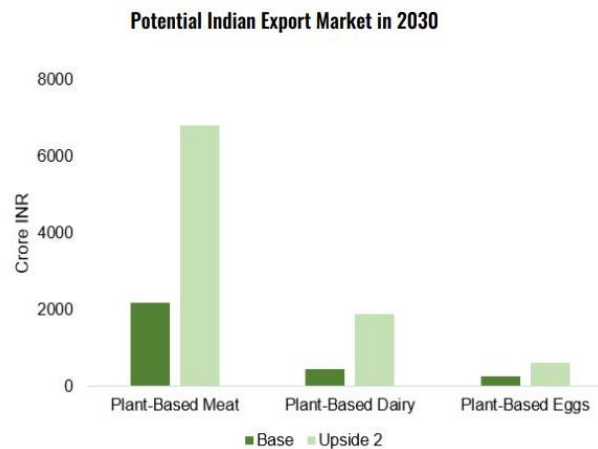
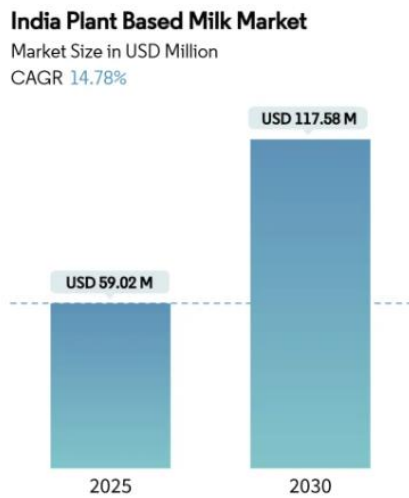


Figure 2: Potential Indian Export Market (2022-2030)

Source: GFI India, 2022

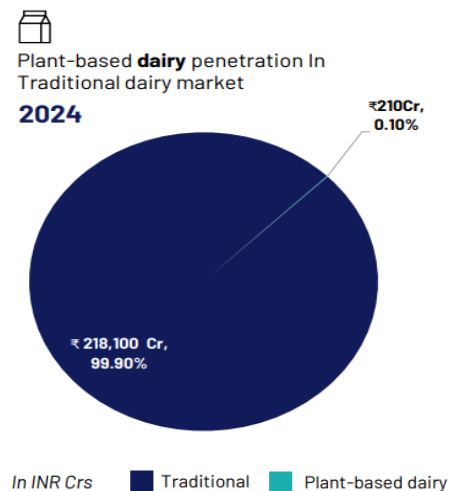
The value of India's plant-based milk market is projected to grow markedly during the forecast horizon, increasing from about USD 59.02 million in 2025 to nearly USD 117.58 million by 2030. This expansion represents a CAGR of 14.78 percent during the 2025–2030 period. Additionally, projections indicate that India's plant-based milk sector will contribute nearly 11.6 percent to the global market between 2025 and 2035 (Mordor Intelligence, 2025).



Source: Mordor Intelligence, 2025

Figure3: India Plant-based milk market (2025-2030)

The figure 4 presents an overview of the plant-based dairy market in India in 2024, highlighting its relatively limited presence within the broader dairy sector as well as the internal composition of the plant-based segment. The Indian dairy industry remains overwhelmingly dominated by conventional dairy products, with a market value of approximately ₹218,100 crore, accounting for 99.9 percent of total market share. In comparison, the plant-based dairy segment is valued at around ₹210 crore, representing only 0.10 percent of the overall market. This substantial disparity underscores the nascent stage of plant-based dairy products within India, despite their gradual emergence as an alternative within the evolving food system.



Source: Ipsos, 2025

Figure 4: Market penetration of plant-based dairy in India in 2024

Table 3: Product-wise Market Share and Market Value of different Plant-based milk in India, 2024

Product Category	Market Share (%)	Market Value (₹ Crore)
Soya Milk	45	95
Almond Milk	31	65
Oat Milk	12	25
Other Products (Cheese, Yogurt, etc.)	12	25

Source: Ipsos, 2025

Within the plant-based segment, the distribution of product categories reflects clear consumer preferences. Soy milk constitutes the largest share at 45 percent (₹95 crore), followed by almond milk at 31 percent (₹65 crore). Oat milk and other plant-based products, including alternatives to cheese and yogurt, each represent 12 percent of the market, with an estimated value of ₹25 crore. The introduction of millet-based milk further indicates ongoing diversification and innovation within the sector. These patterns suggest that while the segment remains small, increasing product variety and improvements in sensory and functional attributes may support gradual market expansion (Ipsos, 2025).

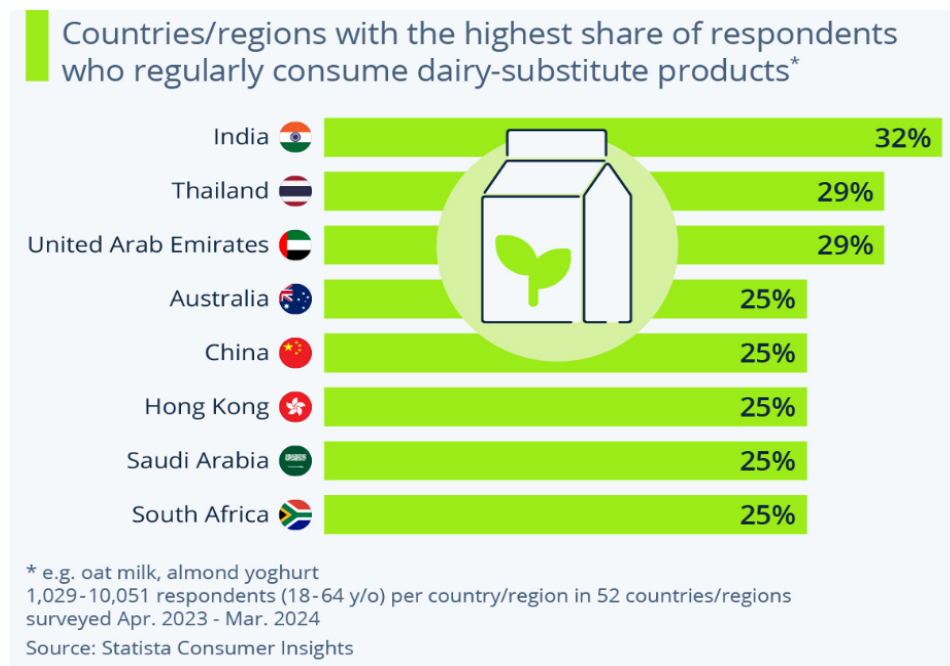
Industry-level evidence reinforces this growth trajectory. According to an economic analysis by the Good Food Institute India in collaboration with Deloitte India, the domestic plant-based dairy sector has expanded to include over 45 brands offering approximately 223 stock-keeping units (SKUs) across a diverse product range, including milk, yogurt, butter, cheese, paneer, and ghee alternatives. In addition, export projections indicate significant potential, with the value of plant-based dairy exports expected to reach between ₹459 crore and ₹1,889 crore by 2030 (GFI, 2023).

Further segmentation highlights key structural characteristics of the market. As of 2024, soy milk held the leading position within the plant-based milk market, comprising 65.40 percent of total share, while hazelnut milk is expected to witness the most rapid expansion, with an estimated CAGR of 19.29 percent by 2030. In terms of distribution patterns, off-trade outlets, including supermarkets, hypermarkets, and e-commerce platforms, represented 68.29 percent of total sales. However, the on-trade segment, comprising cafés, restaurants, and other foodservice outlets, is expected to expand more rapidly, with a projected CAGR of 15.44 percent (Mordor Intelligence, 2025, MarkNtel, 2024, Ipsos 2025).

Packaging and regional trends further illustrate market dynamics. Aseptic cartons dominated in 2024, contributing 60.30 percent of total revenue, while PET and HDPE bottles are anticipated to register the highest growth, with a CAGR of 20.40 percent by 2030. From a regional perspective, West India held the largest share of the market at 34.20 percent, while South India is expected to record the highest growth rate, with a projected CAGR of 17.90 percent over the forecast period. In the global context, India accounted for approximately 5.0 percent of plant-based milk market revenue in 2024 (Mordor Intelligence, 2025), reflecting its increasing participation in the expanding global market for plant-based dairy alternatives.

India's position in the global plant-based milk consumption landscape

The data presented in Figure 5 are derived from a global consumer survey conducted by Statista Consumer Insights between April 2023 and March 2024. The study collected responses from between 1,029 and 10,051 individuals per country or region, focusing on adults aged 18 to 64 years. This large and diverse sample size enhances the reliability and representativeness of the findings, allowing for meaningful cross-country comparisons of consumer behaviour related to dairy substitute products.



Source: Statista, 2024

Figure 5: Countries with highest share of plant-based milk consumers

The figure illustrates the proportion of respondents in selected countries who reported regularly consuming plant-based dairy milk alternatives, such as oat milk and almond-

based products. Among the countries included in the analysis, India recorded the highest share, with 32 percent of respondents indicating regular consumption. This is notably higher than other emerging markets such as Thailand and the United Arab Emirates (29 percent each), as well as developed markets such as Australia (25 percent). Similarly, countries like China, Hong Kong, Saudi Arabia, and South Africa also reported lower adoption levels, each at approximately 25 percent.

These findings suggest that India has emerged as a significant market for plant-based dairy milk alternatives, reflecting a growing shift in dietary preferences among consumers. The comparatively higher adoption rate can be linked to factors such as increasing health consciousness, a growing prevalence of lactose intolerance, and greater exposure to global dietary trends, particularly among urban consumers. Nevertheless, these findings should be interpreted with careful considerations. While the proportion of consumers reporting regular use is relatively high, this does not necessarily indicate deep market penetration across all demographic segments. Consumption in India is likely concentrated within specific consumer groups, particularly in metropolitan areas, and may coexist with continued reliance on traditional dairy products (Statista, 2024).

Furthermore, when compared to developed markets, where plant-based milk is often integrated into daily consumption patterns and supported by strong retail infrastructure, India's market appears to be in a transitional phase. The high percentage of reported consumption reflects growing awareness and experimentation rather than complete substitution. In contrast, countries such as China demonstrate comparable adoption levels but benefit from more established production systems and cultural familiarity with plant-based beverages, particularly soy-based products (Wang et al., 2025).

Overall, this finding reinforces the argument that India is one of the most promising and rapidly evolving markets for plant-based dairy alternatives globally. At the same time, it highlights the unique characteristics of the Indian market, where rising consumer interest coexists with structural and cultural factors that continue to shape the pace and nature of adoption.

Regional Projections of Plant-Based Milk Products Market in India

India's plant-based food sector is experiencing rapid growth, driven by enhanced product accessibility and distribution. While initial demand was primarily concentrated in metropolitan regions, the availability of plant-based food products is gradually extending to non-metropolitan and regional markets. States such as **Andhra Pradesh**,

Punjab, Tamil Nadu, Uttar Pradesh, and West Bengal are witnessing increasing consumer access to and interest in plant-based alternatives. Meanwhile, the sector is already relatively more established in regions including **Delhi, Telangana, Maharashtra, Haryana, and Karnataka**, where consumer familiarity and market infrastructure are more developed (Ipsos, 2025; Assocham, 2023).

The **southern region currently leads the market**, accounting for approximately **40 percent of total market share**. This regional dominance can be attributed to several factors. The **South Indian dietary culture**, which traditionally incorporates **plant-based ingredients such as coconut**, aligns naturally with the adoption of plant-based dairy milk alternatives like **coconut milk**. Furthermore, the region benefits from a **well-developed retail infrastructure**, including both specialty health food outlets and mainstream supermarket chains, which enhances product availability and consumer access (MarkNtel, 2024; Ipsos, 2025).

Urban centres such as **Bengaluru and Chennai** exhibit especially strong consumer engagement with plant-based milk products. Increasing **health consciousness** among urban consumers in these cities has led to growing demand for **lactose-free alternatives** such as **soy and almond milk**, which are perceived as healthier options. The combination of cultural compatibility, modern retail penetration, and rising health awareness positions **Southern India** as the most advanced regional market for plant-based dairy products during the 2025–2030 forecast period (MarkNtel, 2024).

Approximately 9 percent of India's population now identifies as vegan, reflecting a notable cultural shift toward plant-based living. Ahmedabad has emerged as the leading city in this movement, earning the title of India's 'Most Vegan-Friendly City' for 2024, as recognized by PETA India. This recognition has significantly stimulated demand for plant-based milk products across the country. Major food companies, including Daiya Foods, Nestlé, and Sofit, have responded to this demand by expanding their product portfolios to include a variety of vegan and plant-based dairy milk alternatives. These offerings cater to a growing consumer base that is increasingly motivated by health, environmental, and ethical concerns (MarkNtel, 2024).

Cities like Delhi, Bangalore, and Mumbai are witnessing increasing consumption of plant-based milk products. Companies such as Epigamia, with its plant-based yogurt, and Goodmylk, with its almond milk products, have reported significant sales growth in these urban centres. This intersection of consumer ethics, health consciousness, and supportive policy frameworks positions India as a key emerging market for the sustained expansion of the plant-based milk sector (MarkNtel, 2024).

Opportunities in plant-based milk sector in India

India's alternative protein and plant-based milk sectors are experiencing notable growth, driven by a convergence of consumer trends, policy support, infrastructure investment, and market innovation. The foodservice industry is playing a pivotal role in mainstreaming plant-based products. Leading global quick-service restaurant (QSR) chains, such as McDonald's, Subway, and KFC, have introduced an extensive range of plant-based menu options in India, in certain instances exceeding the diversity offered in Western markets, including the United States. Within the beverage segment, multinational chains such as Starbucks, which operates over 250 outlets across India, have integrated plant-based dairy milk alternatives, including almond, soy, and oat milk into their product offerings. In a similar manner, Café Coffee Day (CCD), the largest domestic coffee chain in India with over 900 outlets, has diversified its menu to include a variety of plant-based beverages, reflecting shifting consumer preferences. (Assocham, 2023).

This shift is especially evident in urban areas, where consumers are increasingly motivated by environmental concerns and health awareness. The adoption of low-carbon diets and the growing understanding of the ecological impacts associated with conventional dairy are encouraging more people to explore plant-based dairy milk alternatives. The perceived health benefits of these products further enhance their appeal, driving broader consumer acceptance and accelerating the transition toward sustainable dietary practices.

Policy and regulatory frameworks have also played a critical role in shaping this transformation. Regulatory measures introduced by the Food Safety and Standards Authority of India (FSSAI) have contributed to the standardization of plant-based food products while ensuring consumer protection. In parallel, the Plant-Based Foods Industry Association has been instrumental in supporting the sector through advocacy, public education, and investment facilitation. Vegan advocacy organizations, including Vegan Outreach, contribute to market expansion by framing plant-based consumption within ethical and animal welfare narratives (MarkNtel, 2024; Assocham, 2023; Ipsos, 2025).

From an investment standpoint, India marked a significant milestone with the launch of Ahimsa VC, the country's first venture capital fund dedicated to alternative proteins. This fund supports technologies aimed at reducing harm to human health, animals, and the environment. Globally, the alternative protein sector attracted approximately \$5 billion in investment in 2021, with India receiving a relatively small share of \$10.35 million. The following year, 2022, was marked by global economic volatility, resulting

in a slight slowdown in funding. Nevertheless, the sector remained active, securing \$2.2 billion in global investments, accompanied by the launch of new product lines and brand partnerships signalling continued momentum toward commercialization and consumer integration (Assocham, 2023).

The Indian government has backed this growing sector through a variety of financial and infrastructure-oriented initiatives. Government initiatives, including the Pradhan Mantri Kisan Sampada Yojana (PMKSY), programs led by the National Bank for Agriculture and Rural Development (NABARD), the Production Linked Incentive Scheme for the Food Processing Industry (PLISFPI), and the 'Make in India' campaign, have collectively contributed to establishing a supportive ecosystem for food innovation. Notably, the PLISFPI, with a budget of approximately \$1.5 billion (₹10,900 crore), seeks to develop globally competitive food manufacturing enterprises aligned with India's agricultural strengths. In addition, NABARD's Food Processing Fund, valued at \$265 million, provides concessional financing to food parks and processing units. Complementing these efforts, the government also introduced a \$1.3 billion (₹10,000 crore) package in 2020 to support micro food enterprises, emphasizing grassroots entrepreneurship and decentralized production (Assocham, 2023).

DRIVER	(~) % IMPACT ON CAGR FORECAST	GEOGRAPHIC RELEVANCE	IMPACT TIMELINE
Rise in lactose-intolerance diagnosis among urban consumers	+2.8%	South India core, spill-over to West and North India	Medium term (2-4 years)
Rapid scale-up of D2C and Q-commerce plant-based brands	+2.1%	Metro cities with expansion to Tier-2 urban centers	Short term (≤ 2 years)
Domestic almond cultivation expansion	+1.4%	North India production, National consumption benefits	Long term (≥ 4 years)
Government initiatives boost plant-based milk	+1.9%	National, with early gains in Maharashtra, Gujarat, Karnataka	Medium term (2-4 years)
Vegan options in corporate cafeterias of IT and BPO majors	+1.2%	Bangalore, Hyderabad, Pune, Chennai IT corridors	Short term (≤ 2 years)
Celebrity endorsements boosting category awareness	+0.8%	National, with stronger impact in urban markets	Short term (≤ 2 years)

Source: Mordor Intelligence, 2025

Figure 6: Key Growth Drivers in the Indian Plant-Based Milk Market

While the sub-segments of the alternative protein industry ranging from plant-based to fermentation-derived and cultivated products currently operate under relatively equal market conditions, consumer acceptance will be the decisive factor in determining long-term winners. To maintain global competitiveness alongside nations like China, Canada, and Israel, consistent regulatory support and strategic investment will be essential for scaling innovation and achieving global leadership in sustainable food technologies.

Potential of Indian states in production of plant-based dairy milk alternatives

India possesses considerable potential for the expansion of plant-based dairy milk alternatives, supported by its diverse agro-climatic conditions and high agricultural productivity. States like Madhya Pradesh, Maharashtra, and Rajasthan are national leaders in soybean cultivation, providing a robust foundation for large-scale soy milk production. Jammu & Kashmir and Himachal Pradesh dominate almond output, positioning these regions as hubs for almond milk manufacturing. Oats, while currently grown mostly as fodder, are cultivated in Jammu & Kashmir, Himachal Pradesh, and Uttar Pradesh, all of which could support increased oat milk production if consumer demand rises. Pea cultivation is notable in Uttar Pradesh, Madhya Pradesh, Punjab and Jharkhand, offering an emerging opportunity for pea milk development. Hemp, which is gaining regulatory acceptance and commercial interest, is largely grown in Uttarakhand, Himachal Pradesh, and Madhya Pradesh, and may open doors for hemp milk production in the near future (Indiastat, 2023; APEDA AgriXchange, 2023).

Additionally, southern states such as Kerala, Tamil Nadu, Andhra Pradesh, and Karnataka lead in coconut production, making them ideal for scaling coconut milk, a culturally embedded and nutritionally rich dairy alternative. Madhya Pradesh, Maharashtra, and Karnataka also have extensive millet cultivation, aligning with national millet promotion policies and supporting the development of millet-based milk. Gujarat and West Bengal are key producers of sesame, which can be leveraged for sesame milk, a calcium-rich niche product. Goa, Kerala, and Maharashtra, with strong cashew cultivation, are well-positioned for producing cashew milk, a premium plant-based option. In the north, Punjab, Haryana, and Uttar Pradesh contribute significantly to rice and pulse production, which can be channelled into rice milk and pulse-based dairy products like pea milk (Indiastat, 2023; APEDA AgriXchange, 2023).

Table 4: Major Crop Production and Leading States in India for Plant-Based Milk Alternatives (2023–24)

Crop	Total area under crop (in '000 hectare)	Total production in India (in '000 MT)	Top producing states
Soybean	13255	13062	Madhya Pradesh, Maharashtra, Rajasthan
Almond	9.68	12.35	J&K, Himachal Pradesh
Groundnut	4707.15	10180.08	Gujarat, Rajasthan, Madhya Pradesh
Pea	611.39	6670.60	Uttar Pradesh, Madhya Pradesh, Punjab, Jharkhand
Coconut	2165.20	21373.62	Karnataka, Tamil Nadu, Kerela, Andhra Pradesh, West Bengal
Cereals	104598.90	308052.45	Uttar Pradesh, Rajasthan, Madhya Pradesh, Punjab, Bihar, Telangana
Pulses	27505	24246.00	Madhya Pradesh, Maharashtra, Rajasthan
Rice	47828	137827	Telangana, Uttar Pradesh, West Bengal, Punjab

Source: Indiatat, 2023; APEDA AgriXchange, 2023

This broad geographic distribution of raw materials combined with growing consumer demand, agricultural innovation, and supportive policy frameworks positions India to not only meet domestic needs but also emerge as a key global supplier of plant-based dairy milk alternatives. The regional specialization of crop resources also enables decentralized supply chains, greater price efficiency, and responsiveness to local market conditions, all of which are crucial for sustainable sector growth.

Major brands of plant-based dairy milk alternatives in India

The market for plant-based dairy milk alternatives in India exhibits a dynamic and rapidly developing structure, characterized by the presence of established companies, global market participants, and emerging domestic start-ups, all of which contribute to its expansion and diversification. Leading brands such as Sofit, So Good, and Epigamia

have attained the highest levels of consumer awareness and maintain a strong presence across both mass retail outlets and online platforms. These brands effectively cater to broad consumer bases, leveraging widespread distribution and brand recognition. Concurrently, international premium brands including Silk, Almond Breeze, Alpro, and Oatly primarily serve the upscale retail segment in India, emphasizing high-quality formulations and brand prestige. However, they face intensifying competition from fast-growing Indian start-ups such as Raw Pressery, OatMlk, Goodmylk/One Good, and Only Earth, which have expanded their market share considerably through innovative product offerings, targeted marketing strategies, and direct-to-consumer engagement channels.

In 2024, robust product introductions, particularly emphasizing oat and millet-based milk alternatives is witnessed reflecting a discernible consumer shift toward diverse, nutritious, and sustainable plant-based options. Further, brands like Urban Platter and Country Delight exemplify the growing entry of food service and direct-to-consumer business models into the plant-based milk segment, broadening accessibility and catering to evolving consumer purchasing behaviors. This complex competitive landscape is further strengthened by the presence of prominent industry participants, including Blue Diamond Growers (associated with Almond Breeze), Dabur India Ltd, Danone S.A., Nestlé S.A., Bagrry's India Private Limited, Wingreens Farms Private Limited, Sanitarium Health & Wellbeing Company (Life Health Foods, which manages the So Good brand), The Hershey Company (Sofit brand), The Alternative Company, and Drums Food International Private Limited (Epigamia). These corporations bring diverse portfolios, vast distribution networks, and significant investments in research and development, collectively underpinning sustained innovation, market penetration, and consumer education within the sector (Data Insights Market, 2024).

Collectively, these developments and market participants highlight the significant growth prospects and increasing diversification of the Indian plant-based milk market, supported by rising health awareness, concerns regarding environmental sustainability, greater recognition of lactose intolerance, and evolving consumer lifestyle patterns. The coexistence of strong domestic brands, international leaders, and agile start-ups forms a vibrant ecosystem propelling the expansion and maturation of the industry nationwide.

Table 5: Key Plant-Based Milk Brands available in India

Brand Name	Type of Milk Available	Notable Features/Ownership	Product Highlights
Sofit	Soy, Almond	Owned by Hershey India	Multiple flavors, strong retail presence
So Good	Soy, Almond, Oat, Coconut	Owned by Life Health Foods	Fortified milks, widely available
Epigamia	Almond, Oat	Indian start-up	Also produces plant-based yogurt
Raw Pressery	Almond, Oat, Coconut	Indian start-up (founded 2014, acquired by Wingreens Farms 2021)	Cold-pressed process, clean label focus
One Good	Almond, Cashew, Oat, Peanut, Millet	Indian start-up (rebranded from Goodmylk, merger with Only Earth 2023)	Wide portfolio, sustainability-driven
Urban Platter	Almond, Oat, Soy, Coconut, Rice	Indian start-up	Wide flavor range, strong online availability
OatMlk	Oat	Indian start-up	Café and retail focused expansion
Silk	Almond, Soy, Oat	Owned by Danone S.A. (International brand)	Global leader in plant-based milk
Almond Breeze	Almond	Owned by Blue Diamond Growers (U.S.A)	Imported, shelf-stable options
Country Delight	Oat	Indian dairy brand (diversified into plant-based, 2025 launch)	Preservative-free, allergen-controlled
Alpro	Oat, Almond, Soy	Danone (European leader, entering India)	Premium positioning, fortified and multiple flavors

Source: LoveVeg, 2021; MarknTel, 2024; 6Wresearch, 2025, Mordor Intelligence, 2025

This diversity of brands and product offerings reflects a maturing and competitive plant-based milk market in India, catering to varied consumer demands for taste, nutrition, sustainability, and convenience.

Despite growing attention to the plant-based milk sector, existing literature largely relies on industry reports and market projections, with limited peer-reviewed empirical

research examining consumer behavior, pricing dynamics, and long-term adoption patterns in the Indian context. Furthermore, inconsistencies across market estimates and regional consumption data indicate the need for more systematic and transparent research to better understand the sector's evolving trajectory.

Drivers and Barriers of Plant-Based Milk Adoption in India: Insights from GFI India Report, 2024

According to the Good Food Institute (GFI) India Report, the adoption of plant-based milk in India is shaped by a balance of strong consumer motivations and persistent structural barriers. Understanding these dynamics is essential to evaluate the current market trajectory and to identify strategies for expanding consumer acceptance.

Drivers of Adoption

Health-related factors were identified as the dominant drivers of plant-based milk consumption, with consumers consistently associating these products with improved health outcomes due to their reduced fat levels, lack of cholesterol, and enhanced digestibility relative to conventional dairy. Digestive comfort was particularly important, as lactose intolerance and gastric discomfort are widespread concerns among Indian consumers. The nutritional appeal of plant-based milks such as their protein, vitamin, and mineral content further reinforced their positioning as functional beverages. Beyond health, ethical considerations served as another key motivator. Many consumers associated plant-based milk with cruelty-free sourcing and the avoidance of animal exploitation, thereby aligning their consumption with values of ethical responsibility. These attributes, coupled with the perception of novelty, modernity, and alignment with global food trends, created a strong aspirational appeal, particularly among urban, health-conscious, and younger demographics (Schneider et al, 2021; Basu et al., 2024; Good Food Institute India, 2024).

Barriers to Adoption

Despite the positive drivers, adoption of plant-based milk in India faces critical barriers that limit its mainstream integration. Price sensitivity is the foremost challenge; plant-based milk is widely perceived as expensive compared to conventional dairy, leading to restricted trial and frequent brand switching based on affordability. Limited availability, particularly outside tier-one cities, compounds this issue by reducing accessibility for a broader consumer base. Sensory attributes such as taste, texture, and versatility also present obstacles. In the study conducted by GFI India in 2024, some consumers reported that plant-based milk lacked the desired flavor or does not

perform well in culturally significant dairy applications such as curd, paneer, or ghee, which remain staples in Indian diets. Additionally, while plant-based milk is generally associated with health and ethics, its environmental benefits are poorly understood. Many consumers still associate sustainability primarily with activities such as reducing plastic use or tree planting, rather than dietary choices. This gap in awareness weakens sustainability's role as a driver for adoption (Schneider et al., 2021; Basu et al., 2024; GFI, 2024).

Dual-Consumption Patterns and Implications

An important insight from the GFI India Report (2024) is the persistence of dual-consumption behavior. Nearly two-thirds of plant-based milk users continue to consume animal-derived milk alongside plant-based options. This coexistence is driven largely by the affordability, availability, and cultural embeddedness of dairy, while plant-based alternatives are consumed for health, novelty, or ethical reasons. This indicates that while plant-based milk is gaining recognition, it is not yet viewed as a full substitute for traditional dairy in most Indian households.

In summary, the drivers of adoption which includes health, nutrition, digestibility, and ethical values are counterbalanced by barriers such as high cost, limited availability, perceived sensory limitations, and weak sustainability associations. To accelerate adoption, the need for interventions that address these challenges through improved distribution networks, affordability strategies such as varied pack sizes, product innovations tailored to Indian culinary practices, and consumer education on the environmental advantages of plant-based dairy.

Conclusion

This review provides a comprehensive synthesis of the emerging plant-based milk (PBM) sector in India, examining its nutritional attributes, market trajectory, consumer adoption patterns, and structural constraints. The evidence suggests that the Indian Plant-based milk market is undergoing a period of notable expansion, with projections indicating growth from USD 59.02 million in 2025 to approximately USD 117.58 million by 2030, corresponding to a compound annual growth rate (CAGR) of 14.78 percent. Despite this growth trajectory, the sector remains marginal relative to the conventional dairy industry, which continues to dominate with approximately 99.90 percent market share, valued at nearly ₹218,100 crore in 2024. Nevertheless, the increasing prevalence of lactose intolerance, heightened health awareness, and ethical concerns regarding animal welfare are gradually reshaping consumer preferences and supporting the development of plant-based alternatives.

Nutritional comparisons indicate that plant-based milks, particularly soy and oat varieties, can approximate the macronutrient and micronutrient profiles of bovine milk when supported by targeted fortification and processing technologies, with soy milk demonstrating the closest alignment in protein content. From a production perspective, India's diverse agro-climatic landscape offers a strong foundation for decentralized supply chains, supported by high soybean output in states such as Madhya Pradesh and Maharashtra and significant almond production in Jammu and Kashmir. Regionally, Southern India has emerged as the most advanced market, accounting for approximately 40 percent of the sector's market share due to established retail infrastructure and cultural familiarity with plant-based ingredients such as coconut.

The industry landscape is increasingly characterized by a combination of established brands, international entrants, and emerging domestic start-ups that are diversifying product offerings through innovations involving millets and other functional ingredients. However, several barriers continue to limit large-scale adoption, including price sensitivity among consumers, limited availability outside major urban centres, and persistent sensory expectations related to taste and culinary performance in traditional dairy-based preparations. Furthermore, consumer behavior studies reveal the prevalence of dual-consumption patterns, wherein plant-based milks are typically consumed alongside rather than in place of conventional dairy products. Addressing these challenges will require improvements in product affordability, expansion of distribution networks, and strengthened regulatory frameworks supported by government initiatives such as the Production Linked Incentive Scheme for the Food Processing Industry (PLISFPI). Collectively, these developments suggest that plant-based milks have the potential to become an important component of India's evolving food system while contributing to improved dietary diversity and environmental sustainability.

Implications for Practice

This review yields several significant implications for both industry stakeholders and policymakers involved in advancing the plant-based milk sector in India. For manufacturers, improving the sensory attributes of plant-based milk products remains a key priority, particularly with regard to taste, texture, and their functional performance in culinary applications. Investment in food processing technologies, ingredient optimization, and fortification strategies will be essential to ensure that plant-based milks meet consumer expectations and compete effectively with conventional dairy products.

Market expansion strategies should also emphasize improved consumer awareness and accessibility. Educational initiatives that emphasize the nutritional, environmental, and ethical advantages of plant-based dairy milk alternatives can help mitigate consumer skepticism and encourage more informed dietary decisions. At the same time, expanding distribution networks across organized retail channels, online marketplaces, and foodservice establishments can significantly improve product visibility and accessibility, particularly beyond metropolitan markets.

Policy support will also play a crucial role in enabling sectoral growth. Government initiatives promoting food processing innovation, such as the Production Linked Incentive Scheme for the Food Processing Industry, provide opportunities to strengthen domestic manufacturing capabilities and encourage investment in alternative protein technologies. Collaborative partnerships among research institutions, food technology companies, and agricultural producers can further enhance supply chain resilience and support the development of locally sourced plant-based ingredients.

Future Research Directions

Although this review synthesizes existing literature and market intelligence on plant-based dairy milk alternatives in India, several areas require further empirical investigation. First, future research should focus on conducting primary consumer studies to better understand purchasing behaviour, willingness to pay, and the role of socio-cultural factors influencing the adoption of plant-based milk products in different regions of India. Large-scale surveys and experimental studies could provide deeper insights into consumer perceptions regarding taste, nutrition, sustainability, and price sensitivity.

Further research is also needed to examine supply chain dynamics and production challenges associated with plant-based dairy milk alternatives. Studies exploring raw material availability, processing technologies, and cost structures could help identify opportunities to improve production efficiency and scalability. Comparative analyses between plant-based dairy milk alternatives markets in India and other emerging economies may also provide valuable insights into best practices and policy frameworks that support sectoral growth.

Finally, future research should explore the broader sustainability implications of plant-based milk consumption. Life-cycle environmental assessments, nutritional impact studies, and policy-oriented analyses will be important for evaluating the long-term benefits and trade-offs associated with plant-based dairy milk alternatives relative to conventional dairy systems. Generating such evidence will support informed decision-

making by policymakers, industry stakeholders, and consumers while facilitating the responsible growth of the plant-based milk sector in India.

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Environmental Sustainability in Indian Business: A Bibliometric Review

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Abstract

Environmental sustainability has become an important aspect of modern commerce, significantly impacting operational efficiency, cost management, and overall business growth. Organisations that are socially aware, environmentally friendly, and economically effective are considered sustainable. A business incorporating ecologically sound policies and socially responsible elements into its growth strategy gains a competitive advantage and creates sustainable economic value. The present study has been conducted on the environmental sustainability practices using bibliometric analysis by considering the period from 2000-2025. For conducting the bibliometric analysis, data is used from Scopus. 600 scholarly publications have been analysed using the bibliometric mapping tool, VOS Viewer. Moreover, this study points out exclusive research gaps, mainly in the integration of Sustainable Development Goals within small and medium-sized enterprises (SMEs), cross-sectoral collaboration, and localised policy implementation. This bibliometric analysis provides an insightful and timely contribution to understanding how the demands of global sustainability are influencing research in Indian businesses.

Keywords: *Sustainability, environmental sustainability, bibliometrics.*

Article History

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Introduction

In today's world, environmental sustainability has become a key concern for businesses everywhere, and Indian companies are increasingly recognising its relevance. With the country facing serious environmental issues like air and water pollution, deforestation, poor waste management, and the effects of climate change, there is a growing realisation that economic growth must go hand in hand with environmental care. Simply put, environmental sustainability means using natural resources wisely and maintaining ecological stability over time, all while supporting human development. For businesses, this involves lowering their environmental impact, saving energy, using cleaner technologies, and supporting circular economy practices. In India, where industries are expanding quickly and the use of natural resources is rising, adopting sustainable practices is not just the right thing to do-it has

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become essential for long-term success (Gupta & Sharma, 2020). A major factor influencing Indian companies to adopt sustainable practices is government intervention through policies and regulations. Over the years, the Indian government has introduced various legislative measures and national-level initiatives to encourage industries to operate more responsibly concerning the environment. One significant policy is the National Action Plan on Climate Change (NAPCC), introduced in 2008. This plan lays out strategic approaches across eight key missions, covering areas such as solar energy development, improving energy efficiency, and promoting sustainable farming. These efforts are aimed at helping the nation both respond to and lessen the impacts of climate change (Government of India, 2008). Furthermore, India's pledge under the Paris Agreement, along with its Nationally Determined Contributions (NDCs), has motivated businesses to cut down on carbon emissions and move toward clean energy solutions. Another important regulatory measure is the Companies Act of 2013, which requires large corporations to dedicate 2% of their average net profits to Corporate Social Responsibility (CSR). A significant portion of these CSR efforts is directed toward environmental causes like reforestation, conserving water resources, and managing waste effectively (Ministry of Corporate Affairs, 2013).

In India, environmental sustainability has moved from being a secondary issue to becoming a fundamental aspect of responsible business conduct. This shift is being propelled by a mix of government regulations, market dynamics, and a growing sense of ethical responsibility. Although the journey toward sustainability presents its share of challenges, many Indian companies are beginning to understand that their long-term success, stability, and ability to compete globally are strongly tied to how they manage their environmental impact. As new policies take shape, technologies continue to improve, and expectations from stakeholders grow, a strong commitment to sustainability is likely to distinguish the most successful businesses. By making sustainability a core part of their business strategy, Indian firms have the opportunity not only to support national and international climate objectives but also to help create a more resilient and equitable economy for future generations.

Conceptual framework

Sustainability

Sustainability has been defined as “preserving the resources in such a way that meets the needs of the present without compromising the ability of future generations to meet their own needs” (“Our Common Future”, Brundtland, 1987). The above definition clearly shows the relationship among the environment, society, and the economy. Considering this definition, it becomes clear that the notion of

"development" refers to the method of transitioning natural resources into goods and services that society needs to survive. It also establishes a connection between the utilisation of natural resources and the increased level of welfare of people. Sustainability is the way for any business to achieve its goal by considering society and the environment.

As elegantly brought out by Dyllick and Hockerts (2002), sustainability for a business organisation means:

- a) To manage the cash flow sufficiently to ensure liquidity while producing a persistent above-average return to the shareholders (economic sustainability).
- b) Natural resources like minerals, soil, air, and water are used /consumed by it at a rate below the natural reproduction rate or a rate below the rate of development of substitutes (environmental sustainability).
- c) To ensure that emissions and discharges primarily of air and water that accumulate in the environment due to its activities and services are not at a rate beyond the capacity of the natural ecosystem to absorb and assimilate these emissions and discharges (i.e. working within the carrying capacity of the ecosystem) (environmental sustainability).
- d) To add value to the communities within which it operates by increasing the human capital of individual partners, e.g., Health and Safety of employees, the livelihood of people, etc., as well as furthering the societal capital of these communities (Social sustainability).

Sustainability Practices

Organisations that are socially responsible, environmentally friendly, and economically viable are regarded as sustainable organisations. A business organisation that includes environmentally sound policies and socially responsible elements in its growth strategy gets a competitive advantage and creates sustainable economic value. Several ways exist to explain sustainability. Though there is no broad or universal definition of sustainability.

Environmental Sustainability

Environmental Sustainability is the conservation of natural resources to fulfil the current requirements of the present without impeding the possibilities of future generations. It is an ecosystem wherein biodiversity and overall functionality would be persistently maintained (Ainia & Kusuma, 2014). To sustain the environment, harmful activities should be identified and reduced to the extent possible. Maintaining the balance between profitability and its impact on our natural resources is crucial from both environmental and social points of view. Environmental sustainability also focuses on the rate of replenishment of natural resources, and thus the rate of

utilisation of such resources should not exceed the same. It is a fundamental process where sustainable practices are adopted to let the planet balance itself so that humans and nature can co-exist in harmony (Kesavan and Polisetty 2024). Environmental sustainability included practices such as energy efficiency, reduction of pollution, conservation of biodiversity, and, lastly, adopting more and more eco-friendly practices. The main aspect of environmental sustainability is to preserve the natural resources in such a way that will meet the needs of the present generation and also serve the future generation (Kesavan and Polisetty 2024).

Review of Literature

Bhatt and Ghuman (2022) conducted a study on “*Corporate environmental responsiveness: A bibliometric and content analysis*”. Corporate environmental responsiveness (CERes) has gained significant attention, but existing research offers a fragmented view of its drivers and strategic outcomes. This study uses bibliometric and content analysis, grounded in the strategy tripod framework, to map the development of CERes literature. It identifies eight key themes, proposes a conceptual model, and examines how strategic environmental actions impact firm performance. The study also offers insights for future research and practical guidance for managers and policymakers. Joseph and Asokan *et al.* (2024) had attempted “*Mapping the landscape of green energy integration in business and management: A bibliometric analysis*.” The growing emphasis on sustainability demands a critical evaluation of current social, economic, and environmental policies. Among the key strategies, the adoption of green energy enables businesses to operate in line with global environmental objectives, promoting a sustainable future. This study systematically explores major research themes, trends, and publication patterns related to green energy integration in business and management. It presents a bibliometric framework to guide future studies by assessing the impact of green energy on corporate sustainability and performance. Patel and Singh (2024) conducted a study on “*A bibliometric analysis of sustainability in MSME*”. This research paper explores the significant contribution of Micro, Small, and Medium Enterprises (MSMEs) to the Indian economy, with a particular focus on their progress toward sustainability. By analysing 85 documents indexed in Scopus and sourced from 66 different publications over the period 2014–2024, the study offers a detailed bibliometric overview of research trends in this area. The findings highlight a notable increase in scholarly output in 2023, indicating growing academic and policy interest in sustainable MSME practices. Furthermore, the study uncovers strong collaborative links between Indian researchers and international counterparts, reflecting the global relevance and interconnected nature of sustainability challenges. The paper ultimately reinforces the

need for integrating sustainable strategies into MSME operations to ensure their resilience, competitiveness, and long-term contribution to both the national and global sustainable development agenda. Kesavan and Polisetty (2024) attempted “*A systematic review and bibliometric analysis on the future directions of environmental sustainability and green finance.*” This paper examines the link between environmental sustainability and green finance using a systematic review and bibliometric analysis of 386 Scopus-indexed articles. Findings show a sharp rise in publications from 2017 to 2024, with China, India, and Indonesia leading the research output. *Resources Policy* is the most influential journal, followed by *Sustainability (Switzerland)*, *Energy Economics*, and *Journal of Cleaner Production*. Key research themes identified include green finance, fintech, sustainable development, and green bonds. The study highlights major contributors and provides valuable insights for future research in this emerging field.

Bibliometric Analysis in Environmental Sustainability Practices

Environmental sustainability has become a key area of academic research and policy focus, particularly in response to global challenges such as climate change, biodiversity loss, and resource depletion. In India, the growing need environmental protection has led to a surge in sustainability-focused research. To systematically evaluate this expanding body of work, bibliometric analysis offers a valuable approach by using quantitative methods to track publication trends, identify key contributors, and reveal emerging themes. This study applies bibliometric analysis to examine environmental sustainability research in India from 2000 to 2025—a transformative period shaped by major policy developments such as the NAPCC (2008), the Companies Act mandating Corporate Social Responsibility (2013), and India’s commitments under the Paris Agreement (2015). These milestones have significantly influenced the volume and direction of academic output, institutional involvement, and research funding. By mapping the intellectual trajectory of sustainability research over these 25 years, the study provides insights for researchers, policymakers, and funding bodies, while highlighting future opportunities for investment, capacity-building, and interdisciplinary collaboration.

Research Methodology

The study employs bibliometric analysis to identify the research on environmental sustainability in Indian businesses between 2000 and 2025. Bibliometric methods involve analyzing patterns within published academic work to understand how a particular field has evolved. The aim here is to identify key trends, major contributors, and recurring themes in the existing literature. To begin, data were gathered from Scopus, a well-recognized academic database. A search using the terms “*environmental sustainability*” and “*businesses*” initially returned 18,969 records. To

make the dataset more focused and manageable, the results were narrowed down by selecting specific areas such as Finance, Social Sciences, Management and Accounting; Business, Arts and Humanities; and Economics, Econometrics, and. This step reduced the number of relevant items to 12,581. Additional filters were applied to include only English-language publications that were specifically related to India. After removing unrelated entries and duplicates, a final set of 600 publications remained for detailed study. The data was then saved in a CSV format to make it easier to work with during the analysis. Two tools were mainly used to carry out the bibliometric work: Microsoft Excel and VOS viewer. Excel helped in organizing the data and carrying out basic statistical checks, such as the number of publications per year or the most frequently appearing authors. VOS viewer made it easier to spot research clusters and patterns in collaboration. The analysis placed particular emphasis on key terms including *Sustainability*, *Sustainable Development*, *Environmental Sustainability*, *Environmental Impact*, *Environmental Protection*, *Sustainable Business*, *Corporate Social Responsibility (CSR)*, *Environmental Management*, *Environment*, and *Environmental Policy*. These keywords helped frame the scope of the study and highlight the main areas of focus within the sustainability discussion. Overall, this method provided a structured way to understand how the topic of environmental sustainability in the Indian business context has developed over 25 years. The findings are expected to offer useful insights to scholars, decision-makers, and funding bodies interested in this growing area of research.

Data Analysis and Interpretation

Table 1: Trend Analysis of Publications

Trend of Publications	
Year	Publication
2001	1
2005	2
2006	2
2008	2
2009	2
2010	5
2011	8
2012	7
2013	9
2014	11
2015	8

2016	14
2017	15
2018	22
2019	27
2020	31
2021	40
2022	62
2023	84
2024	189
2025	59
Total	600

Source- Author computation

Table 1 represents the trend of publications relating to environmental sustainability, business in India has steadily increased over the past 25 years. From 2001 to 2010, early research output was limited, with only a handful of papers published annually. This likely reflects the initial stages of scholarly interest in this area. Starting in 2011, a clear upward trend emerges, with the number of studies growing gradually from single digits to the low teens by 2016. This consistent growth continued from 2017 to 2019, indicating rising awareness and engagement among researchers. A significant surge in publication activity is evident beginning in 2020. The number of articles increased from around 30 in 2020 to over 80 by 2023, and 2024 saw a particularly sharp rise, nearly tripling the previous year's total. Although there was a slight decline in 2025, the overall pattern indicates a growing emphasis on environmental sustainability within India's academic and business communities.

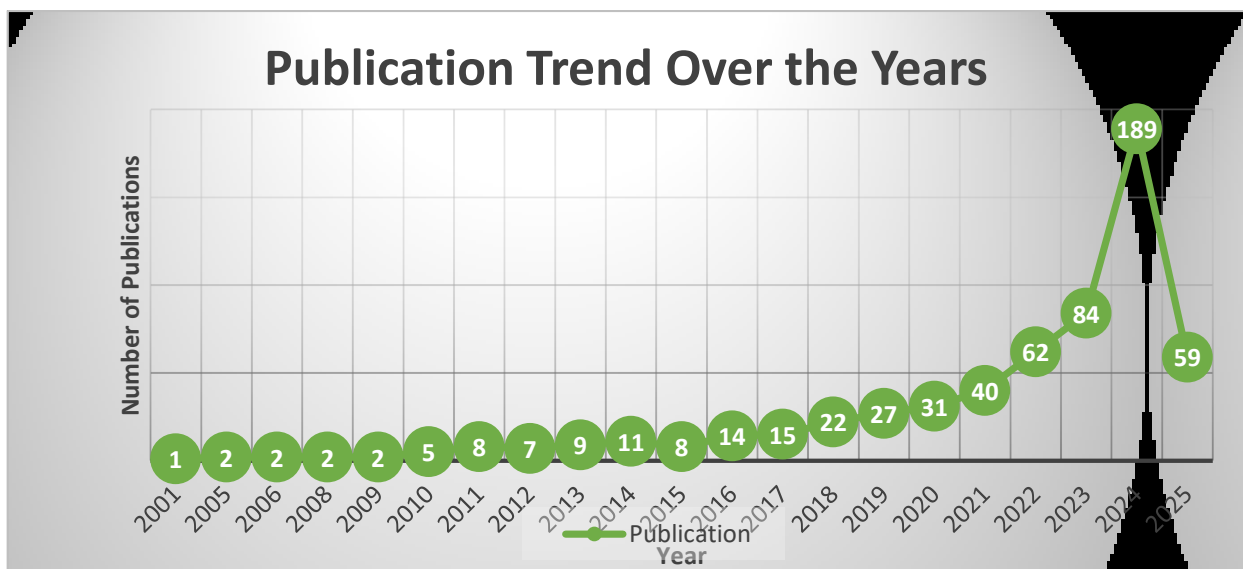


Figure 1: Trend of Publication

Table 2 Most Productive Journals

TOP 10 MOST PRODUCTIVE JOURNALS (with minimum 5 publications)			
Serial no.	Source	Documents	Citations
1	Journal of Cleaner Production	50	4203
2	Business strategy and the environment	40	1408
3	Resources, conservation, and recycling	5	951
4	Environment, Development, and Sustainability	25	633
5	Sustainability (Switzerland)	20	615
6	Technological forecasting and social change	7	597
7	International journal of production research	7	505
8	Benchmarking	11	386
9	Sustainable Development	5	140
10	Business Strategy and Development	7	129
Total		177	9567

Source- Author computation

The table 2 titled "*Top 10 Most Productive Journals (with a minimum of 5 publications)*" offers a detailed comparison of key academic journals contributing significantly to research in areas likely related to environmental sustainability, sustainable development, or green business practices. It ranks these journals based on the number of research papers published and the volume of citations those papers have received-both important indicators of scholarly productivity and influence. The Journal of Cleaner Production stands out as the most prolific, with 50 articles and over 4200 citations, underscoring its central role in advancing sustainability research. In second place, Business Strategy and the Environment has published 40 articles, accumulating more than 1400 citations, revealing its strong relevance at the intersection of environmental concerns and corporate strategy. Interestingly, Resources, Conservation, and Recycling, although only publishing five articles, has received a significant 951 citations. This suggests that its individual publications are particularly impactful, possibly due to the depth or novelty of the research. Similarly, journals like Social Change, the International Journal of Production and Research Technological Forecasting , each with seven contributions, have achieved substantial citation counts, pointing to the importance of forecasting and production-related insights within sustainability studies. On the other hand, journals like Business Strategy and Development and Benchmarking show modest citation figures, likely reflecting either a narrower readership or newer status in the academic landscape. The range of journals included in the list spans various disciplines, from environmental science and

technological innovation to corporate development and industrial efficiency. This diversity highlights the interdisciplinary character of sustainability-focused research.

Table 3: Contribution of Articles

List of the Top Ten Publications Contributed to Research world in Environmental Sustainability in Businesses				
Rank	Title	Journal	Year	Cited by
1	An integrated framework for sustainable supplier selection and evaluation in supply chains	Journal of Cleaner Production	2017	702
2	Risk analysis in green supply chain using fuzzy AHP approach: A case study	Resources, Conservation and Recycling	2015	412
3	Circular economy and big data analytics: A stakeholder perspective	Technological Forecasting and Social Change	2019	363
4	Does environmentally responsible purchase intention matter for consumers? A predictive sustainable model developed through an empirical study	Journal of Retailing and Consumer Services	2021	270
5	Urban sustainability assessment tools: A review	Journal of Cleaner Production	2019	242
6	Demystifying the pollution haven hypothesis: Role of FDI	Journal of Business Research	2021	228
7	Impact of big data and predictive analytics capability on supply chain sustainability	International Journal of Logistics Management	2018	226
8	Pressure analysis for green supply chain management implementation in Indian industries using analytic hierarchy process	International Journal of Production Research	2014	221
9	Sustainable manufacturing. Bibliometrics and content analysis	Journal of Cleaner Production	2020	213
10	Sustainable supply chain management practices in Indian automotive industry: A multi-stakeholder view	Resources, Conservation and Recycling	2018	213

Source- Author computation

The table no. 3 titled “List of the Top Ten Publications Contributed to Research World in Environmental Sustainability in Businesses” highlights the most cited academic

studies that have significantly shaped the field of sustainability within business practices. These works, ranked by the number of citations from other researchers, represent major scholarly contributions to topics such as green supply chains, sustainable manufacturing, environmentally conscious consumer behavior, and the role of emerging technologies, like big data, in promoting sustainability. Topping the list is a 2017 paper from the *Journal of Cleaner Production* that outlines a comprehensive approach to evaluating and selecting suppliers based on sustainability principles. With 702 citations, this study highlights the significance of embedding environmental criteria in supply chain decisions. Following closely is a 2015 case study published in *Resources, Conservation and Recycling*, which employs a fuzzy analytical hierarchy process (AHP) to assess risks in green supply chains—a method that has garnered considerable academic attention, with 412 citations. In third place is a 2019 publication from *Technological Forecasting and Social Change* that investigates the intersection of the circular economy and big data analytics from a stakeholder perspective. This paper, cited 363 times, demonstrates how digital technologies can support sustainable business models. Also among the top are papers that explore eco-friendly consumer intentions and sustainability assessment tools for urban environments, reflecting the growing interest in both behavioral and planning aspects of sustainability.

Other notable contributions include a study on foreign direct investment's role in environmental degradation—challenging the pollution haven theory—which has received 228 citations since its 2021 release in the *Journal of Business Research*. Similarly, a 2018 article from the *International Journal of Logistics Management* explores how the predictive capabilities of big data can improve supply chain sustainability.

Table 4 Author's Contribution

List of the Top 5 Authors Contributing to the Research World in Environmental Sustainability in Businesses			
Rank	Author	Publication	Citations
1	mangla, sachin kumar	12	2031
2	luthra, sunil	12	1446
3	govindan, kannan	11	1460
4	kumar, anil	10	827
5	kannan, devika	7	1229
Total		52	6993

Source- Author computation

The table no. 4 titled “List of the Top 5 Authors Contributing to the Research World in Environmental Sustainability in Businesses” features leading researchers who have each published at least five studies in this field, focusing on both the volume and influence of their work, as indicated by citation numbers. At the top is Sachin Kumar Mangla, credited with 12 publications and 2031 citations, highlighting his significant role in promoting sustainable practices, particularly in supply chain and operations research. Sunil Luthra shares the same publication count but has gathered 1446 citations, marking his consistent contributions to green and sustainable decision-making frameworks. Kannan Govindan, with 11 papers and 1,460 citations, demonstrates both academic productivity and high impact, particularly in research on circular economy and environmental policy. Anil Kumar, with 10 publications and 827 citations, has maintained a steady presence in sustainability-related business research. Devika Kannan, although having a smaller number of outputs (7 publications), has received a notable 1229 citations, pointing to the strong relevance and quality of her work. Together, these scholars account for 52 papers and 6993 citations, establishing themselves as prominent contributors to the academic dialogue around sustainable business practices.

Co-Authorship

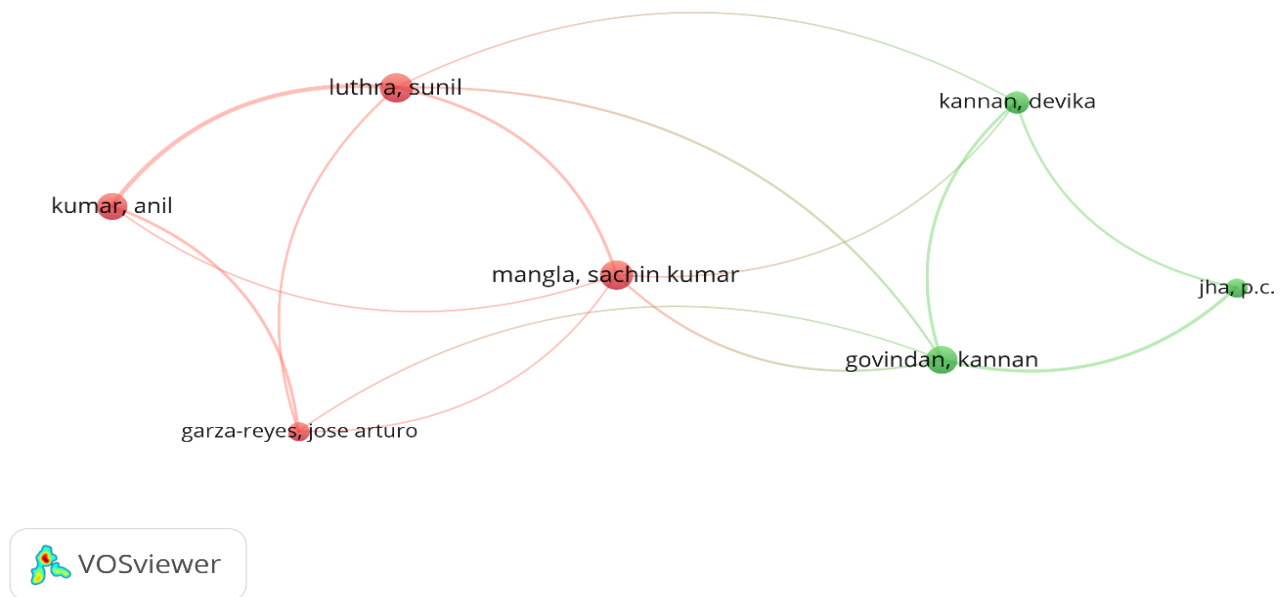


Figure 2

Figure 2 represents the co-authorship network, illustrating the collaborative relationships among leading researchers in the field of environmental sustainability in business. Each node represents an author, with the size reflecting their research output, while the connecting lines show the frequency of joint publications—thicker

lines indicate stronger collaboration. The map reveals two major clusters: **the red cluster** includes “Sachin Kumar Mangla”, “Sunil Luthra, Anil Kumar”, and “José Arturo Garza-Reyes”, who are often co-authors in studies on sustainable operations and green supply chains. The **green cluster** features “Kannan Govindan”, “Devika Kannan”, and “P.C. Jha”, known for their work on circular economy and sustainable decision-making. Interestingly, Sachin Kumar Mangla acts as a link between both groups, suggesting his influential role in fostering interdisciplinary collaboration. Overall, the network emphasizes the value of academic partnerships in advancing research and innovation in sustainable business practices.

Table 5: Keyword

FREQUENCY OF KEYWORDS	
Keyword	Occurrences
sustainability	410
sustainable development	225
India	83
environmental sustainability	74
Supply chain management	64
corporate social responsibility	57
decision making	50
circular economy	44
environmental economics	44
environmental management	38
innovation	38
environmental impact	37
supply chains	31
business	29
environment	26

Source: Author's Contribution

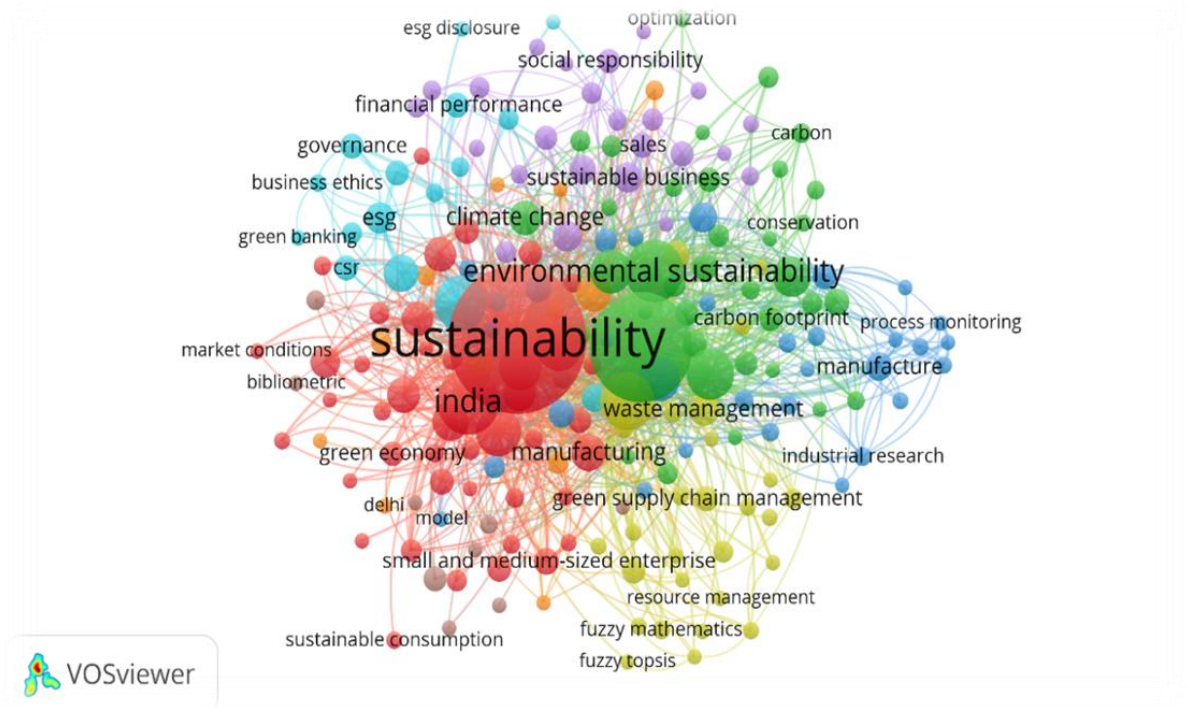


Figure 3

This VOS viewer map graphically illustrates the predominant themes within research related to sustainability. The visual prominence of each node (represented by its size) directly correlates with the frequency of that particular keyword's appearance in the analysed data, indicating its significance and recurring presence in the field. Consequently, larger nodes signify concepts that are more commonly discussed and researched. While precise numerical counts are not discernible from the image, a hierarchy of importance can be readily inferred from the visual scale. "Sustainability" itself stands as the most central and expansive node, serving as the foundational concept that unifies all other elements. Radiating outwards are other considerably sized nodes such as "environmental sustainability," "waste management," and "climate change," collectively underscoring the critical ecological dimensions and primary challenges central to the sustainability discourse. The notable inclusion of "India" as a prominent node suggests a substantial emphasis on sustainability issues, research initiatives, or scholarly contributions originating from or concerning the Indian context within the underlying dataset. Further large nodes, including "manufacturing" and "green supply chain management," highlight the significant interplay between industrial operations and the adoption of sustainable methodologies. A distinct cluster encompasses terms like "social responsibility," "financial performance," "business ethics," and "ESG" (Environmental, Social, and Governance), collectively emphasizing the corporate, economic, and ethical facets of sustainability. The visualization adeptly organizes related terms into distinct coloured clusters, each representing a specific sub-theme or area of inquiry. For instance, the blue grouping appears to pertain to

Indexed keyword



The image is a comprehensive keyword co-occurrence map generated using VOS viewer, illustrating the structure and thematic focus of research related to sustainable development. Each circle in the map represents a specific keyword, with the size of the circle indicating how frequently the term appears across the analysed literature. Thicker lines between circles reflect stronger co-occurrence relationships, meaning the connected keywords often appear together in the same documents. These keywords are grouped into distinct color-coded clusters, each representing a major research theme. The green cluster focuses on industrial practices and supply chain management, highlighting terms like “lean production” and “six sigma,” which suggest an emphasis on integrating sustainability into manufacturing and logistics. The red cluster centers around policy, governance, and regional studies, particularly in the Indian context, with keywords such as “India,” “stakeholder,” and “policy making.”

The yellow cluster pertains to economic development and business sustainability in developing countries, featuring terms like “economic analysis” and “small and medium-sized enterprise.” The blue cluster address’s themes of logistics, commerce, and reverse supply chains, while the light blue cluster includes methodological approaches and analytical tools, such as “fuzzy mathematics” and “sensitivity analysis.” At the core of the map is “sustainable development,” linking all other themes and indicating its role as the central concept in this research landscape. This visualization illustrates the interdisciplinary nature of sustainability studies, which bridges fields such as economics, environmental policy, industrial engineering, and data analysis.

Conclusion

The research on environmental sustainability in Indian businesses from 2000 to 2025 shows a clear and growing interest in the topic. While early research was limited, there's been a noticeable increase in publications, especially since 2020, with a significant jump in 2024. This suggests that both researchers and businesses in India are becoming much more aware and involved in environmental sustainability. Government initiatives, such as the National Action Plan on Climate Change, the Companies Act of 2013, and India's commitments under the Paris Agreement, have been key drivers behind this increased focus on responsible environmental practices and related research. Leading academic journals like the *Journal of Cleaner Production* and *Business Strategy and the Environment* are at the forefront of sharing this crucial research. Their most cited articles highlight the importance of areas like green supply chains, sustainable manufacturing, and how big data can help promote sustainability. Top researchers such as Sachin Kumar Mangla, Sunil Luthra, and Kannan Govindan are major contributors in this field, often working together on topics like sustainable operations, green decision-making, and the circular economy. The main themes in the research revolve around "sustainability" and "environmental sustainability," with considerable attention paid to "waste management," "climate change," "manufacturing," and "green supply chain management". The frequent mention of "India" in the research keywords emphasizes the focus on the country's unique sustainability challenges and initiatives. The research also delves into the corporate, economic, and ethical aspects of sustainability, including "social responsibility," "financial performance," "business ethics," and ESG (Environmental, Social, and Governance). Ultimately, this body of work highlights the interdisciplinary nature of sustainability studies, connecting fields like economics, environmental policy, industrial engineering, and data analysis.

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Data-Driven Approaches to Employee Motivation: Evaluating the Efficacy of Motivational Theories

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Abstract:

Motivation relates to human behaviours and is critical not only to organisations to make strategic human resource management decisions but also to individuals for shaping their performance. The study examines the quantifiability of the theories and how precisely the quantification could be done to make data-driven decision-making. Considering two significant theories, viz. Maslow's Need Hierarchy Theory and Herzberg's Hygiene Theory, the study also examines other motivational theories for contextuality. It formulated two basic objectives to examine the capability of the theories to be quantified and to determine whether there were significant differences between the outcomes generated by the models and which required the collection of some primary data from a small sample. To test significant differences between the outcomes, ANOVA was used, which confirmed $H_0: \mu M_1 = \mu M_2 = \mu M_3$, unveiling the fact that all the models are equally efficient to be applied for organisational purposes. The two other major observations that the study found are that motivational factors could be scored in numbers and that the theories are well-accepted by social scientists, researchers, and industrial establishments; still, there is a need to have further mathematical models in the context of the global and digital world.

Keywords: *Motivation, Human Behaviour, Quantification, Data-Driven Decision Making, Mathematical Model*

JEL Codes: M12, M54, J24, I31, M54.

Article History

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Introduction:

Coupled with anthropological behaviour or behavioural science, motivation is a qualitative facet of humans. It is better to comprehend it qualitatively since it cannot produce meticulous outcomes in all cases. Despite the castle in the air of precisely shaping the score, it gives an inclusive idea of employees' behaviours and provides the establishment with a premise to make strategic decisions. Quantifying the motivational factors individually and total motivational scores collectively is significant from the

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organisational point of view. The employees, too, are always fascinated by numbers rather than qualitative properties of good or bad. Social scientists also view that quantifying the motivational factors is significant in enhancing individual and organisational performance. Pant (2024) observed that by quantifying the motivational factors, the organisation gets a more dedicated workforce, leading to both organisational and individual benefits through higher productivity.

The diverse components of motivation, such as job security, social attachment, leadership, working conditions, etc., critically influence employee performance as pinpointed by Maake (2024) and Constantinescu & Stegaroiu (2023). Xie (2024) emphasised recognising the intrinsic and extrinsic factors and motivational factors to determine the behavioural aspects of the employees. Moreover, precise quantification of motivational factors allows the organisation to align with the strategic goals. (Ibrahim & Abiddin, 2024).

The use of dynamic assessment techniques precisely measures the real-time motivation scores. (Hermand, 2023). Behaviour regulation in exercise questionnaires may be used to measure the potential motivational scores of the students. (Soos et al., 2023). Esposito et al. (2023) developed an interpersonal motivational systems questionnaire for quantifying the motivational factors. Amit and Feitelson (2023) linked motivation to performance metrics to estimate the scores. Coco et al. (2023) highlighted that understanding the precise motivational level is very tough, which might obstruct the empirical studies. Despite the complexities in estimating the degree of motivation, it is quite possible to quantify the motivational factors. All these and many other matters disclose that although it is not possible to estimate the motivational scores, it allows the organisation an overall idea regarding the employee behaviours, take corrective action, and finally make strategic decisions for both the employee and organisational benefits.

Objectives of the Study:

The primary objectives of the study are:

1. To examine whether the factors of the motivational models can be effectively quantified or not.
2. To examine whether the outcomes of the application of the models are identical and equivalent.

Methodology:

The study adopts an extensive literature survey to examine the nature of the motivational theories that permit the creation of flowcharts of each model. It considered the popular theories of Maslow's Need Hierarchy Theory and Herzberg's Hygiene Theory of Motivation. The basic idea was to examine whether the theories could be quantifiable or not. Based on the nature of the theories, the simple algebraic formulae have been developed considering the researchers' perceptions. The study also collected a little bit of primary data from only two Private Hospitals from 15 sample nurses working there. The sample size is too low since one of the basic objectives of the study is to examine the differences between the theories, and not to determine the motivational scores of the individual samples. It involves simple mathematical accomplished in Excel and statistical calculations of ANOVA.

Review of Literature:

Wei et al. (2016) disclosed that the fuzzy set theory is an innovative mechanism, highlighting that need fulfilment is one of the best techniques for measuring the motivational level. Suman (2016) stated that Maslow's need hierarchy theory is a recognised tool for motivation estimation in the workplace. However, Omodan & Abejide (2022) suggested that a more dynamic and comprehensive estimation tool is crucial to changing situations and adapting to the changing contemporary social and economic changes. It is also significant to consider both the theoretical framework of Maslow's theory and its practical applications. Quantifying Maslow's need hierarchy theory involves a separate estimation of the five components he developed. Taormina & Gao (2013) further state that while dealing with the motivational aspects of students, lower-level needs significantly influence the higher-order needs. Accordingly, Akhan (2024) observed that the physiological and safety needs when related to the socio-economic position of the students would be first-rate motivators for the students. The necessities as proposed by Maslow must be further added to modern basic needs, like internet access, since contemporary society cannot visualise lacking the internet. (Rao et al., 2022). Furthermore, matters relating to unfulfilled needs should also be a part of the theory. ((Haruna et al., 2024). As such, quantifying suggested needs must be added to other contemporary elements for effective contextual and empirical application.

Maslow's theory is further advanced by Alderfer and consolidates the needs into three categories, viz. existence, relatedness, and growth, assuming all are the same. (Cebotari, 2024). Ruswanti et al. (2013) further clarified the labelling as basic needs are existence needs, interpersonal needs are relatedness, and growth needs are self-

actualisation needs. According to (Gupta & Singh, 2024) and (Arnolds & Boshoff, 2002), state growth needs are always prioritised as motivators by the employees as they normally get their basic needs satisfied. The ERG framework involves almost all the components of motivation in greater organisational contexts. (Winston & Caulton, 2012)

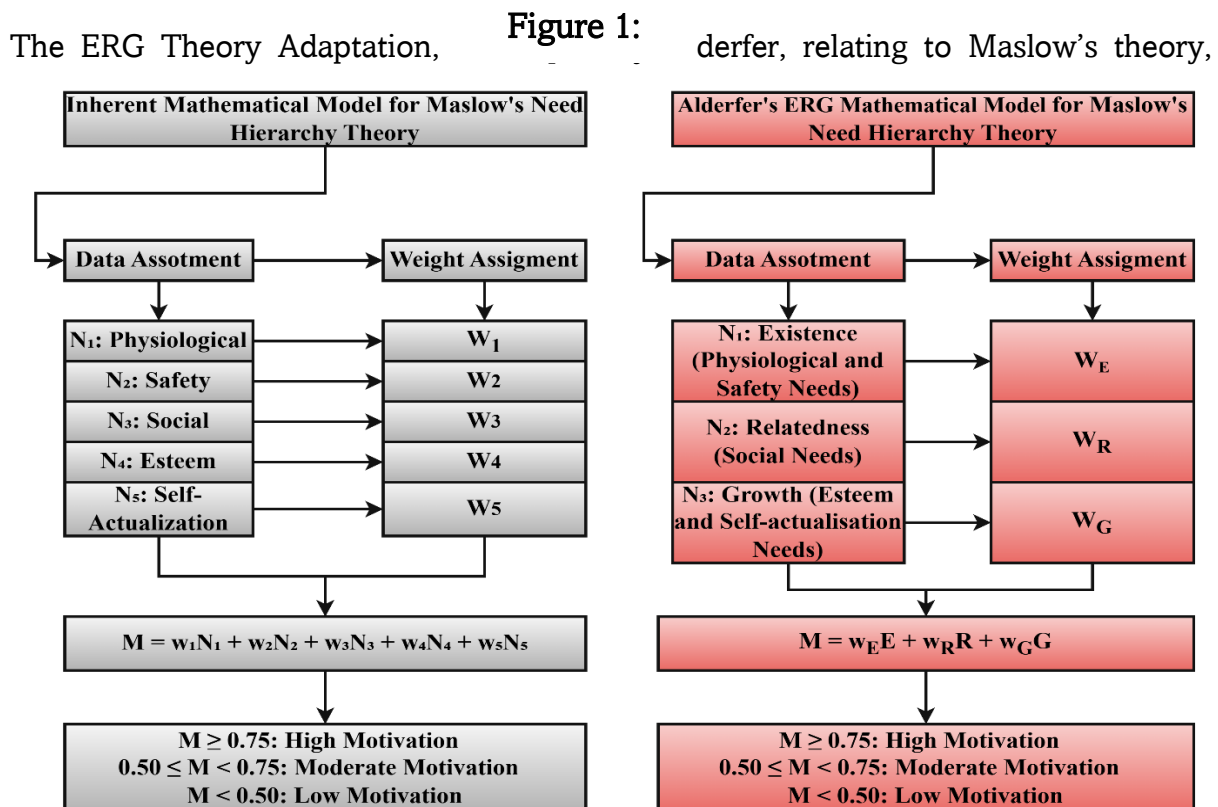
Coming to the Herzberg Two-factor model is an advanced version of Maslow's Need Hierarchy theory and can be quantified using various methodologies like structured questionnaires and statistical software like SPSS. (Jaffar et al., 2024) (Ybañez, 2024). Regression analysis using the Likert scale lets us figure out the correlation between the higher-order needs and the degree of motivation. (Kudaibergenov et al., 2023). Implications that are derived are that the Two-factor model, as furthered by Herzberg, can effectively be quantified provided appropriate methodologies and statistical tools are used. (Ser & Webber, 2024). The mathematical model suggests that growth opportunities and recognition serve as motivators, and the company policies and salary serve as hygiene factors. (Kudaibergenov et al., 2024) (Ybañez, 2024). While Sankaran et al. (2023) and Ahmed & Sultan (2022) observed that motivators have significant impacts on employee bonding, particularly in the industrial, banking and education sectors. Ybañez (2024) further added that hygiene factors create low dissatisfaction, whether the motivators are significant to foster better industrial relations. The theory is a balanced approach to motivators and hygiene, and if effectively applied, it increases employee satisfaction and performance, as well. (Mitsakis & Galanski, 2022)

An advanced concept of the motivational approach is the Integrated Maslow-Herzberg model considers the components of both the original models that can be applied in strategic human resource management. (Турлю & Litvin, 2024) (Kotliarov, 2008). It enables the HR manager to address employee expectations in terms of motivators and foster a productive workforce in the context of the digital and global economy. (Ibietan, 2010)

Results and Discussion:

Maslow's Need Hierarchy Theory of motivation itself has an inherent formula for quantifying the motivational score. It also defines the variables and their relationship that can be established numerically. The mathematical formula encloses the sum of the individual values of each variable weighted by a certain value. The viewpoint behind the weight is that the impact and impression of each variable on the human being are not equal and significant. While $N_1 \dots N_5$ are the variables (finite up to 5 variables), $w_1 \dots w_5$ are the weights assigned to each variable. In principle, the lower-level needs are of higher significance and the higher-level needs are less significant in

terms of their impacts on human beings. Say the basic needs, such as food and clothing, are the highest significant for human beings because, had they not had them, they would not survive. As such, these variables will get the highest weight. A human being would survive without recognition, and this is the reason why it is given lower weight. However, in terms of purchasing power and economic stability, the idea of basic needs changes. While having a luxury car might be a basic need for a celebrity, but might be a higher-level need for the common man belonging to the middle class. In such a way, Maslow's concept of need hierarchy becomes more complex. Nevertheless, a basic idea can be derived from the concept after quantifying the theory. The quantification includes the Overall Satisfaction (M) the sum of the Satisfaction Level of Each Variable (N) Multiplied by Relevant Weights (W) which expressed as $= w_1N_1 + w_2N_2 + w_3N_3 + w_4N_4 + w_5N_5$. On a 1-point scale i.e. $W_t = w_1 + w_2 + w_3 + w_4 + w_5 = 1$, for the 5 variables giving weight 0.3 on physiological needs, 0.3 on safety needs, 0.2 on social needs, 0.1 on esteem needs and 0.1 on self-actualisation needs might be a better idea instead of 0.1, 0.1, 0.2, 0.3, and 0.3 that labels more significance of getting a private jet than breathing for survival. However, in another approach, the way of figuring out the score has been placed differently.

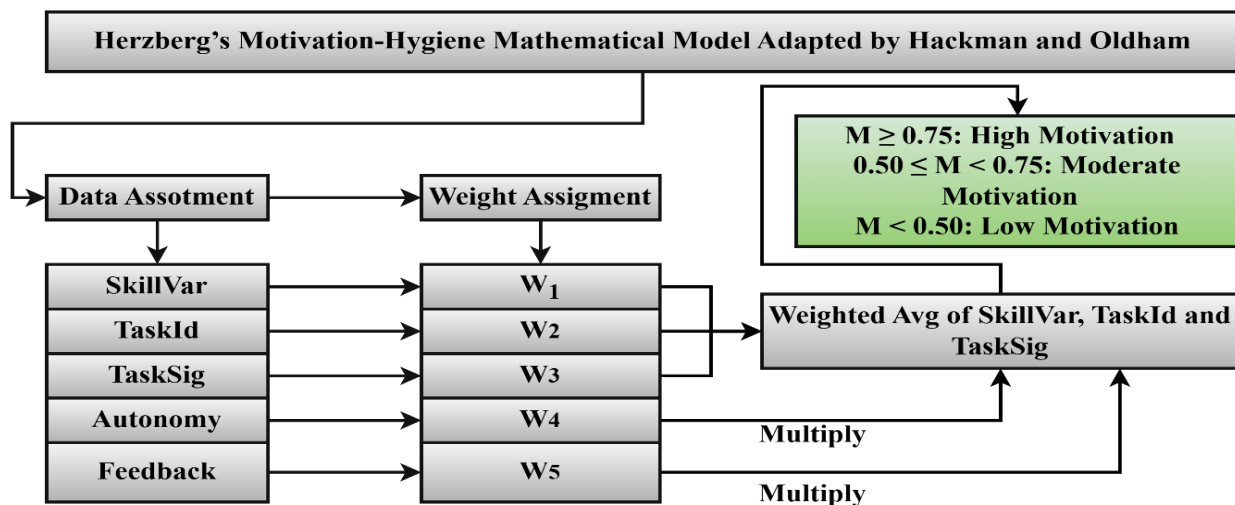


refined the inherent calculation differently. The original 5 variables are combined into 3 variables. The 3 variables 1. Existence needs (E)—combining physiological and safety needs, 2. Relatedness needs (R) with Social needs, and 3. Growth needs (G)—combining Esteem and Self-actualisation needs have been shaped. Thus, the total motivational score = $E + R + G$. The weighted score after application weights is $M = w_E E + w_R R + w_G G$ and $W_t = w_E + w_R + w_G = 1$.

Herzberg's motivation-hygiene mathematical model, adapted by Hackman and Oldham, forwarded a comprehensive approach that calculates the Motivating Potential Score (MPS) considering 5 variables viz. (1) Skill Variety, (2) Task Identity, (3) Task Significance, (4) Job Autonomy and (5) Feedback on Performance. They define the formula $MPS = \frac{(SkillVar + TaskId + TaskSig)}{3} \times Autonomy \times Feedback$. The variable- Skill Variety may be defined as different talents and skills required to perform a job. It is interconnected with job satisfaction in the sense that the higher the skill variety, the higher the satisfaction leads to motivation. Task identity, on the other hand, according to their opinion, is the degree of completion of the assigned task that makes the employee happy, had the employee completed a substantial part of the job or its entirety. The degree of significance of the job indicates task significance, which impacts the employee positively or negatively on motivation according to the degree of significance of the task. These 3 variables are influenced by the delegation of autonomy to the employee and feedback received on the accomplishment of the job. Both the above theories justify themselves in their own way; however, a more systematic model has been extended by Edward E. Lawler, integrating the two approaches.

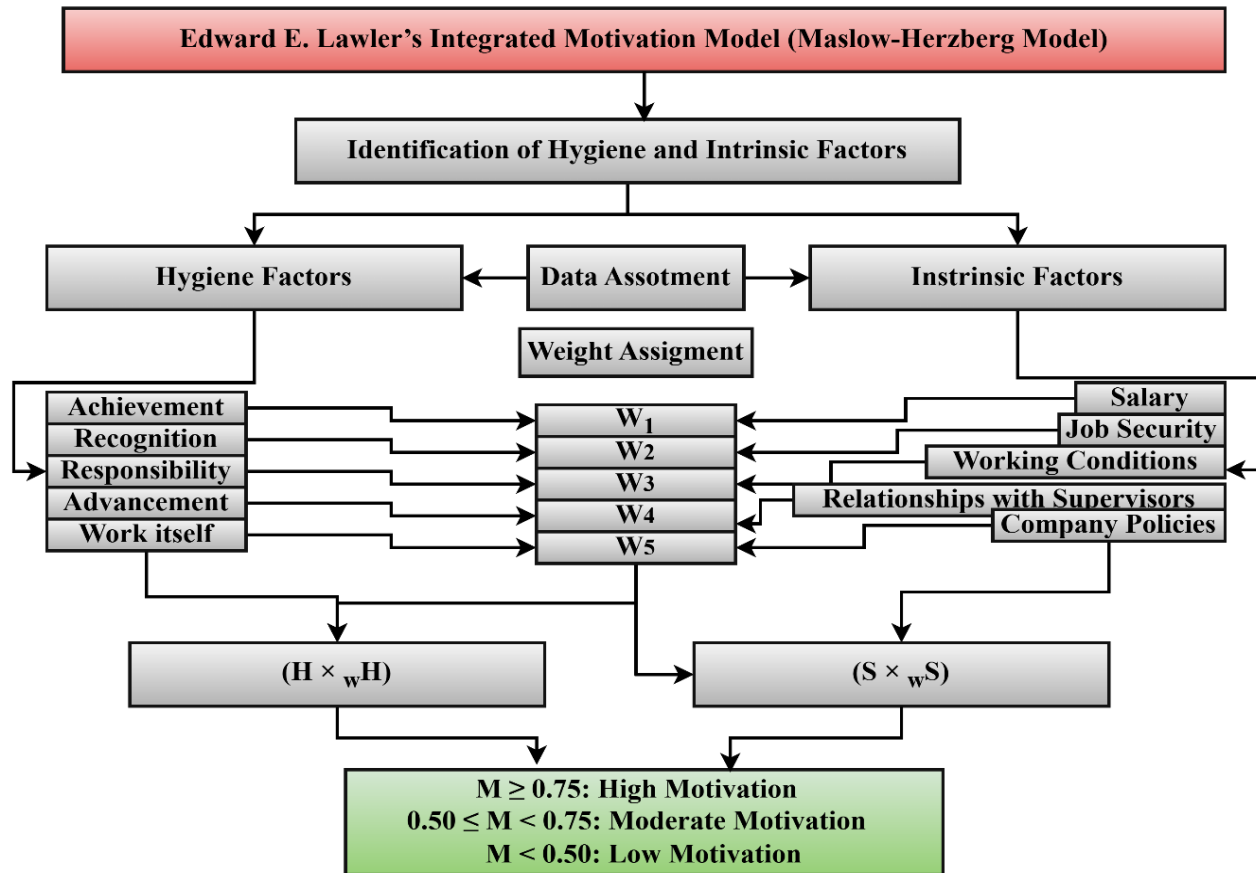
Figure 2

Edward E. Lawler combines the corresponding strengths of both approaches, bearing



in mind motivational factors—*intrinsic* and *hygiene* factors—*extrinsic* factors and following the hierarchical structure of Maslow’s approach. Lawler proposes the model as $M = (S \times w_s) + H \times w_h$ where, M = Motivational score, S = Satisfaction with intrinsic factors (Herzberg), H = Satisfaction with hygiene factors (Maslow), w_s = Weights from intrinsic factors, w_h = Weights from hygiene factors.

Figure 3



The study set an objective to determine the significant differences between the results of the 3 mathematical models, i.e. Maslow’s Need Hierarchy Theory Inherent Mathematical Model (M_1), ERG Theory Adaptation developed by Alderfer (M_2), and Herzberg’s motivation-hygiene mathematical model adapted by Hackman and Oldham (M_3). The small study took 15 sample nurses working in 2 different private hospitals, viz. Dr. N.M.B. Nursing Home and Sarathi Hospital, Nalbari of Assam, were meant to collect data by combining the questions for 3 models. For each variable, there were 2 questions, the responses of which were averaged. The weights assigned to the variables for M_1 are $(0.3)N_1 + (0.3)N_2 + (0.2)N_3 + (0.1)N_4 + (.01)N_5$ based on the significance of the variables. For M_2 weights are $(0.3 + 0.3 = 0.6)E + (0.2)R$

+ $(0.1 + 0.1 = 2)G$, Following the M_1 weight distribution since $N_1 + N_2 = w_E E$, $N_3 = w_R R$ and $N_4 + N_5 = w_G G$. Perceiving the same idea the weights assigned for M_3 are $[S \times (0.3 + (0.3 + .02 = 0.8))] + [H \times (0.1 + 0.1 = 0.2)]$. The descriptive results show that $M_1 = M_2 \neq M_3$. Still, an ANOVA test was conducted to estimate the significant difference between the 3 models.

Table 1
Individual Motivational Scores of M_1 , M_2 , and M_3

	M_1	M_2	M_3
	Maslow's Need Hierarchy Theory	Alderfer's ERG Theory Adaptation	Edward E. Lawler's Combined Approach
$R_1 \dots R_{15}$	$M = w_1 N_1 + w_2 N_2 + w_3 N_3 + w_4 N_4 + w_5 N_5$	$M = w_E E + w_R R + w_G G$	$M = (S \times w_S) + H \times w_h$
R_1	3.70	3.70	3.67
R_2	3.35	3.35	3.37
R_3	3.25	3.25	3.27
R_4	3.65	3.65	3.62
R_5	3.50	3.50	3.43
R_6	3.30	3.30	3.35
R_7	3.50	3.50	3.48
R_8	3.75	3.75	3.63
R_9	3.60	3.60	3.58
R_{10}	3.25	3.25	3.42
R_{11}	2.30	2.30	2.28
R_{12}	3.90	3.90	3.82
R_{13}	3.20	3.20	3.37
R_{14}	3.10	3.10	3.00
R_{15}	3.55	3.55	3.57

Table 2
Significant Difference Test Results

Source	SS	DF	MS	
Between-Treatments	0.0004	2	.0002	F= 0.06948
Within-Treatments	5.8087	42	0.1383	
Error	0.0896	28	0.0032	

The p-value is 9.33. The result is not significant at a .05 level of significance.

As the results of $M_1 = M_2 \neq M_3$ the study conducted the ANOVA test whether the differences are significant. Thus, the best part of the 3 models is that $H_0: \mu M_1 = \mu M_2 = \mu M_3$ is proved to be equally operative and should be accepted. Furthermore, all three models can correspondingly be used in the organisational framework, though Maslow's model is the most extensive compared to the other two. Maslow's Need Hierarchy Theory and Alderfer's ERG Theory Adaptation, though conceptually a little bit different, quantification does not diverge. Edward E. Lawler's Combined Approach is slightly different from the other 2 in both the context of concept and quantification.

Major Observations:

1. Motivation relates to the behavioural aspects of humans but can be estimated numerically, though inexactly, and allows the HR manager to take strategic human resource decisions. The factors have both direct and indirect influences on extending job security, positive employee behaviours, leadership traits, social bonding and above all, conducive industrial relations.
2. Both Maslow's and Herzberg's models are well-accepted by researchers, social scientists, and industrial administrators; more comprehensive and scientific models need to be developed to adapt to the contemporary digital and global economies. The integrated approach, on the other hand, gives a better concept but with the same basic philosophy.
3. The study's objective to examine the similarity of the models clarifies that all three models are equally effective, extending almost the same outcomes, and none can be declared superior or inferior in terms of the outcomes they generate.

Future Research Directions:

1. The study was conducted in a very limited way on homogeneous samples demands that to inflate the sample size be inflated to a more diverse workforce in the healthcare sector. Moreover, a big heterogeneous sample from dissimilar categories of organisations will give solid results, as has not been perceived in the current study.
2. In addition, considering the explicit motivational factors of the 3 models, afresh conceptualised factors such, work-life balance, burn-out, etc. can also be fragments of upcoming studies.
3. For healthier precision, the subsequent research can adopt focus group discussion, ethnographic observations, and personal interviews and not just the use of a structured questionnaire for gathering original information. Methods like structural equation models (SEM), multi-level modelling, and cross-model comparison are the most relevant tools for a better understanding of the relevance of the models.

Conclusion:

The study highlights the importance of quantifying motivational theories, enabling more effective strategic human resource management decisions. It also unveiled the fact that theories are quantifiable and can be efficiently used in the organisational context. The researchers must endeavour to realise innovative models to deal with contemporary digital and global perspectives.

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Factors Influencing User Engagement and Learning Outcomes in Digital Humanities of Bangladesh: An Evaluation

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Abstract

The study examines the determinants influencing user engagement and learning outcomes in the digital humanities of Bangladesh. It aims to identify key factors that enhance user experiences and facilitate successful educational outcomes in the digital context. A quantitative research methodology was utilized to collect data from 97 participants via online learning platforms. A systematic questionnaire was developed to evaluate multiple factors, including content quality, instructor support, technology accessibility, user motivation, and peer collaboration. The data were analyzed using Structural Equation Modelling (SEM) with Smart PLS 4 to assess the correlations among the variables and their influence on user engagement and learning outcomes. The study reveals a substantial correlation between user involvement and enhanced learning outcomes. High-quality information and prompt instructor assistance are essential in improving user engagement. Technological accessibility significantly contributes to strengthening positive learning experiences. Moreover, user motivation and peer collaboration surface as critical factors affecting engagement levels. The investigation validates that all proposed links are substantiated, thereby demonstrating a comprehensive model of user participation in digital learning. Based on the findings, digital humanities should invest in developing interactive and user-friendly platforms to augment participation. Educating instructors to deliver prompt and constructive feedback is crucial for fostering a supportive educational environment. Enhancing technology infrastructure and guaranteeing accessibility are essential for reducing interruptions. Furthermore, institutions should adopt incentive strategies to promote goal-directed learning. Ultimately, promoting collaborative learning opportunities among peers can significantly enhance the overall digital humanities learning experience.

Keywords: *Digital humanities, digital learning, user engagement, learning outcomes, content quality, instructor support, technological accessibility, peer collaboration, motivation*

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Introduction

Digital Humanities (DH) is an interdisciplinary field that integrates traditional humanities disciplines with computational methods and digital technologies. It includes a broad range of practices, including data analysis, digital archiving, computational linguistics, and digital media studies. The integration of digital tools has revolutionized traditional research methodologies, offering new ways of exploring texts, media, and historical data. The rise of the internet and digital platforms has further amplified the potential for digital engagement, especially in educational contexts, fostering new learning paradigms and outcomes (Schreibman, Siemens, & Unsworth, 2004; Menon, & Shanmugapriya, 2020). The integration of digital technology into the humanities, including history, literature, and culture, is increasingly important in today's world. In Bangladesh, digital tools enhance education, support the dissemination of knowledge, and preserve cultural heritage. They enable efficient data access, foster engagement through e-learning platforms, and safeguard cultural history through digital archives. However, challenges such as limited infrastructure, particularly in rural areas, and inadequate resources for both students and educators hinder the effective use of these technologies. Addressing these barriers is crucial for maximizing the scope and potential of digital humanities in Bangladesh.

Digital humanities is a rapidly growing field worldwide. It ties technology to traditional areas such as history, literature, and the arts. The digital environment provides new opportunities to investigate these areas. Researchers employ digital tools to acquire, analyze, and present data. The digital humanities create new opportunities for collaboration. The field employs techniques such as data mining, digital archiving, and 3D modelling. It offers new insights into human culture and society.

Globally, the field of digital humanities has grown significantly. Universities and research institutions are implementing digital methods. Scholars are now using techniques such as computational analysis and digitization. These techniques enable them to investigate old texts, historical documents, and cultural relics. Digital tools simplify the preservation of cultural heritage and enable researchers to disseminate their findings to a broader audience. As technology continues to advance, digital humanities have become increasingly important in academic research. The field also influences the public's understanding of history and culture. It contributes to the widespread availability of knowledge.

Bangladesh is undergoing digital transformation in various sectors. Education, society, and technology are driving this transition. The government is fostering digital growth

through its Vision 2041 strategy. This strategy seeks to establish a "Smart Bangladesh" by enhancing technology and infrastructure. The rise of the digital economy has influenced how individuals work and learn. Online learning and remote employment have become increasingly popular in recent years. Digital platforms are employed in practically every industry, including education and business.

Education in Bangladesh is increasingly reliant on digital means. Schools and universities are implementing e-learning technologies. These solutions enable students to access learning resources from anywhere. The COVID-19 epidemic accelerated the spread of online education. Many institutions are now using digital classrooms. Students and teachers can communicate using internet platforms. The change to digital schooling has created new opportunities. However, it has also highlighted issues like digital access and infrastructure.

Digital change also benefits Bangladesh's cultural sectors. Digital archives are being established to preserve and protect cultural heritage. These archives preserve important texts, photographs, and artefacts. They facilitate the dissemination of Bangladeshi culture worldwide. Digital media are being utilized to promote local art, music, and literature.

Social media plays a crucial role in connecting people to their cultural heritage. Digital technology makes cultural content more accessible to all.

The digital economy in Bangladesh is quickly expanding. Businesses are using new technology to increase efficiency. E-commerce is gaining popularity, with more individuals shopping online. The digital economy offers new job opportunities and fosters growth. Companies use digital tools for marketing, sales, and customer service. The surge in digital payments is also benefiting the economy. Mobile banking and online transactions are increasingly widespread. This trend toward digital financing benefits small firms.

The digital humanities in Bangladesh remain in their early stages. However, the country has a solid foundation for development. The government's push for digitalization is generating opportunities in this area. Universities and research institutions are increasingly adopting digital methods. These institutions are developing digital archives and internet databases. Scholars in Bangladesh are beginning to utilise digital technologies in their studies. This trend is expected to intensify as the country's internet infrastructure continues to improve.

The digital humanities have the potential to significantly impact education and research in Bangladesh. They can help to protect the country's cultural legacy. Digital techniques can provide access to historical data and cultural artefacts. This is crucial

for both researchers and the general public. Digital archives can store documents, photographs, and videos about Bangladesh's past. These resources can be utilized for both educational and research purposes. The digital humanities also provide innovative approaches to the study of literature, history, and the arts.

The importance of digital humanities in Bangladesh is obvious. As the country's digital economy continues to expand, so will the opportunities in this industry. Digital technology is already transforming the way people work, learn, and connect. The digital humanities provide a means to combine technology and culture. They introduce fresh approaches to analysing the past and moulding the future. The advent of digital technologies in Bangladesh is opening up new opportunities for education and research.

Digital humanities can also help alleviate some of Bangladesh's challenges. Digital preservation is an important concern in the country. Many cultural and historical materials are at risk of disappearing. Digital humanities provide options for conserving these artifacts. They make it easier to save and distribute essential papers, manuscripts, and artifacts. Digital archives can help to preserve Bangladesh's rich cultural history for future generations. Digital tools can also help to address concerns of access and inequality.

Literature Review

Digital Humanities in Academic and Research Institutions

Academic environments are witnessing a sharp growth of digital humanities. These days, educational institutions worldwide are incorporating digital tools into their teaching and research (Chaudhury & Chattopadhyay, 2024), and Bangladesh is no exception. The digital humanities combine modern technologies with traditional humanities disciplines, such as history, literature, and culture. They allow academics to handle vast volumes of data (Maniar, 2022). This facilitates their simpler sharing of knowledge and discovery of fresh ideas. The change is being facilitated in great part by libraries. Digital tools are increasingly being used in Bangladeshi university libraries. These tools simplify access to, organization of, and storage of data. Libraries are incorporating digital resources into their offerings, as noted by Rahman, Ahmad, and Zakaria (2023). They consult digital archives, e-books, and internet databases. These tools enable scholars and students to quickly locate the data they need. Libraries are also digitizing historic documents and books. Important historical and cultural documents are preserved in part by this procedure.

Digital tools also enable libraries to expand their catalogues. They can today provide materials from all around the world. This worldwide knowledge enables Bangladeshi scholars and students to remain current. It also provides them with access to a more diverse range of resources. In the past, students had to rely on physical books in their neighbourhood libraries, whereas today they can access digital resources from anywhere with an internet connection. Not all libraries, meantime, have the same degree of digital presence. Certain libraries have digital tools readily available. Others find it difficult to get or apply digital resources. Islam and Mostafa (2013) compared various types of Bangladeshi libraries and found that the integration of digital technologies in university libraries is a notable example. Conversely, public and school libraries usually lack the required materials (Chowdhury, 2012). Many lack consistent internet connectivity or the means to access digital technology. This disparity generates information access inequality. Digital tools help college students who have well-funded libraries. People attending less well-equipped universities may find it challenging to access the necessary tools. Bangladesh faces a great difficulty here. Enhancing the digital infrastructure in all types of libraries facilitates equal access to knowledge. Despite these obstacles, the use of digital resources is becoming increasingly common. Many libraries endeavour to enhance their online offerings. Their employees are learning to apply digital tools more effectively. They also want methods to grow their online archives. This is a positive trend, as digital tools can enhance research and education in Bangladesh.

Digitalization in Education and Teaching

The function of digital platforms in education has evolved recently. The shift toward digital learning in Bangladesh has transformed the learning process for pupils. Digital tools have completely transformed the educational landscape (Al-Zaman, 2020; Wong., 2019). Digital learning allows students to access materials at their convenience. Teachers, like students, benefit from this adaptability. It also generates new chances for distance education. Students in remote locations can now access the same tools as those in cities through digital channels.

During the COVID-19 epidemic, educational institutions had to close their on-site education. This rapid closure led to a swift transition to online learning. Examining how this shift affected higher education, Chowdhury and Behak (2022) found that many institutions were unprepared for the shift to digital channels. Still, the change also revealed the possibilities of online learning. It emphasised the importance of incorporating technology into learning. Noor and Shaoun (2021) examined how Bangladeshi students responded to pandemic internet learning. Technical problems and internet connectivity issues were particularly challenging for many students. These obstacles hindered their ability to take part in online courses. Conversely,

several students welcomed the freedom afforded by online learning. They could access resources when it fit them and learn at their own speed. This change has raised fresh questions about Bangladesh's educational future. Once the epidemic is fully under control, will schools revert to conventional approaches, or will online learning continue to expand?

Online learning also altered the job description for educators. Teachers must adopt new instruments and approaches quickly. They had to acquire skills in delivering lectures via online platforms and videoconferencing. For many, this was a fresh experience. While some teachers felt the change was a great teaching tool, others battled with it. The shift to digital learning also fostered greater teamwork between students and teachers. More interactive classes, enabled by digital channels, help involve pupils in new ways.

The digitalization of education presents significant difficulties, even with the advantages. Access to technology is a major problem. Not every instructor or student possesses the tools or internet access required for online learning. This produces disparities in the educational system (Islam & Inan, 2021). Rich students can afford laptops and fast internet; those from less privileged homes sometimes cannot. This digital gap hampers the performance of online education in Bangladesh.

Teacher preparation presents another difficulty as well. Before the epidemic, many educators lacked training in the use of digital tools. For some, this absence of instruction made the move to online learning challenging. It is crucial to provide teachers with extra support going forward. They require the ability to utilise digital tools effectively in their classes. The advantages of digital schooling may not be fully appreciated without proper training.

Difficulties Regarding Infrastructure and Digital Preservation

Managing digital resources depends much on digital preservation. Maintaining digital preservation techniques poses a significant challenge in Bangladesh. In 2012, Rahman and Mezbah-ul-Islam investigated the main concerns in this field. The inadequate infrastructure is one of the key issues here. Digital preservation requires both dependable backup plans and robust storage systems. Many Bangladeshi institutions, meanwhile, lack the necessary tools to preserve their digital archives. The rapid pace at which technology is changing presents another significant problem. Old formats vanish as technology develops. Long-term preservation of digital resources becomes challenging this way. Digital data can become unavailable without frequent updates. Older digital formats could not be supported by contemporary

software, for instance. For libraries and archives that rely on digital preservation to preserve significant records, this poses a major issue.

Digital preservation also relies heavily on policy-related issues. Kolly (2014) noted that Bangladesh's national strategy on digital preservation is not very explicit. Institutions often struggle to develop consistent policies without clear direction. Every organization has to develop its own policies without a national structure. This leads to disparities in the maintenance of digital resources nationwide. Effective digital preservation is further hindered by budget constraints. Retaining digital collections requires ongoing expenditure. Institutions require funding to purchase the necessary technology and train their personnel. Nevertheless, many Bangladeshi institutions face financial constraints. They lack the means to make significant, widespread investments in digital preservation. Consequently, over time, crucial digital files risk being lost or corrupted.

Beyond preservation issues, digital infrastructure poses another challenge. The National ICT Policy of Bangladesh seeks to advance digital inclusion. Aziz (2020) discussed the challenges posed by the implementation of this policy. The lack of digital instruments in rural areas presents a significant challenge. Rural communities are often left behind, even when cities have access to sophisticated technologies and high-speed internet. This digital divide makes it challenging to ensure equitable national access to knowledge and services.

The lack of collaboration among sectors presents another obstacle to the implementation of the National ICT Policy. Digital inclusion requires collaboration among government, business, and educational institutions. These groups may operate alone; nevertheless, in Bangladesh. This lack of cooperation results in digital projects lagging behind others.

Aziz (2020) also underlined the matter of digital literacy. Digital tools are not widely known among Bangladeshis. They lack the ability to operate computers, cell phones, and the internet effectively. Reaching the objectives of the National ICT Policy is much hampered by this lack of digital literacy. People cannot really engage in the digital economy without appropriate training. They forgo opportunities for social interaction, employment, and education. Notwithstanding these obstacles, initiatives are underway to upgrade Bangladesh's digital infrastructure. Several government initiatives have been launched to increase digital literacy and expand internet access. These initiatives aim to bridge the digital divide, enabling every person to benefit from digital technologies. Still, much work remains to be done. Realising the National ICT Policy and building a really inclusive digital society will need time and money.

Digital Humanities and Cultural Heritage

The digital humanities offer numerous opportunities to conserve cultural heritage. In Bangladesh, this is significant because the country has a rich cultural history. Khalid and Chowdhury (2020) investigated how digital tools can capture both tangible and intangible elements of culture. Monuments, artworks, and artefacts all fall under the category of tangible heritage. Intangible heritage encompasses traditions, languages, and cultural expressions, including performances. Preserving both is critical for future generations. Digital platforms provide new opportunities to store and disseminate cultural elements.

One critical aspect is the establishment of digital archives. These archives contain historical papers, photographs, and other cultural materials. Bhaumik (2022) addressed the importance of these archives in Bangladesh. They make cultural resources easily accessible to researchers and the general public. However, administering these archives presents issues. Creating digital reproductions of cultural things requires time and money. Furthermore, there are frequently questions concerning how to safeguard digital files against corruption or loss.

Arora (2021) emphasized the technological constraints of digital archives. One challenge is the demand for high-quality digital storage systems. These systems should be reliable and capable of processing large volumes of data. Many Bangladeshi institutions lack the infrastructure required to implement such systems. Another challenge is maintaining the security of digital files. Hackers or technical problems can jeopardize digital archives. Thus, significant security measures are required to safeguard these cultural riches.

The digital humanities can also help increase public access to cultural heritage. Virtual displays, for example, can be created by museums and cultural institutes. These internet platforms allow people to encounter cultural phenomena from around the world. Zaidi and Pue (2022) discussed how virtual platforms are utilized to promote cultural awareness. In Bangladesh, this could help raise awareness of the country's cultural heritage. Cultural heritage can be shared with new generations and transported across borders by utilizing digital tools.

Language preservation is one of the most useful applications of the digital humanities. Many languages in Bangladesh are at risk of extinction. Digital platforms can store audio recordings, written materials, and other resources associated with these languages. This helps to preserve them for later use. It also makes them available to language students and academics. Khalid and Chowdhury (2020) emphasised the

necessity to safeguard intangible cultural heritage, such as language. The digital humanities play a crucial role in preserving Bangladesh's cultural diversity.

Potential for Growth and Innovation

The future of digital humanities in Bangladesh holds great promise. As technology advances, new growth opportunities emerge. Bhuiyan et al. (2020) examined how Industry 4.0 technologies, such as AI and big data, can enhance digital humanities. These techniques can be used to examine vast amounts of information, such as historical documents or cultural items. Academic institutions can utilise digital innovation to enhance their research and expand the scope of their activities (Hess & Zeyen, 2019).

One area of growth is the incorporation of digital tools into education. Rahman & Yeasmin (2013), Cicha et al. (2021) investigated how academic institutions use digital tools to teach humanities courses. This transition offers students new opportunities to engage with conventional information. For example, students can use virtual reality to tour historical locations or data analysis to investigate literary patterns. These tools offer more dynamic learning experiences and have the potential to enhance the humanities' relevance in the digital era.

Digital humanities also allow for multidisciplinary research. Gonzalez and Rodrigues (2022) demonstrated that cooperation between the humanities and technical domains, such as computer science and engineering, can lead to new discoveries. In Bangladesh, scholars from several disciplines can collaborate on initiatives that combine cultural studies and technology. They can, for example, create software to digitise ancient texts or utilise algorithms to identify trends in historical data. Such cooperation can spur innovation in both sectors.

Another significant possibility lies in digital preservation. Bhuiyan et al. (2020) stated that several cultural institutions in Bangladesh are starting to invest in digital preservation methods. These tools can help preserve cultural heritage. However, additional funding is needed to ensure that institutions have the necessary infrastructure and training for efficient digital preservation. By focusing on digital preservation, Bangladesh can conserve its cultural history while also contributing to global research.

Another key area for expansion is the possibility of international partnerships. Bangladesh can form partnerships with other countries to share resources and knowledge, thereby enhancing its capabilities and promoting global cooperation. Digital humanities initiatives often benefit from global participation, as they encompass the study of shared human experiences. Bangladeshi institutions can gain access to cutting-edge tools and expertise through participation in international

research networks. These collaborations can enhance research quality and generate new funding opportunities.

Cultural preservation is another area where digital humanities innovation is evident. New technological tools, such as 3D scanning and virtual reality, enable more detailed preservation of cultural items. Rahman et al. (2023) pointed out that these techniques can be utilised to make digital copies of historical sites and things. This not only protects the items but also makes them available to a larger audience. Virtual tours, for example, enable visitors worldwide to visit cultural sites in Bangladesh.

Furthermore, there is room for innovation in the way digital humanities are funded. Bhuiyan et al. (2020) proposed that commercial enterprises may help support digital humanities projects. By collaborating with academic institutions, corporations can help preserve cultural heritage and develop innovative technologies. This form of engagement benefits both parties by increasing corporations' cultural legitimacy and providing much-needed financial support to academic institutions.

Despite the growing interest in digital learning, the principles of user engagement remain inadequately understood. Limited research has investigated the impact of content quality on digital engagement. Issues of technology accessibility are frequently overlooked, despite their huge influence on user engagement and learning in many educational settings. The efficacy of teacher assistance, particularly in engagement strategies, remains relatively underexplored. Motivation is essential; however, its impact on digital engagement and learning outcomes is rarely examined. Peer contact may enhance learning outcomes, while the quality of materials and teacher support remain ambiguous. This study investigates the impact of material quality, teacher assistance, and user motivation on enhancing digital learning engagement. The impact of user involvement on learning outcomes is analyzed to ascertain if participation enhances education. The initiative will analyze the significance of technology accessibility on engagement and learning outcomes, pinpointing possible obstacles. This study will investigate the effects of instructor assistance on engagement and learning outcomes, as well as the effects of user motivation on engagement and success. The research will evaluate the influence of peer cooperation on learning and examine the effectiveness and viability of collaborative methods in digital education. The study will also propose a comprehensive model that integrates these elements to enhance understanding of their interactions and effects on user engagement and learning.

Research Gap

Limited User Engagement study: Insufficient study on aspects affecting user engagement in digital learning settings, especially on content quality.

Technological Accessibility Challenges: Studies sometimes underestimate the influence of accessibility on user engagement and learning outcomes across diverse educational settings.

Instructor Help Effectiveness: The instructor's help on user engagement and learning outcomes remains understudied, particularly with respect to effective tactics.

Motivation Dynamics: Despite its importance, research has not fully explored how various motivational elements impact user engagement and learning outcomes in digital settings.

Peer Collaboration Impact: Uncertainty remains regarding the effects of peer collaboration on learning outcomes and whether these effects vary by content quality or teacher support.

Objectives Of the Study

1. **Analyze User Engagement:** Examine the factors that enhance user engagement in digital learning environments, focusing on content quality, instructor support, and user motivation.
2. **Examine Learning Outcomes:** Assess the relationship between user engagement and learning outcomes to measure the extent to which engagement translates into educational success.
3. **Assess Technological Accessibility:** Evaluate its impact on user engagement and learning outcomes, and identify barriers that may hinder effective learning.
4. **Investigate Instructor Support:** To examine the particular elements of instructor support that influence user engagement and improve learning outcomes.
Examine User Motivation: Assess the impact of different types of user motivation on engagement and overall learning outcomes.
5. **Evaluate Peer Collaboration:** This involves analyzing the impact of peer collaboration on improving learning outcomes and exploring the potential of collaborative strategies within digital education environments.
6. **Develop a Comprehensive Model:** Create a model that integrates all identified variables to enhance understanding of their interactions and effects on user engagement and learning outcomes.

Hypotheses

H1: Higher levels of User Engagement (DV1) lead to improved Learning Outcomes (DV2).

H2: The quality of content (IV1) positively influences User Engagement (DV1).

H3a: Greater Technological Accessibility (IV2) enhances User Engagement (DV1).

H3b: Increased Technological Accessibility (IV2) leads to better Learning Outcomes (DV2).

H4a: Strong Instructor Support (IV3) contributes to higher levels of User Engagement (DV1).

H4b: Strong Instructor Support (IV3) results in improved Learning Outcomes (DV2).

H5a: Higher levels of User Motivation (IV4) positively affect User Engagement (DV1).

H5b: Increased User Motivation (IV4) leads to enhanced Learning Outcomes (DV2).

H6: Greater Peer Collaboration (IV5) positively influences Learning Outcomes (DV2).

Conceptual Framework

The following figure (Figure 1) presents the study's conceptual framework.

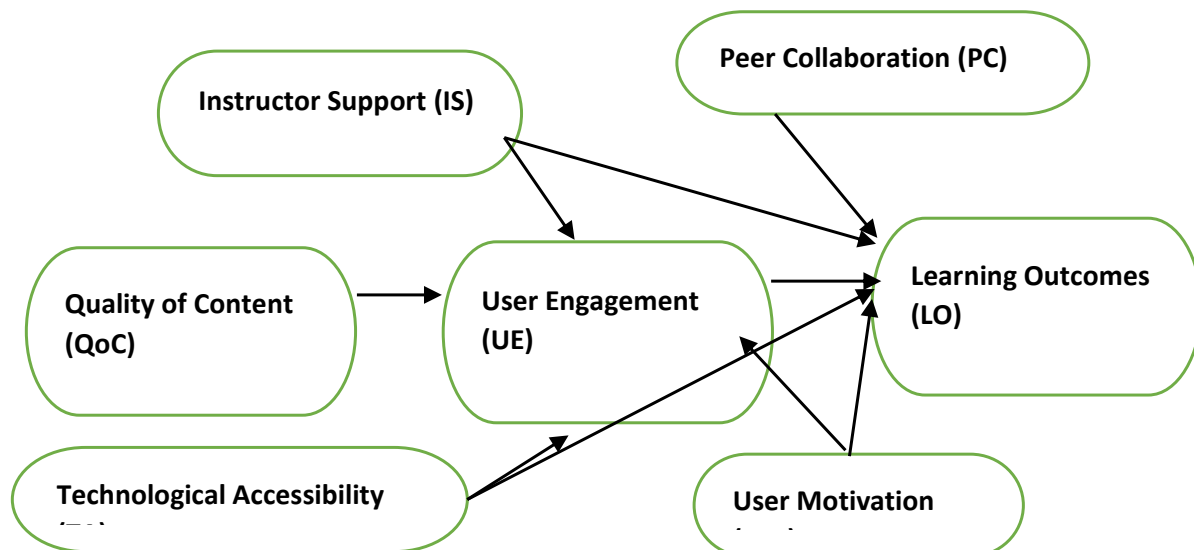


Figure 1: Conceptual Framework

User Engagement (UE) measures the interactions between users and a digital platform. This variable indicates the degree of user engagement with the content. Engaged users

typically allocate more time to a platform. The features are examined in greater depth. Increased user engagement correlates with enhanced learning experiences. Research indicates that engagement is essential for effective learning (Baker & Smith, 2019). Understanding User Engagement is crucial for evaluating its effects on Learning Outcomes.

Learning Outcomes (LO) evaluate the efficacy of the educational process. This variable encompasses knowledge retention and the capacity to apply learned information. This indicates the effectiveness of an educational program or tool. Strong learning outcomes demonstrate that learners have effectively comprehended the material. Studies indicate that effective educational tools enhance learning outcomes (Hattie, 2009). Measuring Learning Outcomes is essential for assessing educational effectiveness.

Quality of Content (QoC) assesses the depth and pertinence of educational resources. This variable examines the accuracy and value of the information. High-quality content enhances user engagement. Engaging materials enhance user interaction with the platform. Research demonstrates that content quality substantially affects learning experiences (Mayer, 2009). Assessing the Quality of Content is crucial for understanding its impact on User Engagement.

Technological Accessibility (TA) refers to the ease with which users can access digital tools and resources. This variable accounts for factors such as internet connectivity and device availability. Enhanced accessibility can lead to increased user engagement and improved learning outcomes. Easy access to content increases the likelihood of user participation. Research highlights the importance of accessibility in educational settings (Burgstahler, 2015). It is essential to assess Technological Accessibility in this study.

Instructor Support (IS) evaluates the accessibility and efficacy of instructional guidance provided by educators. This variable examines the role of instructors in facilitating user navigation through learning processes. Robust instructor support can enhance user engagement. Instructors play a significant role in enhancing learning experiences. Studies indicate that effective instructor support positively affects learning outcomes (Garrison & Vaughan, 2008). Understanding Instructor Support is essential for this study.

User Motivation (UM) evaluates the intrinsic and extrinsic factors that influence user engagement. This variable examines the factors that motivate users to engage with educational content. Motivated users tend to engage more effectively and achieve better learning outcomes. Numerous studies have associated motivation with

improved learning outcomes (Ryan & Deci, 2000). Assessing User Motivation is essential for understanding its impact on engagement and outcomes.

Peer Collaboration (PC) assesses the level of interaction among users within a learning environment. This variable examines users' collaborative efforts in knowledge sharing and mutual support. Collaborative learning enhances user engagement and learning outcomes. Studies demonstrate that peer interaction enhances community engagement and facilitates learning (Johnson et al., 2014). Therefore, examining peer collaboration is crucial for this study.

Methodology

Research Design

This study employed a quantitative research design to examine the factors influencing user engagement and learning outcomes in the digital humanities in Bangladesh. The design supported objective measurement and statistical testing of relationships among variables.

Population and Sampling Technique

The study population comprised academics, students, and staff members from humanities disciplines in Bangladesh. These groups are key stakeholders in the digital humanities learning ecosystem. Students are the main users of digital platforms, while academics and staff support content delivery and system implementation. A probability sampling approach was used; specifically, simple random sampling was employed to ensure that each individual at the selected universities had an equal probability of selection. Respondents were drawn from two public and two private universities to mitigate selection bias and enhance the sample's representativeness.

Sample Size Justification

The final sample consisted of 97 respondents, which was determined using Slovin's formula:

$$n = N / (1 + Ne^2)$$

where n represents the sample size, N represents the population size, and e represents the margin of error. Using a 10% margin of error, which is acceptable in exploratory social science research, the calculated minimum sample size was 97 respondents. This size is also adequate for Partial Least Squares–Structural Equation Modeling (PLS-SEM), as the method performs reliably with small to medium samples and complex models.

Research Instrument

To collect data, the study used a structured questionnaire based on a 5-point Likert scale. The scale ranged from 1 (Excellent) to 5 (Poor) to enable systematic measurement of perceptions of user engagement and learning outcomes. The questionnaire was distributed through Google Forms. The survey link was shared via email and WhatsApp. After data collection, responses were downloaded and carefully screened for completeness and accuracy.

Data Analysis Techniques

The data were analyzed using Structural Equation Modelling (SEM) with Smart PLS 4. SEM was employed to assess the relationships between independent and dependent variables. The analysis included measurement model assessment and structural model evaluation to examine both direct and indirect effects influencing user engagement and learning outcomes in digital humanities education.

Ethical Considerations

Ethical standards have been strictly maintained. Participation was voluntary. Respondents were informed about the study objectives and their right to withdraw at any stage. Confidentiality and anonymity were strictly maintained. All the collected data were used only for research.

Findings

Table 1. Descriptive statistics of key variable indicators.

Construct	Item	Statement	M	SD	Related Studies
User Engagement (UE)	1	I actively participate in online discussions.	4.2	0.75	(Rahman, Ahmad, & Zakaria, 2023)
	2	I frequently interact with the digital content.	4.15	0.68	(Rahman, Ahmad, & Zakaria, 2023)
	3	I often share resources with my peers.	3.9	0.8	(Chowdhury & Behak, 2022)
	4	I find the platform easy to navigate.	4.3	0.7	(Aziz, 2020)
	5	I enjoy the learning experience on this platform.	4.25	0.65	(Khalid & Chowdhury, 2020)
Learning Outcomes (LO)	1	I can effectively apply the knowledge gained from this course.	4.1	0.72	(Noor & Shaoun, 2021)
	2	I feel confident in my understanding of the subject	4	0.76	(Chowdhury & Behak, 2022)

		matter.			
	3	My performance in assessments has improved due to this course.	3.95	0.77	(Kolly, 2014)
	4	I can recall information learned in this course when needed.	4.05	0.74	(Aziz, 2020)
	5	I have developed new skills through this learning experience.	4.2	0.73	(Gonzalez & Rodrigues, 2022)
Quality of Content (QoC)	1	The content is relevant to my learning goals.	4.25	0.67	(Bhuiyan et al., 2020)
	2	The materials provided are up-to-date and accurate.	4.15	0.7	(Rahman et al., 2023)
	3	I find the content engaging and interesting.	4.1	0.71	(Islam & Mostofa, 2013)
	4	The diversity of content enhances my learning experience.	4.2	0.66	(Mani, 2024)
	5	The learning materials are presented clearly.	4.3	0.64	(Rahman et al., 2023)
Technological Accessibility (TA)	1	I have reliable internet access for online learning.	3.8	0.82	(Rahman & Mezbah-ul-Islam, 2012)
	2	I have access to the required technology for digital learning.	3.9	0.79	(Kolly, 2014)
	3	Technical issues do not hinder my learning experience.	3.85	0.77	(Chowdhury & Behak, 2022)
	4	Online platforms are easily accessible.	4	0.75	(Aziz, 2020)
	5	I can easily navigate through different online resources.	4.05	0.73	(Gonzalez & Rodrigues, 2022)
Instructor Support (IS)	1	Instructors provide timely feedback on my work.	4.1	0.7	(Khalid & Chowdhury, 2020)
	2	I feel comfortable reaching out to my instructor for help.	4.15	0.69	(Chowdhury & Behak, 2022)
	3	The support I receive enhances my understanding of the material.	4.2	0.66	(Noor & Shaoun, 2021)
	4	Instructors encourage active participation in discussions.	4.25	0.68	(Rahman, Ahmad, & Zakaria, 2023)

	5	The instructional materials are straightforward and easy to follow.	4.3	0.65	(Gonzalez & Rodrigues, 2022)
User Motivation (UM)	1	I am motivated to learn through digital platforms.	4.2	0.72	(Aziz, 2020)
	2	I find digital learning enjoyable.	4.1	0.76	(Bhuiyan et al., 2020)
	3	I have specific goals for my online learning.	4.15	0.7	(Khalid & Chowdhury, 2020)
	4	I believe digital tools can enhance my learning.	4.3	0.69	(Rahman et al., 2023)
	5	I engage in digital learning regularly.	4.25	0.67	(Islam & Mostofa, 2013)
Peer Collaboration (PC)	1	I collaborate with peers during online learning.	4	0.73	(Noor & Shaoun, 2021)
	2	I share knowledge with my classmates.	4.05	0.7	(Kolly, 2014)
	3	Group projects enhance my learning experience.	4.1	0.71	(Aziz, 2020)
	4	I receive support from peers in my studies.	4.2	0.68	(Rahman & Mezbah-ul-Islam, 2012)
	5	Peer discussions help clarify my understanding.	4.15	0.65	(Chowdhury & Behak, 2022)

Table 2. Demographic characteristics.

Measure	Items	Frequency	Percentage (%)
Gender	Male	45	46.4%
	Female	52	53.6%
	Other	0	0.0%
Age Group	18-24 years	30	30.9%
	25-34 years	40	41.2%
	35-44 years	20	20.6%
	45 years and above	7	7.2%
Education Level	Undergraduate	50	51.5%
	Graduate	30	30.9%
	Postgraduate	17	17.5%
Field of Study	Arts and Humanities	97	100%
Location	Urban	60	61.9%
	Rural	37	38.1%

Measurement Model Assessment

Table 3. Measurement model results (sample size = 97).

Factors	Standardized Loading	Cronbach's Alpha	CR	AVE
QoC	0.825	0.753	0.773	0.789
	0.665			
	0.736			
	0.711			
	0.539			
	0.702			
	0.67			
TA	0.808	0.836	0.848	0.606
	0.816			
	0.816			
	0.783			
	0.655			
IS	0.808	0.875	0.881	0.667
	0.856			
	0.782			
	0.8			
	0.836			
UM	0.872	0.89	1.039	0.738
	0.943			
	0.815			
	0.799			
PC	0.688	0.785	0.804	0.607
	0.793			
	0.812			
	0.815			
UE	0.7	0.852	0.858	0.632
	0.819			
	0.802			
	0.771			
	0.872			
LO	0.721	0.692	0.785	0.791
	0.63			
	0.849			
	0.806			
	0.821			

The Fornell-Larcker criterion assesses discriminant validity by verifying that the square root of a construct's average variance extracted (AVE) exceeds its correlation with any other construct. This study demonstrates that all constructs satisfy the established criterion, thereby affirming discriminant validity.

Gefen and Straub (2005) assert that discriminant validity is established when items exhibit weak correlations with constructs other than their own. In reflective relationships, referred to as Loadings, it is essential that values are elevated within the same construct while remaining diminished across distinct constructs. Table 3 substantiates the presence of significant within-construct loadings alongside minimal cross-construct correlations, thereby affirming the integrity of the outer model in the context of cross-loading analysis.

In line with the findings of Franke and Sarstedt (2019), if the HTMT value falls well below the critical threshold of 0.9, it indicates the presence of discriminant validity. The value in this instance is less than 0.9. It can be asserted that the model is both valid and well-established.

Structural Model Assessment and Hypotheses Testing

VIF is less than 5. VIF values below 5 indicate no significant multicollinearity, and the path coefficient is also significant (***) $p < 0.001$.

Table 4. Structural model analysis process.

Hypotheses	Hypothesized Association	Path Coefficients	Collinearity Assessment		
		Hypothesized Relationships	VIF	t-Value	p-Value
H1	UE-LO	0.168 ***	1.915	10.61	0
H2	QoC-UE	0.182 ***	1.934	3.58	0
H3a	TA-UE	0.078 ***	2.61	6.34	0
H3b	TA-LO	0.245***	1.101	1.103	0.000147
H4a	IS-UE	0.567 ***	1.243	5.143	0
H4b	IS-LO	0.135***	1.912	1.23	0.000106
H5a	UM-UE	0.025 ***	1.112	1.745	0
H5b	UM-LO	0.02***	1.149	3.104	0
H6	PC-LO	0.232 ***	1.761	4.286	0
Note: path coefficients are significant at *** $p < 0.001$.					

Table 5. Structural model evaluation

	R2	Q2
UE	0.449	0.347
LO	0.345	0.362

R Square (R2) quantifies the extent to which variance in endogenous variables can be attributed to exogenous variables. The values of 0.449, 0.345, and 0.535 can be considered moderate, as they correspond with the benchmarks established by Cohen and Chin.

Q-square (Q2) serves as an indicator of predictive relevance; values exceeding zero indicate a strong model fit.

Beta coefficients (B) provide estimates of path relationships within the structural model, reflecting consistency among items. The threshold for B is established at >0.20, and all values presented in Table 6 satisfy this criterion.

Goodness-of-Fit Index (GFI): The value of 0.987, which exceeds the recommended threshold of 0.90, indicates a strong fit between the model and the observed data.

The Adjusted Goodness-of-Fit Index (AGFI) value of 0.920 exceeds the recommended threshold of 0.80, indicating a favorable fit when accounting for the number of parameters adjusted.

The Normed Fit Index (NFI) of 0.964 exceeds the recommended threshold of 0.90, indicating strong alignment between the model and the data.

The Comparative Fit Index (CFI) is 0.985, exceeding the recommended threshold of 0.90. This indicates a satisfactory alignment between the model and the observed data.

The Root Mean Square Error of Approximation (RMSEA) value is 0.031. Below the recommended threshold of 0.08, there is clear evidence of satisfactory alignment between the model and the data.

The Standardized Root Mean Square Residual (SRMR) value is 0.046, indicating a clear outcome. Aligns with the recommended value of 0.07 and demonstrates a favorable fit for the structural model.

The bootstrapping procedure was established with 97 samples to assess the significance of the path coefficient. The data presented in Table 4 indicate that all path

coefficients are statistically significant. The SmartPLS model and the results obtained from the PLS algorithm are illustrated in Figure 2.

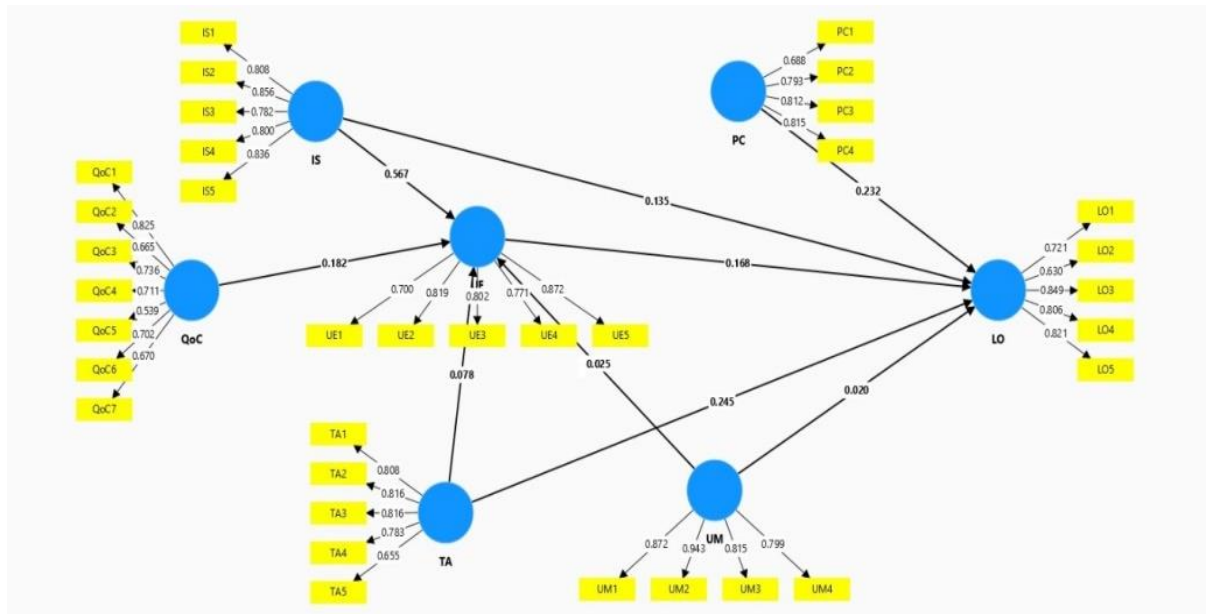


Figure 2: Model Resolution by Smart PLS using PLS Algorithm

Mediation Analysis

The analysis presented in Table 6 indicates that both direct and indirect effects are statistically significant, as evidenced by p -values < 0.05 for all variables. The standardized coefficients indicate positive relationships for the direct effects: the effect of QoC on LO has a direct coefficient of 0.044, whereas IS exhibits a direct effect of 0.0412. TA and UM demonstrate direct effects on LO, with coefficients recorded at 0.00215 and 0.031, respectively.

The indirect effects for all variables are likewise significant. The indirect standardized coefficients are as follows: QoC at 0.031, IS at 0.045, TA at 0.013, and UM at 0.004. The confidence intervals for both direct and indirect effects do not include zero, thereby reinforcing the statistical significance of these relationships.

Table 6. Significance analysis of direct and indirect effects

	Direct Standardize d Coefficient	95% Confidenc e Interval of the Direct Effect	Significanc e (p < 0.05)?	Indirect Standardize d Coefficient	95% Confidence Interval of the Indirect effect	Significanc e (p < 0.05)?
QoC→L O	0.044	(0.001318, 0.0178)	Yes	0.031	(0.008, 0.0125)	Yes
IS→LO	0.0412	(0.001152, 0.0342)	Yes	0.045	(0.049, 0.0144)	Yes
TA→LO	0.00215	(0.0018, 0.00613)	Yes	0.013	(0.094,0.01 5)	Yes
UM→LO	0.031	(0.00218, 0.0146)	Yes	0.004	(0.00140, 0.01500)	Yes

Discussion

This investigation centres on understanding the key factors that influence user engagement, learning outcomes, and the overall learning experience in the digital humanities in Bangladesh. From the analysis of the descriptive statistics and measurement model, several insights emerge.

Firstly, user engagement is crucial for improving learning outcomes. The results we obtained are consistent with the work of Rahman, Ahmad, and Zakaria (2023), who identified active participation in online discussions and regular interaction with digital content as fundamental components of engagement. This aligns with earlier investigations that have linked increased engagement to improved evaluation performance (Chowdhury & Behak, 2022). The high mean values ($M = 4.2$, $SD = 0.75$) suggest that users are actively engaging with content, sharing resources, and participating in discussions. The findings emphasize the necessity of developing interactive and user-friendly platforms to enhance overall user experiences. Secondly, the Quality of Content (QoC) has been shown to be a crucial factor affecting both User Engagement (UE) and Learning Outcomes (LO). In alignment with the findings of Bhuiyan et al. (2020), it was determined that relevant and current materials are crucial for sustaining learner engagement and improving knowledge retention. The clear presentation of content ($M=4.3$, $SD=0.64$) was notably emphasized as an essential element in enhancing learning experiences. This aligns with earlier findings (Aziz, 2020), suggesting that content clarity enhances comprehension and encourages user engagement.

Thirdly, the influence of Technological Accessibility (TA) on engagement and learning was significant. The availability of reliable internet access and devices is essential in digital learning environments (Rahman & Mezbah-ul-Islam, 2012). The findings indicate that although a majority of users possess the necessary technology, sporadic technical difficulties can still impede their learning experience ($M = 3.85$, $SD = 0.77$). The results suggest a need for improved infrastructure and technological support to minimise interruptions in online education. The study revealed that Instructor Support (IS) substantially affects learner engagement and educational outcomes. Prompt feedback and support from educators enhance confidence in mastering the subject, aligning with the findings of Khalid & Chowdhury (2020). The results indicate that students highly value clear and easily accessible instructional materials ($M = 4.3$, $SD = 0.65$), emphasizing the essential role of active instructor engagement in online learning settings.

Furthermore, User Motivation (UM) directly affects engagement and learning outcomes. Users who are motivated and exhibit goal-oriented behaviour ($M = 4.2$, $SD = 0.72$) show higher engagement with digital tools, consistent with earlier research by Bhuiyan et al. (2020). This suggests that educational platforms should prioritize motivational strategies to maintain learner investment and engagement.

Finally, the positive impact of Peer Collaboration (PC) on the learning experience is supported by the findings of Noor & Shaoun (2021). Collaborative engagement among students leads to improved comprehension and more defined viewpoints regarding the subject matter. This reinforces the idea that peer interactions can enhance the depth of learning experiences in digital settings.

Regarding the assessment of the structural model, all proposed relationships were supported by significant path coefficients, indicating that Quality of Content, Instructor Support, Technological Accessibility, and User Motivation play significant roles in influencing Learning Outcomes, both directly and indirectly. The mediation analysis indicates that these variables not only affect learning outcomes independently but also contribute to user engagement, fostering a holistic digital learning environment.

Conclusion

The factors influencing user engagement and learning outcomes in the digital humanities in Bangladesh were investigated in this paper. The findings emphasise the importance of user involvement in enhancing educational outcomes. Good evaluation performance results from active engagement. The results validate earlier studies linking user involvement with constructive learning opportunities. This research confirms that user participation is essential in digital humanities learning.

User interaction and learning outcomes are also strongly influenced by the quality of the material. Relevant and current resources keep students engaged. Presenting material clearly improves understanding and memory. Users reported high satisfaction with the content quality. They say good learning depends on this.

The experience of digital learning depends much on technological accessibility. Users depend on consistent internet access as well as the required tools. Although most participants reported having the necessary tools, others experienced sporadic problems. These problems distorted their educational process. Greater digital humanities learning thus depends on a more robust technology infrastructure.

Another vital component of digital humanities learning is instructor support. Teachers' timely comments help students feel more confident. Teachers should foster lively engagement in debates. Effective and readily available teaching tools improve user involvement. Students really respect the teacher's direction and support.

Results of engagement and learning also depend much on user motivation. Engaged users of digital tools interact more. Their learning comes from goal-oriented activity. Educational systems should consider ways to enhance user motivation. Improved learning opportunities and more involvement can follow from this. Improvement of the learning process depends on peer cooperation. Students who work with others report having better comprehension. Sharing information with classmates helps create a friendly classroom environment. Peer debates help clarify ideas and enhance the learning outcomes. In digital environments, peer collaboration is highly beneficial.

The structural model evaluation of the investigation validated all expected correlations. Learning outcomes depend largely on the quality of content, teacher support, access to technology, and user motivation. Together, these elements build a complete digital humanities learning environment.

Conceptual Consequences

This study contributes to the existing body of knowledge on digital learning. It figures out the key elements that affect user involvement and learning outcomes. The research confirms that effective digital humanities learning, or online learning, depends on user engagement. It clarifies how instructor support and content quality affect learning opportunities.

The results may support the development of theoretical models of digital education. They provide insight into the dynamics of virtual classrooms. The study validates the interdependence between learning outcomes and user involvement. This emphasizes even more the need to include user experiences in theories of education.

The results of the research align with previous investigations in this domain. They provide empirical evidence of the need for user involvement. The study also highlights the significance of motivation in online learning. These additions complicate the current understanding of digital education.

Managerial Implications

Practical implications of this study for managers and educational institutions are numerous. It underlines the need to raise user involvement. Institutions should fund the creation of interactive platforms. Easy interfaces help to increase involvement and happiness. Good learning depends on providing interesting and pertinent material.

Instructors should be trained to give timely comments. Teachers should encourage lively participation in class discussions. They must be equipped with plans to support students effectively. Effective teaching tools can enhance the educational process as a whole. Teacher growth and support should be institutions' top priorities.

Enhancement of the technological infrastructure guarantees accessibility. Institutions should provide the necessary tools, as well as a consistent internet connection. Minimising disturbances depends on addressing technical problems. This will generally improve students' learning.

User involvement should be encouraged through motivational techniques. Features of educational systems ought to support goal-oriented learning. This can boost inspiration and support frequent involvement. Encouragement of a supportive community among colleagues can also promote teamwork. Institutions should support group projects and dialogues. Peer contacts can improve knowledge and learning results. Every student gains from a culture of cooperation.

Limitations And Future Studies

We must recognize the limits of this research. A sample of 97 individuals was utilized. A larger sample may yield superior results. The study context may restrict generalizability. Subsequent investigations ought to analyze these characteristics across various contexts.

The study data were self-reported, resulting in bias. Participants may have overestimated or underestimated their potential for learning. Subsequent studies ought to encompass the collection of extensive data using diverse methodologies. Qualitative interviews improve understanding of user experience. The study's cross-sectional design imposes additional limitations. Modifications based on time are disregarded. Longitudinal research may provide more insights into user participation.

Subsequent studies ought to investigate the impact of online learning on these variables.

Individual variances must also be taken into account. Age, gender, and educational background may influence user involvement. Subsequent research should investigate the impact of these categories on learning outcomes. Tailoring educational strategies to meet student needs would be feasible. However, despite having its limitations, this research offers a thorough review of user involvement and learning outcomes in Bangladeshi digital humanities. It underscores the significance of content quality, educator support, technological accessibility, user engagement, and peer collaboration. The findings contribute to digital humanities and theory. Subsequent studies should investigate novel digital humanities experiences and address the limitations of the current ones.

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Glass Ceiling and Barriers to Women Career Development: Evidence from Bangladesh

Abdul K Nazmul¹

Abstract

This research explores the barriers of women managers to their career progression for acquiring higher management positions and the challenges they face for such career development in Bangladesh. Both qualitative and quantitative data have been analyzed for this study. Disproportionate stratified sampling has been adopted for the present study. Two strata were developed based on the study objectives. One stratum is of telecom companies' employees, and another stratum was of private banks employees of Bangladesh. Total population of the strata was unknown; hence a proportionate sample couldn't be drawn from the population. Therefore, disproportionate stratified sampling was adopted, and it was decided to split the total sample into two equal halves. Strata 1 of telecom company's employees were 190. Similarly, sample size of strata 2 is also 190. Primary data has been collected by conducting personal interviews with the respondents at the workplace. Before the data collection process, due permission was taken from the branch manager for the said purpose. Total 400 interviews were taken, but due to respondents' inability and unwillingness to answer, twenty responses were removed, and data analysis was done with 380 responses only. The findings suggest that the barriers and challenges posed by individual factors i.e. cultural expectations of women managers within the family set up and Bangladeshi society and organizational factors within their context of operations are the key factors perceived by women managers of Bangladesh in attaining top management positions in service sectors of Bangladesh.

The present study aims to capture the existence of glass ceiling in Bangladesh's private sector especially banking and telecom. This paper sets the research background for the study and explains the concept of glass ceiling. It also provides an industry overview and explains the relevance of glass ceiling in present scenario. The objective of this study is to assess implications of glass ceiling for the employers, policy makers, the government, and the employee rights advocate and to identify measures or strategies to mitigate and overcome the glass ceiling effects.

Keywords: *Glass Ceiling, Barriers, Career Development, Banking and Telecom*

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Introduction

Definition of Glass Ceiling

Glass Ceiling refers to that invisible roof which restricts women and the lower/weaker sections of society from being raised in the upward direction i.e., Executive and Top-level designations within a structure'. The term is used in order to highlight the problems faced by women when trying to push their limits in terms of achieving something good that they may truly deserve.

Understanding the concept of Glass Ceiling

Glass Ceiling is considered as a promotional barrier not an entry barrier, this phenomenon helped women candidates to make some extra efforts and anyhow make an entry into the organization. Now, after entering the organization there is another big challenge i.e., to prove their presence that they also can be as hard working as their male candidates. But due to the equal presence of glass ceiling, women generally need to face the issues like salaries being hold, promotions being stopped, working hours have been increased and many more problems which pretend to be a big wall in front of them and they need to climb it by any means (Chliwniak,1997; Woodard and Britnall,1997)

Glass Ceiling: Discrimination

Glass Ceiling is considered as a blockage which stops women when they try to make advanced moves in the upward direction in an organization. It is an artificial discrimination which generally occurs at the time of promotion because organizations only want the males to occupy the high payout jobs because the recruiters and board members think that women will disappoint them in future and leave the organization, so they do not find any point in promoting women candidates whether they are highly qualified or not.

Male employees possess the characteristics which firms expect from them and due to this matching concept; organizations find it easy to hire/promote a male instead of a female, (Morrison et al.1987; Powell and Butterfield, 1997). Both the cited studies did not only highlight such worse experiences of women at the workforces but also throws light on the other difficulties faced by women like slower growth rate, less chances of being promoted, major gaps in payouts and unprofessional behaviour too.

Overcoming Discrimination

In order to make a way out of this never ending like phenomenon, the only way is to try at individual levels, because no person can provide the exact result-oriented strategies which can help women to facilitate growth. But there are various exceptions to every rule and due to this fact females should at least expect that their climb to top

will be a difficult journey for them. They may need to act extraordinarily at the workplaces like they have to take on extra assignments, need to prove themselves as many times as they can, take on high profile cases so that it will be easier for the supervisors to identify their unique attributes.

Women and Corporate World

From a long span of time, females tend to be homemakers and keepers of the home (Wright et. al.1995). This has been followed for an exceptionally long time despite the fact that the present scenario gives the impression that people are somehow broad-minded about the mishaps related to gender disparities. Clutter-buck & Devine (1987) given a report which shows that only one in six females and one in five males agreed that male should go out of their house to work while female stay at home only. This practice has stopped females many times when they decide something good for them in terms of their career. Kimmel (2001) says that females refuse to have it all because male didn't; male had the aspiring careers as well as their caring families to which they surely could come home to. In this diversified era, as married women have so much responsibilities after her marriage and usually after some time when they wish to pursue their careers outside their family boundaries, according to their abilities and freedom chances are so much lesser that they could proceed in equal footing like their male counterparts do, and also without sacrificing their family goals too. This troubled both the policymakers as well as economists (Blau, 2000). Ilagan-Bian (2004) says that women are the bravest among all the species present in this world obviously because of the challenges they had faced in their life and at the workplaces such as biased bosses, sexual discrimination and male dominating environment. To achieve equality, women need to do a lot more homework than the men working at the same workplace, women need to be more talented than men, more hard working and more competent too.

Significance of the Present Study

This study attempts to determine the extent up to which female employees of Bangladesh face the problem of glass ceiling, what types of problems they face, to provide solution that would help in overcoming a particular problem. In Bangladesh, the number of females entering the workforce has been increased over the last few decades. Due to religious restrictions and cultural constraints, female employees are often reluctant to express voice against discrimination and unfair treatment against them. As a result, they are more prone to glass ceiling effects than their male counterparts. But unfortunately, there is a very much emergent need of research studies in this highly sensitive and important area. The purpose of this study is to identify whether Bangladeshi women employees experience glass ceiling and suggest implications for employers, government and employee rights advocates.

Research Questions:

The research questions of the study are as follows:

1. What are the individual specific factors, which lead to glass ceiling in Bangladesh private sector.
2. How to assess organization specific factors, which lead to glass ceiling in Bangladesh private sector.
3. How to compare whether glass ceiling varies in banking and telecom sector of Bangladesh.
4. What are the implications of glass ceiling for the employers, policy makers, the government and the employee rights advocate and to identify measures or strategies to mitigate and overcome the glass ceiling effects.

Literature Review

The research started with a review of existing literature to have a deep insight into the concept of glass ceiling. Review provided an understanding of the concept and how it has been addressed by the researchers. The literature review has been categorized into different subcategories, which have been explained in the next sections of the paper. Review also helped to found research openings for the present study and laid the foundation to develop its objective. Research gaps have been discussed at the end of the chapter.

Glass Ceiling

The term glass ceiling was identified first by Hymowitz & Schellhardt in an article, published on March 24th edition of the "Wall Street Journal" in 1986. This article revealed invisible barriers that impede the career advancement of women in the American workforce. Lawrence & Schreiber (1979) explained how while on the surface, there seemed to be a clear path of promotion, but in reality, women seemed to hit a point where they seemed unable to progress beyond. However, Bryant used the term prior to that, in one of his articles published in *Adweek*, March 1984. According to Davidson and Burke (1994), the concept of glass ceiling refers to an invisible but impermeable barrier that limits the career advancement of females. Glass ceiling is a specific type of gender or racial inequality that can be distinguished from other types of inequality (Cotter et al. 2001).

Glass Ceiling in Bangladesh

Research on "glass ceiling" in Bangladesh is extremely limited and unexplored. Previous research work in Bangladesh (Zafaruallah, 2000; UNDP, 1993) on 'glass ceiling' was focused mostly on the public sector. This led the researcher to conduct the

study to identify the factors, which are creating glass ceiling effects in the private sectors of Bangladesh.

Afza and Newaz (2008) examined the existence of glass ceiling in different industries and service sectors in Bangladesh. This study also attempted to identify the contributing factors that create the glass ceiling effects and women career advancement in an organization. The analysis of this study indicated five factors responsible for glass ceiling effects which eventually restricts women career opportunity and progression at a certain stage. The identified factors are management perception, work environment, work-life conflict, sexual harassment, and organizational policy. The study confirmed the existence of glass ceiling in the organizations included in the sample. The study also found that management perception and work environment are most significant factors for creating glass ceiling, whereas organizational policy and work-life conflict are the second most significant factors. On the other hand, respondents disagreed about sexual harassment as a contributing factor for creating glass ceiling effect in the organization. Whereas pleasant appearance, attitude towards organization, career focused, and family support were found to influence career advancement of women in an organization.

Research Gaps

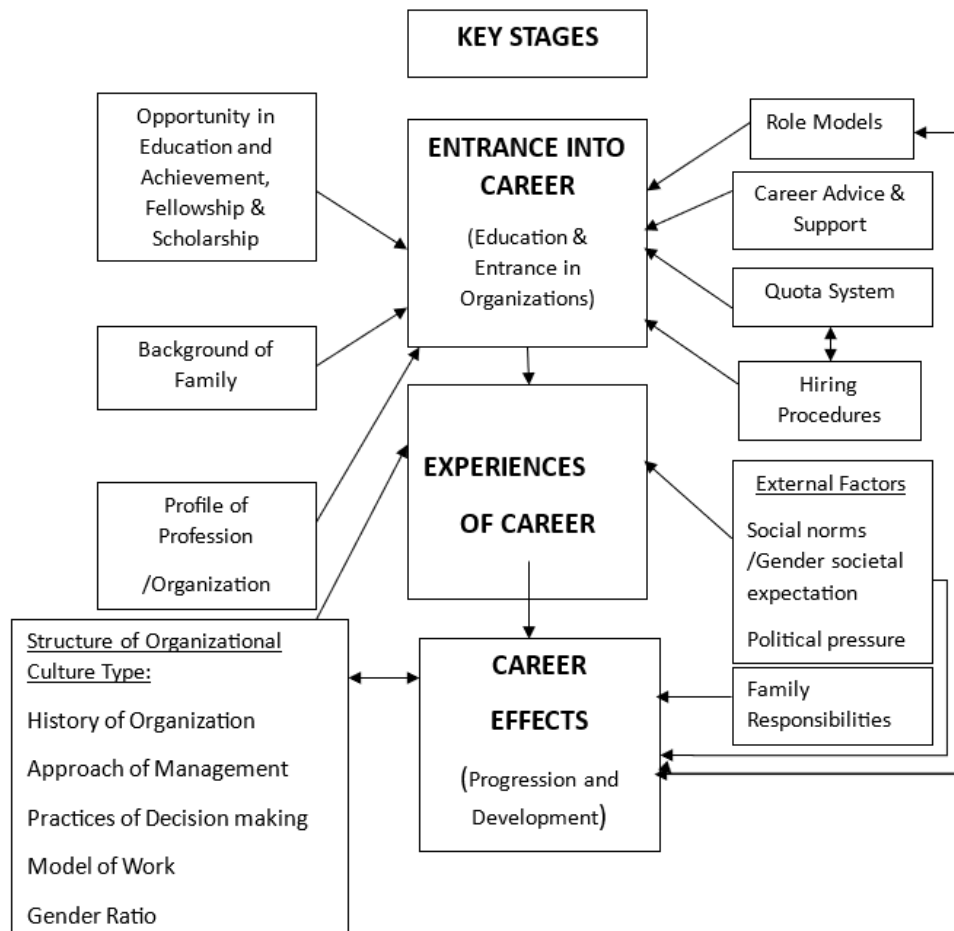
The literature suggests that both organizational cultural factors and external environmental factors can account for the low proportion of female employees at the top levels of different organizations. Also, these factors are very context-specific. Hence, it is worth to undertake research considering these factors that lead to different outcomes for female employees in Bangladesh as the factors need to be identified for developing the solutions to the problems of glass ceiling that are creating obstacles for female career progression in Bangladesh.

This study argues that both organizational culture and external environment (such as social, cultural, and political pressures) influence female employees' career advancement in private sector industries in Bangladesh. Further, regarding women's entrance and career advancement more research is needed to examine the specific factors (such as organizational culture type), which can help women advance or progress in their careers in private sector industries in Bangladesh. As of the present time, none of the studies has examined why the obstacles exist in the private sector industries in Bangladesh based on the organizational culture typologies. Briefly, this study aims to assess organizational factors as well as individual specific factors leading to glass ceiling in Bangladeshi private sector especially telecom and banking sector. With the above conclusion, the following conceptual framework can be developed for this study.

Conceptual Framework

This study is concerned with the careers of female employees working in the private sector organizations in Bangladesh. The variables conceptualized in this framework could be useful in stimulating positive organizational change, which is critical to the entrance and career advancement of female employees in private sector industries in Bangladesh. Three major stages which emerged from literature reviewed, are used to conceptualize and analyse female employees' entrance and career advancement in private sector industries (Figure 2.1).

Figure 1 Conceptual Framework for Analysing Female Employees' Entrance and Career Advancement in Private Sector Industries in Bangladesh



Research Design

The present research study is descriptive in nature as it aims to understand the perception of telecom and banking sector employees towards glass ceiling. The research is specifically aiming to determine the obstacles in the way of female employees to move ahead in their career ladder. Descriptive research design is used to

understand the characteristics of relevant groups and to estimate the percentage of units in a specified population exhibiting a certain behavior (Malhotra & Dash, 2011).

Sample Design

Disproportionate stratified sampling has been adopted for the present study. Two strata were developed based on the study objectives. One stratum is of telecom companies' employees, and another stratum was of private banks employees of Bangladesh. Total population of the strata was unknown; hence a proportionate sample could not be drawn from the population. Therefore, disproportionate stratified sampling was adopted, and it was decided to split the total sample into two equal halves. Strata 1 of telecom company's employees were 190. Similarly, sample size of strata 2 is also 190.

Sample Size Determination (please refer Nargundkar, 2008)

The total sample size was calculated using the following formula

$$\begin{aligned} n &= (Z/e)^2 (\sum W_i S_i)^2 \\ &= (1.96/0.05)^2 (\sum 0.5 \times 1)^2 \\ &= 384 \end{aligned}$$

Z= Z score from standard normal distribution at the 95% confidence level with the two-sided probability value.

e= e signifies tolerable error; in this study it is five percent which has been used as 0.05 in the above formula.

W_i= W_i signifies stratum proportion which is 50% in the present study; hence the W_i stand to be 0.5.

S_i= Standard deviation of the population was unknown. Five-points interval scales have been used in the questionnaire. Range represents maximum value-minimum value, which is 5-1=4. The value of variables would lie ± 2 . Hence, the approximate value of standard deviation can be obtained by dividing the range by 4, which comes to be 1.

Questionnaire Development

A structured questionnaire was adopted for the present study. Questionnaire was designed into different sections namely academic life, academic achievement, job/employment history, background of the organization, career difficulties, and

career expectations. Closed ended questions were utilized in the study along with open ended questions at appropriate places. Open-ended questions were used to give the respondents an opportunity to express their thoughts in a clearer manner.\

Scale Adopted for the study

A five-points Likert scale has been used in this study; as 1=strongly disagree, 2= Disagree, 3= Neutral, 4= Agree and 5 being the highest represented strongly agree. Likert scale has been used to measure career expectations of the study respondents. Nominal scales have also been utilized to measure organizational and personal factors which strengthen glass ceiling, and to measure personal details of the respondents.

Data Collection and Analysis

Primary data Source

Primary data has been collected by conducting personal interviews with the respondents at the workplace. Before the data collection process, due permission was taken from the branch manager for the said purpose. Total 400 interviews were taken, but due to respondents' inability and unwillingness to answer, twenty responses were removed, and data analysis was done with 380 responses only. The data was collected within a span of six months from July 2022 to December 2022.

Secondary data source

Secondary data has been collected from available books, journals, articles, newspapers, magazines, brochures, reports, policy papers, research findings, country presentation papers, annual reports, project documents, study reports etc. from various government and private sources.

Once the data was collected the data sheet was prepared in SPSS and a random check of data accuracy was done; in this process no error was identified. Missing value in SPSS has been dealt with accordingly by assigning number 9 to it. However, very few questions had missing data and had low frequency.

Study Area

Since, all the major private industrial sectors have head-office or main corporate office and most of the branches in Dhaka, (the capital city of Bangladesh); hence Dhaka is selected as research area for this study.

Data Analysis

Both qualitative and quantitative data have been analyzed for this study. As stated by McILwee and Robinson (1992), the most fruitful area of sociological investigation is the intersection between the two. Using only quantitative data, explanation will be more strictly structural; for example, the attitudinal measures from the questionnaires

may indicate only minor gender-based differences between female and male employees (ibid). Differences in organization type and occupational specialty stand out most strongly and qualitative methods will enable the researcher to consider the differences of female employees, and attributes suitable for females to express their perceptions. Similarly, without quantitative data, we might be less able to see the structural variables that prove so important (McILwee and Robinson, 1992). Therefore, this study has attempted to collect and analyze both quantitative and qualitative data.

Data Presentation

After analyzing the data, it has been presented in the form of bar chart, pie chart and tables. The next section, namely the 'data analysis', speaks about the in-depth analysis of the data collected. The present paper has been concluded by incorporating 'major findings and conclusions highlighting the key issues of this research.

Content Validity of the Questionnaire

Research instruments were initially developed by extracting variables from the existing research literature. It was drafted and corrected twice based on the discussion with the subject experts. This establishes the content validity of the questionnaire (Malhotra & Dash, 2011).

Reliability of the Questionnaire

Questionnaire had most of the questions on nominal scale. To fulfill study's objective, open ended questions were also included in it. Hence, its reliability was checked through a pilot study. Initially questionnaire was distributed to a small sample of 50 respondents, and it was analyzed. Again it was tested on another set of 50 respondents, and the same results were obtained which shows greater internal consistency of the questionnaire. Hundred responses obtained from pilot study were good enough to be assimilated in the main study data set maintaining the stratum's proportions.

Ethical Considerations:

All the information provided for this study has been collected and utilized in a confidential manner. The respondents' consents have been properly accounted for. Also, the integrity of the data provided in this research was strictly maintained. All individuals and sources for this research were duly cited with proper APA style references. The safety and truthfulness of the data and information provided by the respondents were duly maintained.

Concluding Remark: Organization specific factors leading to glass ceiling

Women are being equally treated within the organization, and their intelligence and ideas are being similarly entertained and, they are heading towards higher level management. In the study, people with different experiences have closely been observed in order to track their perception to thoroughly understand what and how changes in these industries have been made and what are yet to be made.

Table 1 Demographic Details of the Study Respondents

Demographic factor	%	Demographic factor	%
Gender	-	Educational Background	-
Male	54.5	Bachelors	29.2
Female	45.5	Masters	70.3
Religion	-	PhD	0.5
Islam	94.7	Business of respondent's organisation	-
Hindu	4.2	Banking	50
Christian	0.8	Telecommunications	50
Buddhist	0.3	Age Group	-
Marital Status	-	21-25 years	15.2
Single	51.6	26-30 years	38.4
Married	48.4	31-35 years	29.4
Nationality	-	36-40 years	13.6
Bangladeshi	100	41-45 years	5.3
Other	0	46-50 years	5.7
Family Status	-	-	-
Joint Family	37.9	-	-
Nuclear Family	60	-	-
Others	2.1	-	-

Source: Personal information of the respondents

Interpretation: 45.5% of the study respondents were female. While males constitute 54.5% of the sample. Male population has also been selected in the study to track their perceptions about glass ceiling as it will help us knowing that how efficiently we can break this legacy. Six different age groups have been taken into consideration, 21-25 years (15.2%), 26-30 years (30.8%), 31-35 years (29.4%), 36-40 years (13.6%), 41-45 years (5.3%) and 46-50 years (5.7%) Thus, the study has captured the viewpoint of female as well as male employees working in telecom and banking sector of different age groups in Bangladesh. 94.7% of the sample study was Islamic as the population of Bangladesh has majority of them. 4.2% of the respondents were Hindu while 0.8% was Christian and rest was Buddhist. Marital status of the responders is also taken into

consideration and clinched that 51.6% were single and 48.4% were married. Family status has also been traced to understand the influence of the family environment on a person's approach. Education background is the most important standards to be analysed to know whether the questionnaire has been answered in the appropriate manner or not. Information is collected equally from both the industries for appropriate knowledge of both telecom and banking sectors.

Qualitative Survey of Women Respondents

For the qualitative analysis, the data was analysed using a grounded theory approach (Cresswell 2007). This aims to uncover theories, concepts, hypotheses and propositions that are "grounded" in the collected field data (Glaser and Strauss, 1967). The first stage involved the verbatim transcription of interview data. Secondly, a coding dictionary was developed using the interview schedule as a framework to organize and segment the data. Thereafter, the interview transcripts were coded independently and involved indexing the transcripts. Codes with similar features were identified and were appropriate amalgamated by the researcher to form categories. New categories were created when two or more similar codes did not fit with an existing category. Through the combination /collapsing of codes with similar properties nine dominant categories emerged representing the different career barrier factors expressed by the participants. For instance, the codes created separately e.g. "need a helper, I need someone who can teach me and advise me ", "someone to show me the way", a coach were amalgamated to form a core category on mentorship. Along similar lines, codes emerging from the data for instance, "being trained", "sponsor for workshop and seminars and other related themes were amalgamated to form core category Training and Development opportunities for women managers. This coding process is similar to the approach used by Ituma et al. 2009, in which any code mentioned by more than two participants are collapsed to form a category. Coding categories were not imposed a priori; rather they remained open to insight by allowing the categories to emerge from the data in order not to miss any important theme. While considering the labelling of the categories to be accurate and reflective of the meaning participants expressed about their career success, it was recognized that this is an inherently subjective exercise (Ituma et. al., 2009). The transcripts were analysed independently and then corroboration was given to emerging themes by comparing and discussing individual interpretations. According to the findings, the barriers to the career advancement of Bangladeshi women to top management positions identified in the study include Lack of mentoring; fewer opportunities for training and development for women; low aspiration level of women managers, challenges that come with social networking among women, family responsibilities, gender role socialization, historical precedence and corporate culture. This list is not exhaustive of all the barriers, but the study has confirmed them as some of the

prominent constituents of glass ceiling inhibiting the upward mobility of women managers.

Discussion, Conclusion and Contribution to Knowledge

The study was undertaken with the objective to analyse existence of glass ceiling in Bangladesh private industry mainly telecom and banking sector. Glass ceiling has become one of the noteworthy arguments worldwide and majorly in Bangladesh. With the thorough study of data, it was identified that major shift in the approach of civilization of Bangladesh has taken place and the women community of the country is stepping forward with strong base and wider range of ideas and experiences. The women of Bangladesh well maintain all the aspects whether it is personal life or professional journey, which leads to equal distribution of responsibilities within the organizations which has a great contribution in women's successful career and motivation. The entire study originates from the fact that various encouraging and helpful measures have been taken by society in terms of financial support by family, academic support by teachers and friends and professional support by co-workers and higher management of the organizations in terms of financial benefits, promotion opportunities, and equal involvement in important decision making. The present scenario of the Bangladesh has been changed in comparison of past since these steps have moved the graph of discrimination vastly to the lower degree. Hence, it is seen that enormous transformation is being practiced enhancing the women community. The synthesis of the entire study is women were at behind in every field and nowadays the situations are being changed altogether with the collective efforts of both women and society of Bangladesh.

Managerial Implications

With this study, factors which are important from the organizational point of view are discussed.

- This study will be a massive contribution for the organizations that are lacking behind. New team-based collaborative working pattern is being suggested in the study which should be executed to drop the remaining percentage of discrimination.
- Women are strongly heading towards higher level management and participating in each crucial decision makings and meetings of the organizations which will ultimately be beneficial for the company as variation of ideas and strategies will be suggested and contributed by women.
- Respecting and accepting women will also contribute to the goodwill of the company. This research can motivate such companies to undertake the policies which can boost up the confidence of female staff of the companies.
- Cross-sectional study is required on the same concept to have an exact idea of glass ceiling or discrimination against women.

- Organizations should review their employment policies to use women's talent and encourage their contribution.
- Strong policies should be made for the childbirth leaves of women so that it will not turn as a barrier in women's career or hurdle in the success ladder.
- Managers of the organizations should judiciously make use of women's talent and ideas to eradicate glass ceiling from the roots.

Academic Implications

Under this, the major points where the study can contribute in context of academic are being discussed as follows:

- The study will act as recent data and research about glass ceiling as no recent research is available on the same topic in context of Bangladesh.
- This study will also be useful for human resource researchers who are doing research on glass ceiling in Bangladesh.
- Different variables on which glass ceiling could be studied is discussed in the entire study; therefore, it will be an important base of discussion within the education institutes.
- This paper will contribute to the women motivation sessions held in schools and colleges as the statistics demonstrate the understandable data of dropping rate of discrimination against women.

Limitations of the Study

This study will be limited to male and female employees from two leading industries in the private sector of Bangladesh, namely banking and telecommunication. Hence the glass ceiling effects from other sectors and industries will not be known. Also, the findings from this study cannot be generalized for other private sector industries. Since the respondents will remain busy at work and they normally suffer from job insecurity, unbiased responses may not be reported. It may be difficult to identify the minimum number of female employees experiencing glass ceiling due to lack of sufficient promotional channels in many organizations. However, this study will be helpful in providing a wide scope for further relevant research studies

Future Scope of Research:

- A study based on male vs. female's perception about glass ceiling can be done separately to identify the gap between their viewpoints.
- Same study can be done on different industries so that the scenario of those industries in context of glass ceiling could be understood and improved.
- Employee and employer's perspective can also be studied in future on the grounds of glass ceiling to comprehend the difference between their mindsets.

- Glass ceiling is the major issue in many under-development and developing countries therefore the study can be done in other countries with same conditions as well.
- The conditions of developing and developed countries need to be measured by future research on the basis of glass ceiling and discrimination against women.
- A thorough study needs to be undertaken on the policies of the organizations of the selected industries for eradication of glass ceiling or discrimination against women and government policies and measures which has been taken or should be taken to root out glass ceiling from Bangladesh.
- Other measures which innate discrimination can be studied, and their solutions can be found with the motive of speedy elimination of discrimination against women.

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Antecedents of FinTech Payment Service Adoption among Gen Z Users: Investigation using PLS-SEM & IPMA Approach

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Abstract

Globally, the new cutting-edge technology known as FinTech is displacing traditional financial services. Because they are more tech-savvy, young people are usually the most open to the rapidly growing FinTech services. PayTech, or payment technology, is among the vital subcategories of financial technology services. Numerous payment applications are becoming increasingly popular these days. This research intends to assess the key determinants impacting Gen Z users' behavioural intent to utilize FinTech payment services. Young students from several disciplines from Assam University participated in a survey using a questionnaire. An extended technology acceptance model (TAM) was applied in this research to examine Gen Z's adoption of PayTech services. The established literature served as the source of all measuring items, which were slightly modified to better suit the needs of our investigation. Structural Equation Modelling (SEM) and IPMA approach have been applied to analyze the theoretical structure of the study. Age and gender are taken as control variables in the current study. Among Generation Z users, the study's findings identified the principal elements that determine the behavioural desire to use. The addition of new elements to the TAM model and a more thorough examination of the variables affecting users' intentions further expand the corpus of research on FinTech acceptance.

Keywords: *FinTech; PayTech Services; Behavioural Intention; Adoption; GenZ*

Article History

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Introduction:

FinTech is an umbrella term for a collection of cutting-edge services backed by developments in ICT. FinTech is the consequence of combining the terms "finance" and "technology" to create "financial technology," and it comprises creative businesses that provide technologically based financial services. FinTechs save customers time by providing quick services that are available online (Barbu et al., 2021). FinTech activity commenced with peer-to-peer loans, crowdfunding, mobile payments, and money

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transfers before expanding to the more recent realms of cryptocurrencies, blockchain technology, and robo-advisory services (Goldstein et al., 2019).

Financial technologies brought a drastic transformation in the financial services industry. Alt et al., (2018) broke down the FinTech market's evolution into three phases: analog, digital, and financial technology. Regulatory fallout from the world financial crisis of 2008, the rapid spread of IT solutions, the emergence of new start-ups, and bank clients' shifting preferences for digital financial services are the main drivers of Fintech development. According to the definition presented by the semantic analysis, fintech is a new financial sector that uses technology to enhance financial operations (Schueffel, 2016). According to Gomber et al., (2018), the technological changes in payment services include the following: the disruption of traditional modes, the digitization of payment infrastructure, the acceleration of domestic and international payments, the growth of cryptocurrencies, worldwide remittance, and foreign exchange (FX) applications.

The pioneers of the Indian FinTech industry have surely been payment systems. The payments sector is undergoing a period of significant transition, with major shifts across the industry. With a US\$240 trillion market, payments are crucial to both business and the digital economy. As PayTechs gain momentum, we witness a surge in innovation and new offerings that are revolutionizing the payments industry, enabling connected commerce, and providing consumers with a level of choice never previously possible. In essence, payments are becoming more seamless, instantaneous, and integrated into customer journeys (EY report, 2022). The growing usage of cell phones and the internet is largely to blame for the shift in consumer expectations. As a result, the Indian FinTech sector has expanded rapidly. Additionally, the Indian government and authorities spearheaded a number of technology-enabled inclusion programs (Deloitte report, 2019).

Numerous empirical studies on the use of FinTech services by individuals across various age groups and demographics have been conducted. Ryu, (2018) examined the

factors behind people's willingness or reluctance, and looked at the effect of perceived risks and benefits on continuation intention. Patnaik et al., (2023) carried out an investigation on users' uptake of digital payments in India by employing extended TAM. Another study examined the factors influencing farmers' plans to use FinTech services in the agrarian ecosystem (Sharma et al., 2024). The antecedents of FinTech uptake behaviour among small and medium enterprises (SMEs) in Ghana have also been investigated using TAM (Krah et al., 2024). Studies are also conducted on the e-wallets use behavior among young Generation Z students and found that they opt for e-wallets while purchasing food, drinks, clothing, and entertainment (Fatimah et al., 2024). Determinants influencing Colombian university students' perceptions of how they use these services are also identified (Bermeo-Giraldo et al., 2023). Another identical study was conducted among accounting students from 40 universities in Brazil (Frare et al., 2023). Although many studies have explored the adoption behavior of young students in international contexts, the linkage of TAM with other key factors has not been sufficiently examined in the Indian context.

Despite India's rapid growth in digital services, empirical evidence on FinTech acceptance among Gen Z in the northeastern states remains limited. Assam presents a unique context characterized by varying levels of digital infrastructure, and socio-economic conditions. Thus, the determinants influencing FinTech adoption among students in Assam may differ from those reported in metropolitan and developed regions. Second, existing research has focused on traditional TAM variables, while the combined influence of brand image and perceived trust alongside perceived usefulness and ease of use has received comparatively less attention. Therefore, this study seeks to address this gap by examining the integrated effects of perceived usefulness, perceived ease of use, brand image, and perceived trust on user attitude and behavioral intention towards FinTech among Generation Z students in Assam.

Literature Review:

Theoretical background:

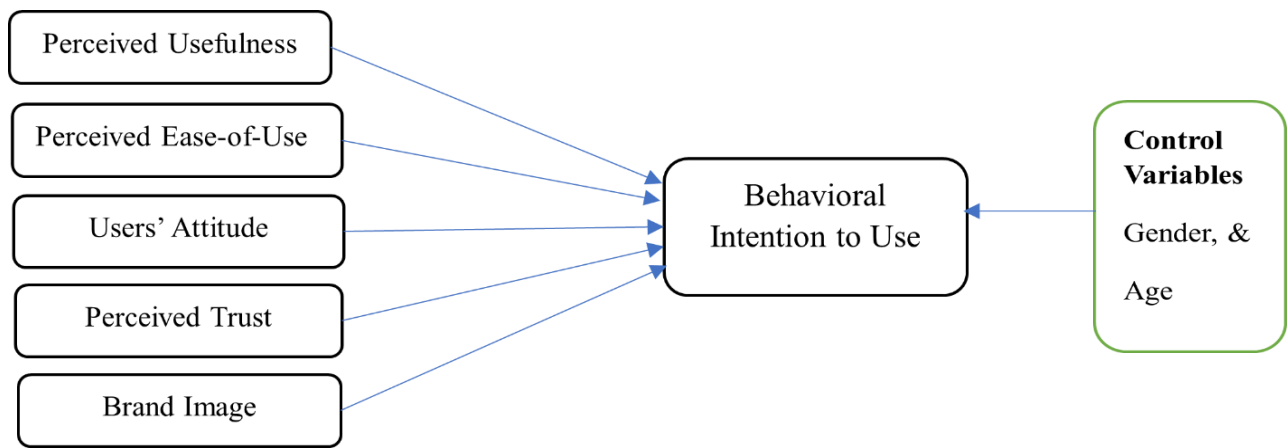
This empirical research proposed a conceptual model to evaluate the factors impacting users' adoption of FinTech. To put forth such a structure, various popular technology acceptance theories, and models are taken into consideration like: the technology acceptance model (TAM) (Davis, 1989); the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975); theory of planned behavior (TPB) (Ajzen, 1991); TAM2 (a revision of TAM) (Venkatesh & Davis, 2000); unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003); UTAUT2 (an updated UTAUT model) (Venkatesh et al., 2012).

The TAM is a popular framework for investigating variations in consumer propensity to adopt diverse categories of technologies and can be modified to fit the analytical problem (Z. Hu et al., 2019). An investigation was conducted applying the TAM on Indonesian women in an effort to identify the antecedents influencing their FinTech adoption behavior and the key factor found is user attitude (Igamo et al., 2024). The TAM approach is again used to explain the variables influencing consumers' inclination to use FinTech budgeting apps in South India (Savitha & Hawaldar, 2022). The behavioral intention to invest in sustainable cryptocurrency is predicted using an improved version of TAM, and the significant direct impact of attitude towards investment was supported (Drăgan et al., 2025). Similarly, the adoption of cryptocurrency in the Indian market is also examined utilizing TAM (Sharma, Panse, et al., 2024). The e-wallet adoption behavior of Jordanian users is examined through the mediating effect of perceived usefulness in the TAM framework (Matar & Aloqaily, 2025). Therefore, although TAM is a classical technology adoption model, it remains highly relevant and is still extensively employed in contemporary FinTech research (e.g., 2024, 2025). Accordingly, this study adopts TAM as the theoretical basis for examining FinTech adoption.

Conceptual model & hypotheses:

The theoretical framework offers an insightful perspective on PayTech acceptance among the young generation by including two new factors (trust and brand image) into the TAM model (Figure 1). The additional constructs are incorporated after a thorough literature review of relevant studies.

Figure 1: Proposed Theoretical Framework



Source: *Authors' own creation*

Perceived Usefulness (PU): PU denotes the degree to which a person thinks utilizing a specific mechanism will enhance his or her effectiveness at work (Davis, 1989). PU is a key component of the TAM and a major variable in the uptake of novel inventions. PU has the strongest relationship with FinTech adoption intention (Almashhadani et al., 2023; Das & Das, 2023).

H 1: PU is positively correlated with the user's BI to use PayTech services.

Perceived Ease-of-Use (PEOU): PEOU is the extent to which consumers are eased and exert effort when attempting to use FinTech services (Z. Hu et al., 2019). PEOU has a noteworthy favourable effect on users' intention to use mobile payment services (Tsai et al., 2022).

H2: PEOU is positively correlated with the user's BI to use PayTech services.

Attitude (ATT): TAM supports the idea that a person's attitude toward novel innovation usage influences their behavioural intentions (Tsai et al., 2022). Attitude refers to a client's assessments and personal tendencies toward something and is strongly related to the acceptance of FinTech products (Setiawan et al., 2021).

H3: ATT is positively correlated with the user's BI to use PayTech services.

Perceived Trust (TRU): Trust motivates an individual to agree with and stick with a product. Faster adoption and use of different applications are also fuelled by trust in FinTech platforms (Savitha & Hawaldar, 2022; Stewart & Jürjens, 2018).

H4: Perceived TRU is positively correlated with the user's BI to use PayTech services.

Brand Image (BRI): The provision of consistent services to users is significantly influenced by service providers' brand image, and an ideal image can enhance customer trust by effectively reducing uncertainty (Z. Hu et al., 2019). The elevated usage of financial technology has been facilitated by brand image (Setiawan et al., 2021).

H5: BRI is positively correlated with users' BI to use PayTech services.

Research Methodology:

Research Design: This research used a descriptive research design and quantitative methodology. A survey method was applied to accumulate primary data. A descriptive design was employed to empirically examine the proposed relationships among factors.

Sampling Technique: The non-probability convenience sampling was applied to collect responses; therefore, participants were selected from those who were readily accessible and willing to participate in the survey. The population of the current survey is young Generation Z students at Assam University who have prior experience with FinTech payment-based services. The study considered students from all education levels, including undergraduates, post-graduates, and diplomas across various fields such as engineering, science, humanities, and commerce.

Sample Size: If the population is unknown, the minimum size of the sample will be obtained by multiplying the number of items by 5. The minimal number of participants needed for the current research must be 100 respondents because there were 20 indications in total (Hair et al., 2014). The current study's sample size is 152 Gen Z students, which is above the minimum criteria.

Data Collection: A structured online questionnaire with 25 questions—including 20 items pertaining to the study's antecedents and 5 demographic questions—was used to gather data between January and March 2025. A Likert scale of five-points was employed to evaluate the constructs, where one represented "strongly disagree" and five represented "strongly agree".

Data Analysis: Following data collection, the authors used descriptive statistics to perform a demographic inspection to better recognize the traits of the respondents. Additionally, partial least squares structural equation modelling (PLS-SEM) using SmartPLS to assess the overall research model and test the hypotheses. PLS-SEM was chosen as it can estimate complex route models with smaller sample sizes and is efficient in handling data that is not normally distributed (Rigdon et al., 2017).

Common Method Bias (CMB): We used straight-lining patterns to reduce bias in data collection by excluding respondents who gave the same response to every question. In addition, the questionnaires were distributed among respondents who are acquainted with PayTech services (Marhadi et al., 2024).

Data Analysis:

Descriptive Statistics

The data was collected on respondents' age, gender, education level, and their selected course or program (Table 1). Out of 210 questionnaires distributed, 152 responses were collected. Out of 152 valid responses, 39% of respondents were male, while 61% were female.

Table 1: Respondent Demographic Profile

Demography	Particular	Frequency	Percentage
Gender	Male	59	38.8%
	Female	93	61.2%
Age	18-21 years	55	36.18%
	22-25 years	97	63.82%
Education level	H.S.	3	2%
	UG	54	35.5%
	PG	92	60.5%
	Diploma	3	2%
Course or Program	Engineering	17	11.2%
	Arts	43	28.3%
	Science	31	20.4%
	Commerce	61	40.1%
PayTech App Used	PhonePe	33	21.7%
	GooglePay	108	71.05%
	Paytm	7	4.60%
	Amazon Pay	4	2.63%

Source: *Authors own work*

The age group of respondents differed, 36.18% lie in the “18-21 years” group, and the rest 63.82% in “22-25 years”. When it comes to education, the majority of the participants were at postgraduate stage (approximately 60.5%), followed by undergraduate level (35.5%), with the remainder at the high secondary or diploma level (2% each category). The program pursued by the majority of students is Commerce (40.1%) followed by Arts (28.3%), Science (20.4%), and Engineering (11.2%). The majority of the respondents used GooglePay app (71.05%).

Measurement (Outer) Model:

The starting point of the PLS-SEM technique involves examining the measurement model by conducting confirmatory factor analysis (CFA). In CFA, the reliability and validity of the outer model will be assessed. Every construct used in this investigation is reflective in nature, so the item-level reliability is reported by factor loadings which should be above 0.70 (J. F. Hair et al., 2017).

Table 2: Reliability and Validity of the Constructs

Construct	Items	Factor loadings >0.708	Cronbach's Alpha	Rho_A	Composite Reliability (Rho_C)	AVE $\geq$ 0.50
Attitude	ATT1 ATT2 ATT3	0.859 0.851 0.852	0.814	0.815	0.89	0.729
Behavioral Intention to Use	BIU1 BIU2 BIU3	0.838 0.846 0.835	0.791	0.792	0.877	0.705
Brand Image	BRI1 BRI2 BRI3	0.726 0.878 0.866	0.769	0.803	0.865	0.682
Perceived Ease-of-Use	PE1 PE2 PE3 PE4	0.776 0.78 0.792 0.828	0.805	0.807	0.872	0.631
Perceived Usefulness	PU1 PU2 PU3 PU4	0.841 0.808 0.669 0.697	0.753	0.778	0.842	0.573
Perceived Trust	TRU1 TRU2 TRU3	0.71 0.794 0.821	0.669	0.669	0.819	0.603

Source: *Authors' own work (SmartPLS 4)*

Table 2 demonstrates the result of CFA; the majority of the items have good indicator reliability above 0.70, except for two items (PU3: 0.669 and PU4: 0.697). However,

items with lower loadings can be retained as the AVE value of PU exceeds the standard threshold of 0.50 (J. Hair & Alamer, 2022). All the constructs are found satisfactory in terms of composite reliability with ideal values above 0.70. The validity of the outer model is estimated by two benchmarks i.e. discriminant validity and convergent validity. The average variance extracted (AVE) value above 0.50 shows good convergent validity ([Table 2](#)). Construct-level discriminant validity is assessed using two criteria: the Fornell-Larcker criterion and the HTMT ratio. The diagonal values should to be higher than the off-diagonal values of the column and row (Fornell & Larcker, 1981). [Table 3](#) demonstrates that the Fornell–Larcker correlation was satisfied. Most HTMT values are lower than the ideal limit of 0.90 except for three values. To bring down the increased HTMT values, two items (BIU1 & ATT3) that correlated highly were removed.

Table 3: Discriminant Validity of Constructs

Constructs	HTMT	Fornell & Larcker Criterion					
	HTMT <0.90	ATT	BIU	BRI	PEOU	TRU	PU
ATT	Yes	0.854					
BIU	Yes	0.731	0.84				
BRI	Yes	0.68	0.778	0.826			
PEOU	Yes	0.758	0.666	0.643	0.794		
TRU	Yes	0.57	0.522	0.507	0.476	0.776	
PU	Yes	0.678	0.615	0.606	0.713	0.431	0.757

Source: Authors' own work (SmartPLS 4)

Structural Model

In this analysis, 10,000 bootstrapping subsamples were utilised to evaluate the hypotheses of the structural model (J. F. Hair et al., 2019). [Figure 2](#) depicts the path relationships and the model's explanatory power. [Table 4](#) displays the R² value for behavioral intention, which is 0.569 or 56.9%, explaining moderate explanatory power. The multicollinearity of the inner model was checked by the VIF; values ≤5 indicate no collinearity issues in our model. The f² values ≤0.15 show a small effect. As shown

in Table 5, only brand image has a moderate effect size ($f^2 < 0.35$) on the endogenous variable.

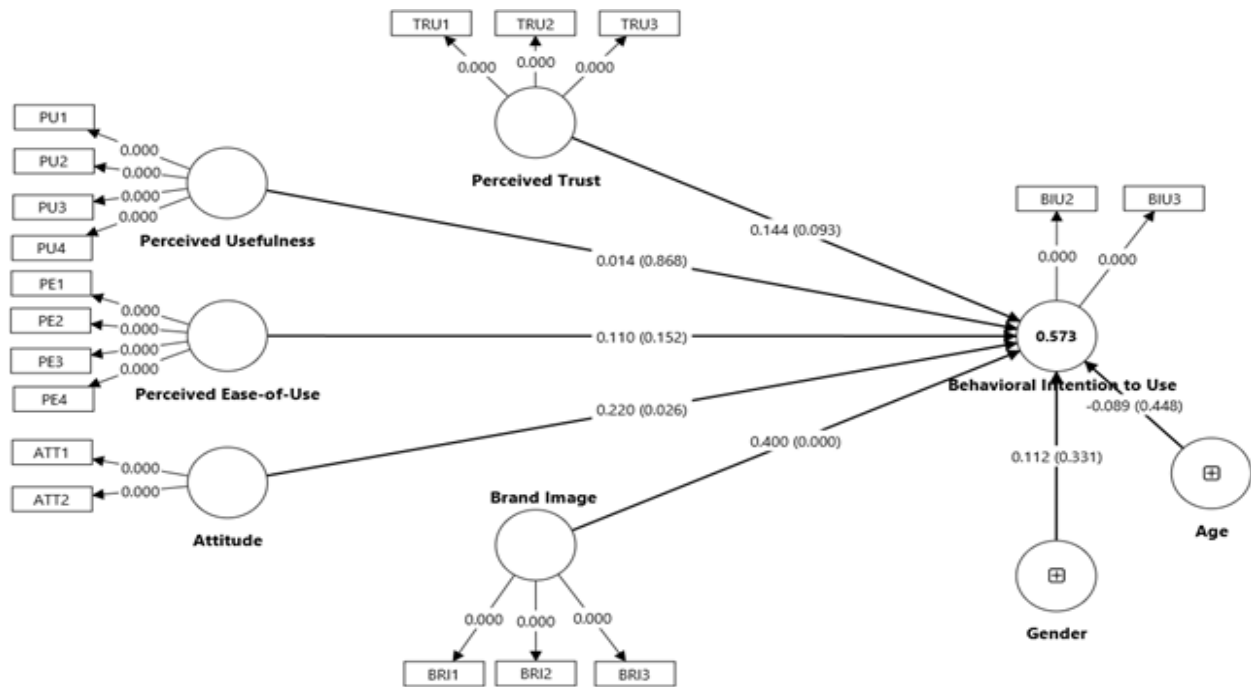


Figure 2: Hypotheses Testing Results

Table 5: VIF and f^2 Values

	VIF Inner Values	f-square values	Effect
ATT -> BIU	2.758	0.041	Small effect
BRI -> BIU	2.079	0.182	Moderate effect
PEOU -> BIU	2.678	0.009	No effect
TRU -> BIU	1.511	0.029	Small effect
PU -> BIU	2.443	0	No effect

Source: Authors' own work (SmartPLS 4)

Table 6: Hypotheses Testing Results

Hypotheses	Path Relationships	Beta (β)	T-Stats	P Values	C.I.		Decision
					2.50%	97.50%	
H1	PU -> BIU	0.014	0.167	0.868	-0.149	0.194	Rejected
H2	PEOU -> BIU	0.110	1.431	0.152	-0.033	0.271	Rejected
H3	ATT -> BIU	0.220	2.226	0.026	0.018	0.406	Accepted
H4	TRU -> BIU	0.144	1.682	0.093	-0.025	0.314	Rejected
H5	BRI -> BIU	0.400	4.952	0	0.244	0.56	Accepted
CV	Age -> BIU	-0.089	0.759	0.448	-0.33	0.133	Rejected
CV	Gender -> BIU	0.112	0.972	0.331	-0.123	0.334	Rejected

Source: *Authors' own work (SmartPLS 4)*

The outcomes of the evaluation of hypotheses are summarized with the values of path coefficient (β), p-value, and class interval in [Table 6](#). Among the five proposed hypotheses, only two are accepted (H3 & H5) based on the data analysis outcome. Key findings revealed that the attitude of the user has a positive and significant influence ($\beta = 0.220$, $p < 0.05$) on behavioral intention to use (BIU), leading to acceptance of H3. Similarly, brand image shows a strong positive correlation ($\beta = 0.400$, $p < 0.05$) with BIU, confirming H5. However, perceived usefulness (H1) has a statistically insignificant association with use behavior, leading to rejection of H1. The other two hypotheses (H2 and H4) are also rejected as PEOU and TRU have no significant impacts on BIU. Control variables (CVs) such as age and gender, are both found to be insignificant. However, the beta of gender is positive ($\beta = 0.112$), indicating female users have more impact on the intention of behavior. The SRMR value should be less than 0.08 for the model to be a good fit (Hu & Bentler, 1998). [Table 7](#) shows that the SRMR of both the saturated and estimated models is 0.081, highlighting the goodness of fit.

Table 7: Model fit measurement

	Saturated model	Estimated model
SRMR	0.081	0.081
d_ULS	1.123	1.123
d_G	0.549	0.549
Chi-square	467.331	467.331
NFI	0.674	0.674

Source: Authors' own work (SmartPLS 4)

4.4 Importance-Performance Map Analysis (IPMA):

Table 8: IPMA results

	Importance	Performance
Attitude	0.221	51.876
Brand Image	0.404	58.927
Perceived Ease-of-Use	0.102	67.711
Perceived Trust	0.139	61.84
Perceived Usefulness	0.02	65.226
Mean Values	0.1772	61.116

Source: Authors' own work (SmartPLS 4)

The IPMA was also applied to support the study's findings. A key target construct (BIU in our study) in the PLS path model is the primary focus of the IPMA (Sarstedt et al., 2016). The creation of IPMA of BIU is made possible by the importance and performance values of its exogenous constructs, namely PE, PU, ATT, TRU, and BRI (Table 8). The map highlighted that BRI has high importance with a total effect value of 0.404, but slightly low performance in the determination of behavioral intention to use FinTech. It was then followed by attitude and perceived trust (Figure 3).

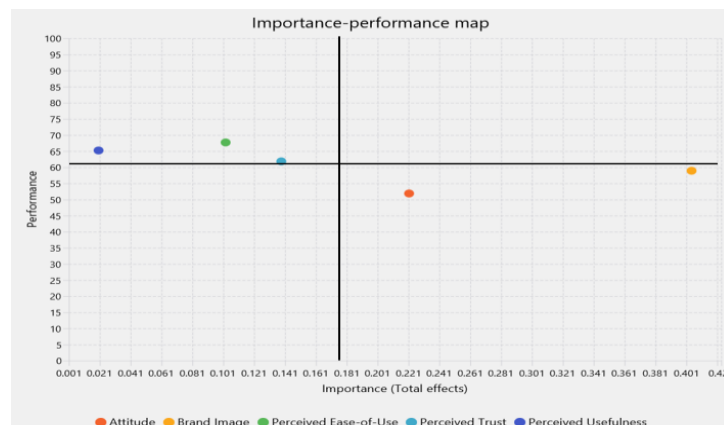


Figure 3: Importance-Performance map

Discussion:

Individual students' behavioral intention was explained by the proposed adoption model with a variance of 57%. The objective was to look into how behavioral intention to use PayTech offerings was positively impacted by PU, PEOU, TRU, ATT, and BRI. The empirical result revealed that the first hypothesis (H1), perceived usefulness positively affects BIU, but cannot be supported statistically. This result corresponds to the research of Igamo et al., (2024), but is contradictory to another study where PU was the key factor influencing Generation X's desire to utilize mobile payments (Daragmeh et al., 2021). In our study, **users' attitude (H3) and brand image (H5)** are the only two hypotheses that have a significant favorable influence on Gen Z's behavioral intention. This analysis signifies that Gen Z consumers in Assam are more inclined to rely on PayTech if they have a favorable attitude toward utilizing it. PEOU (H2) and TRU (H4) are also not significantly influencing BIU, the aforementioned result aligned with the outcome of Hu et al., (2019). However, contrary to these findings, it was discovered that consumers' trust in FinTech platforms had a major impact on their adoption and attitude (Shahzad et al., 2022). Therefore, the key finding is that Gen Z students in Assam are not primarily driven by functional considerations such as usefulness, ease of use, or trust. When deciding to adopt FinTech services, their intention is primarily influenced by attitude and the brand image of the service provider.

Implications of the Study

Theoretical Implications

This study contributes to the FinTech adoption literature by extending the Technology Acceptance Model by incorporating perceived trust and brand image as antecedents of attitude and adoption intention. While prior empirical studies have consistently identified perceived ease of use and perceived usefulness as significant determinants of FinTech adoption, the present study yielded contrasting results. This finding

suggests that the influence of these traditional TAM constructs may vary across contexts and user groups, thereby contributing new insights to the literature.

Managerial Implications

The findings offer several practical implications for FinTech companies, policymakers, and digital service providers seeking to increase FinTech adoption among Generation Z students in Assam. First, the significant influence of **attitude on behavioral intention** indicates that positive perceptions and overall evaluations of FinTech services play a crucial role in encouraging adoption. Therefore, FinTech providers should focus on creating favorable user experiences that foster positive attitudes toward digital financial services.

Second, the strong effect of **brand image on behavioral intention** suggests that Gen Z students are highly influenced by the reputation and image of FinTech providers. This generation often associates well-known and reputable brands with innovation, reliability, and social status. Consequently, FinTech firms should invest in strengthening their brand identity through consistent service quality, strategic branding efforts, influencer marketing, and social media partnerships with educational institutions.

Third, the insignificant effects of perceived usefulness and perceived ease of use indicate that Gen Z students may already view digital technologies as a normal part of their daily lives. Since this generation is generally technologically proficient, ease of use and functionality may be considered basic expectations rather than factors that differentiate one FinTech service from another. Therefore, managers should focus on creating engaging, personalized, and emotionally appealing experiences that strengthen users' connection with the brand. Fourth, the insignificant relationship between trust and behavioral intention suggests that trust may have become a baseline requirement rather than a decisive adoption factor among young users.

Societal Implications

The findings of this study have important societal implications for promoting digital financial inclusion among young people in Assam. The significant influence of attitude and brand image on FinTech adoption suggests that increasing usage among Generation Z requires not only accessible digital financial services but also positive perceptions and confidence in FinTech brands. In the long run, this may support broader goals of economic development, financial empowerment, and the creation of a technologically engaged society in Assam.

Limitations and Future Research Scope:

Nevertheless, our study has substantial limitations. Social influences and other psychological variables have not been examined in the current analysis. At the same time, we should also examine risks from a variety of angles, including cyber security, privacy, and financial risks. The data is collected only from Generation Z, who are mainly students so generalization of the results to other working professionals cannot be possible. Future studies may take other significant socio-demographic factors as moderators to better analyze the impact on behavioral intention.

Conclusion:

The current research has contributed to our theoretical understanding of the determinants influencing Generation Z students' use of payment-based FinTech services in Assam. Notably, the TAM is compatible with the additional constructs of perceived trust and brand image. The findings suggest that FinTech firms should differentiate themselves through strong brand positioning and positive customer experiences that foster favorable attitudes toward digital financial services.

Disclosure Statement:

The authors declare that they have no known financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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