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ASYMMETRIC GROWTH IN INDIA'S COIR EXPORTS: A QUANTITY-VALUE TREND ANALYSIS

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Abstract
The Indian coir industry's green product and natural fibre based exports, constitutes a major source of rural livelihoods and sustainable economic activity. An analysis of the long-term export performance of the Indian coir industry, through a review of coir export quantities and values over the period between 2000-2001 and 2023-2024. Using secondary data from a well-established industry-specific database the study reports on its growth pattern, stability and threats it faces, such as production-level uncertainty, product quality inconsistency and limited adoption of advanced production technologies. The analysis identifies a strong export quantity- and value-export asymmetry, with export quantity exhibiting much higher volatility than the stable, value-exhibiting export value. These export parameters align with the coir export sector's structural characteristics and highlight the value realisation aspect of the sector. Additionally, it identifies how technology upgradation projects, such as mechanised fibre extraction, improved quality inspection procedures and automated packaging, can be introduced as enhancement activities to improve production stability and enhance the sector's export competitiveness. By combining a historical performance analysis approach with an interpretative approach, the analysis offers policy implications to policymakers, exporters and other stakeholders in the industry that can be applied to formulate a strategy for not only retaining the strong position India holds in the global coir market but also identifying a route for a sustainably green industry that is enabled to experience coir production led growth.
Keywords: Indian coir industry, export trends, industrial automation, production stability, Quantity, value, sustainable growth, technology adoption, global competitiveness.

INTRODUCTION

The coir industry is India's oldest coconut based industry, with significant reliance on the rural economy and high environment sustainability link [1][2]. Coir is the fibrous material found between the outer shell and the husk of the coconut, it is strong, water resistant and biodegradable. These characteristics make it a raw material of preference for a vast array of products ranging from mats, ropes, mattresses, brushes, geotextiles and horticultural substrates [4]. Besides its utility attributes, coir is also of great environmental importance as a sustainable,

eco-friendly alternative to man-made fibres [5]. The industry creates large-scale rural employment, especially for women and foreign exchange earnings for India.

India dominates the global coir market, accounting for over two-thirds of the world's coir fibre and over 80 percent of the world's overall export of coir [6]. The highest production units are Kerala and Tamil Nadu and major units of processing and export are districts such as Pollachi and Coimbatore [7][8]. Indian coir is supplied to every corner of the world and the main markets are Europe, North America, the Middle East and the Asia-Pacific region [9]. With increasing awareness of sustainability across the globe, the demand for natural fibre products will keep on rising and new opportunities will open for India's coir industry [10]. Given India's leadership in this industry, examining long-run export performance is essential to understand where the industry is going, where it is doing well and where it is not and how to prepare for future competitiveness. Following trends in value and quantity of exports over long time periods allows one to discern patterns, shifts in patterns and exogenous factors that affect the industry [11][12]. Analysis of this kind also helps identify whether export growth as a production statistic is matched by proportionate revenue growth or whether there are value realisation gaps due to pricing, quality, or market positioning problems [13][14].

Previous studies on the coir industry have been in the direction of production patterns, export performance, government support schemes and socio-economic impacts [15][19]. Researchers have examined issues such as volatile foreign demand, competition from man-made substitutes, labour intensive production and lack of new technology adoption [2][23]. While most studies confirm the importance of foreign technology upgradation, few have attempted an analysis of the possible role of the coir supply chain in catalysing industrial automation towards transformation. Very little research has been conducted establishing a correlation between export performance data and technological preparedness, leaving a knowledge gap regarding the role of automation in eliminating the uncertainty of production, variability of quality and value addition needs. This research attempts to bridge that gap by integrating comprehensive trend analysis of India's coir export with a discussion of industrial automation and its role in enhancing efficiency and competitiveness. It involves more than just plotting trends from historical export data but also connecting trends to the operational issues that can be addressed with automation.

Industrial automation refers to applying control systems, machines and advanced technologies in performing production processes with minimal or no intervention by humans. Automation in the coir industry may include mechanised fibre extraction, automated weaving and finishing, AI-driven defect detection and automated packaging. This technology can solve these problems of supply, product variability, processing variability and overdependence on manual labour. With automation, the firm can be more efficient, it can have consistent export quality product, reduced waste and increased overall price realisation.

The main objectives

• To analyse trends in coir exported from India over the past 20 years, in terms of volume and value and chart the growth patterns, volatility patterns and market development.

• To find a link between volume growth and value growth in export value and export volume, whether growth in export volume translates to growth in export revenue on a 1 to 1 basis.

• To investigate the potential role of industrial automation in enhancing the performance of Indian exports by finding out how technology can make output more consistent and reduce output variability and improve India's edge in the world coir market.

• To analyse the asymmetry between export volume growth and export value growth in Indian coir exports.

Merging historical performance analysis with a technology oriented vision for the future, this study aims to add to scholarly research as well as business practice. It offers suggestions that policymakers, producers, and exporters can use to make strategic choices about where to invest in automation, how to position themselves based on trends, and how to leverage India's natural advantage in coir production. In essence, this two pronged approach aims to connect traditional strengths with contemporary capabilities, turning the coir industry into not only a symbol of India's heritage but also a symbol of sustainable, competitive and technology oriented manufacturing in the global economy.

STATEMENT OF THE PROBLEM

The Indian coir sector, despite its world-champion status and continual growth, faces grave challenges that threaten its long-term viability as a competitive sector. Export volume and value fluctuate, as development is followed by retrenchment driven by market demand, output constraints and external economic shocks. Price and quality instability, inconsistent product quality and increasingly cut-throat competition from synthetic counterparts further aggravate the sector's problems. One of the major challenges, however, is the relatively low uptake of modern processing technology and industrial automation, which limits productivity, output size and supply reliability for the global market. These issues call for a thorough analysis of export trends over time and the technological improvements that can stabilise the sector and enhance its performance.

RESEARCH METHODOLOGY

The research utilises the descriptive and analytical method, making use of secondary data collected from credible sources like the Coir Board of India and trade databases. Analysis was done export value and quantity-wise for the years 2000 - 2001 to 2023 - 2024. Trend analysis was conducted using linear regression to determine growth trends and assess statistical significance [20]. The trend equation formula was utilised to provide estimates of average annual increases and measure the variance explained by time. The method allows one to easily comprehend the direction and trend of the industry's performance and the underlying market behaviour.

OVERVIEW OF COIR INDUSTRY

The coir sector occupies a preponderant position in the international natural fibre trade, appreciated for its eco-friendliness, strength and versatility [1][5]. Coir is obtained from the coconut husk and is used extensively in flooring coverings and ropes, geo-textiles and nursery growing media [3][4]. Its production is located in the tropics since coconut farming is common there. India, Sri Lanka and the Philippines are the prime producers and exporters, followed by others like Indonesia, Thailand and Vietnam [6][9]. India is the preponderant producer and exporter in terms of volume and value, accounting for more than two-thirds of global coir fibre production and holding more than 80 percent of world trade [7][10]. Sri Lanka is famous for high quality brown coir fibre and brushes and brooms and the Philippines deals in white coir fibre and geo-textiles to check erosion [12]. In the Indian context, the coir industry is one of the oldest and most organised rural industries, creating massive volumes of employment, particularly for women [2][15]. The country has a wide range of products, from mats, rugs, carpets, ropes, yarn, curled coir, rubberised coir, geotextiles, coir pith and composite materials. The products are marketed to diversified international markets, from home furnishings in Europe, horticultural applications in North America and infrastructure development in the Middle East. Government agencies, particularly the Coir Board of India under the Ministry of MSME, vigorously promote research, technology upgradation, marketing support and export promotion. Initiatives such as

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Coir Vikas Yojana and export promotion activities are aimed at productivity enhancement, product diversification and improved availability in global markets [14]. As the world leader in coir trade, India has a strong record of long-term export performance. For the last two decades, the volume and value of coir exports from India have demonstrated remarkable growth while showing the typical annual variability that results from market and production conditions. Table 1. shows India's export performance of coir over the years from 2000 - 2001 to 2023 - 2024, including fluctuations in quantity, value and growth rate from one year to the next.

Table 1. India's Export Performance

Year	Quantity	Value	Quantity Growth	Value Growth
2000-2001	67493.08	31366.23		
2001-2002	71334.81	32058.35	5.692035391	2.206576946
2002-2003	84182.56	35270.57	18.01049165	10.01991681
2003-2004	102253.4	40749.67	21.46625144	15.53448101
2004-2005	122926.77	47340.27	20.21778249	16.17338251
2006-2007	136026.97	50844.75	10.65691387	7.402746119
2007-2008	168754.75	60516.59	24.05977285	19.02229827
2008-2009	187566.74	59288.08	11.14753214	-2.030038375
2009-2010	294508.05	80405.2	57.01507101	35.61781727
2010-2011	321016.02	80707.1	9.000762458	0.3754732281
2011-2012	410853.9	105262.54	27.98548185	30.42537769
2012-2013	4229501	111602.74	92.94416093	6.023225356
2013-2014	537040	147603.84	-87.30252103	32.25825818
2014-2015	626666	163033.77	16.68888723	10.45361015
2015-2016	752020	190142.52	20.00331915	16.62769008
2016-2017	957045	228164.82	27.26323768	19.99673718
2017-2018	1016564	253227.84	6.219038812	10.98461191
2018-2019	964046	272804.57	-5.166226622	7.730875878
2019-2020	988996	215790	2.588050778	-20.89941895
2020-2021	1163213	377897.91	17.61554142	75.12299458
2021-2022	1234855	434005.1	6.158975183	14.84718188
2022-2023	1264784	399217.97	2.423685372	-8.015373552
2023-2024	1232097	339690.84	-2.584393857	-14.9109345

Source: Coir Board of India

From the above Table I. The information indicates considerable spikes in India's coir export performance during the research period. The export quantity was highest in 2012-2013 at 4,229,501 metric tons, a considerable spike from other years. In terms of value, it was highest during 2021-2022 at ₹434,005 crore. The greatest year-over-year growth in terms of quantity was also seen in 2012-2013 at a record 92.94 percent, possibly due to exceptional market or production conditions. In contrast, the greatest year-over-year growth in terms of export value was 75.1 percent in 2020-2021, owing to high demand from all over the world and good pricing.

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Tamil Nadu is a key producer of India's coir industry, with key clusters based in Coimbatore and Pollachi. Tamil Nadu is well endowed with large-scale coconut cultivation, particularly in its western and southern districts, to provide a guaranteed supply of raw materials. Coimbatore is well established as an industrial cluster with a number of coir processing and machinery manufacturing units, several of which are export-oriented. Pollachi, with its large coconut plantations, supports an active cluster of small and medium-sized enterprises involved in fibre extraction, product manufacturing and pith processing [21]. These clusters produce high-demand products such as coir pith blocks, curled coir and geo-textiles, supplied to markets in the USA, Europe, Australia and the Middle East. The state's industry is now increasingly turning towards mechanisation and improved processing to maintain international quality levels, while government training programs and cluster development projects support productivity, skill development and product diversification [22]. All these factors underpin Tamil Nadu's leadership role in sustaining India's world leadership in the coir industry.

TREND ANALYSIS OF COIR EXPORT

A. Trend Analysis in Quantity of Coir Export

Table 2. Descriptive Statistics of Quantity and Year

Descriptive Statistics			
	Mean	Std. Deviation	N
Quantity	736249.7413	879137.64503	23
Year	2011.78	7.090	23

Source: Computed Data

From the above Table 2. illustrates the mean Quantity exported over the period of study was 736,249.74 units, having a high standard deviation of 879,137.65, which reflects high variation across the years. The sample size captures 23 observations (years/months according to your dataset).

Table 3. Correlations of Quantity and Year

Correlations			
		Quantity	Year
Pearson Correlation	Quantity	1.000	.491
	Year	.491	1.000
Sig. (1-tailed)	Quantity	-	.009
	Year	.009	-
N	Quantity	23	23
	Year	23	23

Source: Computed Data

The Pearson correlation between Quantity and Year is 0.491 (p = 0.009), In Table 3. showing a moderate positive relationship as the years progress, export quantity tends to rise.

Table 4. Model Summary of Quantity and Year

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate

1	.491[a]	.241	.205	784079.66971
a. Predictors: (Constant), Year				

From Table 4. The correlation coefficient R = 0.491 indicates a moderate linear relationship. R^2 = 0.241 implies that 24.1 percent of the variation in Quantity can be explained by Year, with a standard error of estimation of 784,079.67 units.

Table 5. ANOVA of Quantity and Year

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4093026478668.787	1	4093026478668.787	6.658	.017[b]
	Residual	129103994973 67.467	21	614780928446.070		
	Total	17003425976036.254	22			

a. Dependent Variable: Quantity

b. Predictors: (Constant), Year

Source: Computed Data

As shown in Table 5. The F-test statistic of 6.658 with p = 0.017 affirms that Year is a statistically significant predictor of Quantity at the 5 percent level, confirming the trend equation.

Table 6. Coefficients of Quantity and Year

Coefficients[a]						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-121652877.103	47433299.146		-2.565	.018
	Year	60836.159	23577.606	.491	2.580	.017

a. Dependent Variable: Quantity

Source: Computed Data

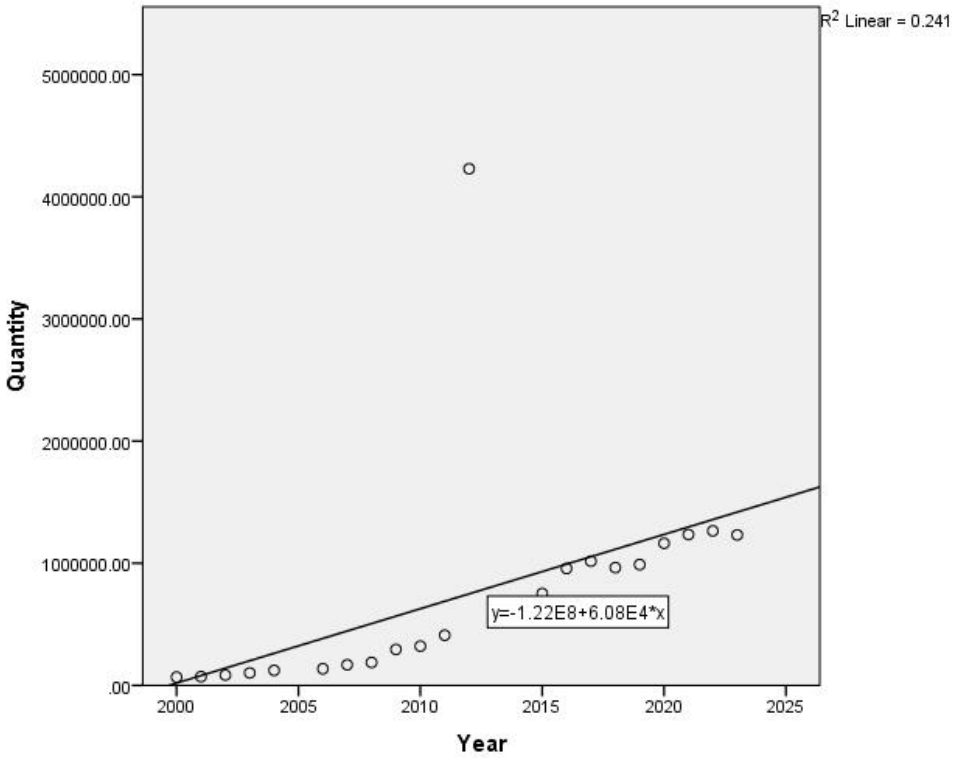
From the above Table 6. The regression analysis between Quantity and Year indicates a positive growth trend over the study period. According to the trend equation: $\hat{Y} = a + bt$

$$Q = -121652877 + 60836.159Y$$

The coefficient for Year is positive and statistically significant at the 5 percent level (p=0.017), indicating that Quantity has been increasing over time. The annual average increase in Quantity is 60,836.159 units per year. The R^2 value of 0.241 shows that around 24.1% of the variation in Quantity is explained by the Year variable.

Fig.1. Scatter Plot for Quantity of Export

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From the above Fig. 1, the scatter plot also graphically verifies the positive trend of Quantity over time, although the dispersion of points indicates that some years are far from the regression line.

B. Trend Analysis in Value of Coir Export

Table 7. Descriptive Statistics of Value and Year

Descriptive Statistics			
	Mean	Std. Deviation	N
Value	163347.4465	129222.00788	23
Year	2011.78	7.090	23

Source: Computed Data

As shown in Table 7. The mean Value exported was 163,347.45 with a standard deviation of 129,222.01, indicating high variability. The data again consist of 23 observations.

Table 8. Correlations of Value and Year

Correlations			
		Value	Year
Pearson Correlation	Value	1.000	.926
	Year	.926	1.000
Sig. (1-tailed)	Value	-	.000
	Year	.000	-
N	Value	23	23
	Year	23	23

Source: Computed Data

From Table 8. The Pearson correlation between Value and Year is 0.926 (p = 0.000), showing a very strong positive correlation, export value has increased steadily over the years.

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Table 9. Model Summary of Value and Year

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.926[a]	.858	.851	49924.86653

a. Predictors: (Constant), Year
Source: Computed Data

From Table 9. The correlation coefficient R = 0.926 reflects an extremely strong correlation. R^2 = 0.858 implies that 85.8 percent of Value variation is explained by Year, with a comparatively low standard error (49,924.87).

Table 10. ANOVA of Value and Year

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3150208627 81.064	1	3150208627 81.064	126.388	.000[b]
	Residual	52342338267.995	21	2492492298.476		
	Total	367363201049.059	22			

a. Dependent Variable: Value

b. Predictors: (Constant), Year

Source: Computed Data

As shown in Table 10. F-test statistic of 126.388 with p = 0.000 reflects that Year is a very significant predictor of Value and reinforces the model strength.

Table 11. Coefficients of Value and Year

Coefficients[a]						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-33790595.740	3020230.240		-11.188	.000
	Year	16877.541	1501.262	.926	11.242	.000

a. Dependent Variable: Value
Source: Computed Data

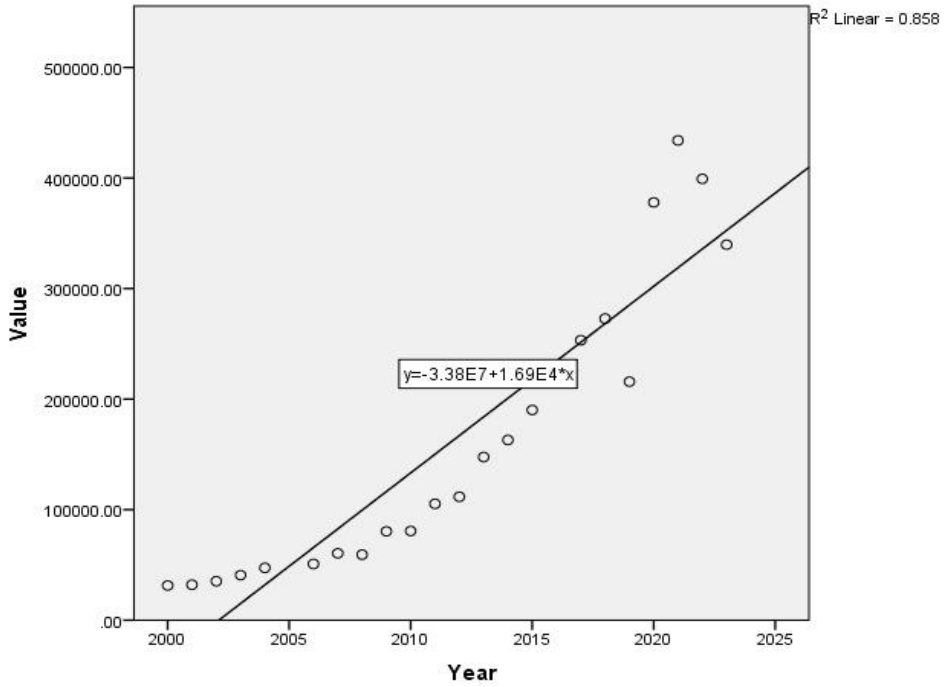
From Table 11. The regression analysis between Value and Year also shows a strong upward trend. According to the derived trend equation: $\hat{Y} = a + bt$

$$V = -33790595.7 + 16877.541Y$$

The coefficient for Year is highly significant at the 1 percent level (p=0.000), indicating that Value has shown substantial growth during the study period. The annual average increase in Value is 16,877.541 per year. The R^2 value of 0.858 indicates that about 85.8% of the variation in Value is explained by the Year variable, reflecting a strong linear relationship.

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Fig.2. Scatter Plot for Value of Export



As plotted in the fig.2. has a clustering of points close together along the regression line, graphically indicating the high linear relationship between Value and Year.

C. Linking Export Trends and the Need for Process Improvements in the Coir Sector

India's coir export trend pattern over the period 2000-2001 to 2023-2024 is two-faceted. Quantity traces a growth trend of an increase by a mean of 60,836.16 metric tons per year, though it is highly volatile. The R^2 of 0.241 indicates that only 24.1 percent of the variation in quantity is explained by time, indicating that factors like production capacity limitations, availability of raw materials and fluctuations in market demand have a major role to play in determining output levels. Export value traces a much stronger and more stable trend of increase, with a year-average rise of ₹16,877.54 crore and an R^2 of 0.858, indicating 85.8 percent of its variation is accounted for by time. Yet, the presence of value troughs in years of maximum quantity indicates a pricing strategy, product quality and market positioning problem.

These trends imply the imperative of strategic interventions towards the stabilization of production levels and superior value capture. Industrial automation is one of the remedies to these challenges in upgrading the coir production process. Automated fibre extraction machines have the potential to enhance efficiency and provide consistent raw material quality. Mechanised weaving and finishing units have the potential to provide consistent product standards, eliminating variability that can influence market prices. AI-based defect detection can be a key driving force in achieving stringent export quality specifications, reducing rejections and building brand credibility. Automated packaging machinery can accelerate export readiness, minimise handling errors and streamline logistics operations. By incorporating all these automation tools, the coir sector can minimise volatility in production, enhance operational performance and achieve better price per unit. This technological shift would not only fill the gaps identified from the trend analysis but also enhance India's competitiveness in the international coir market.

FINDINGS AND DISCUSSION

India's coir export trend analysis covering the years 2000-2001 to 2023-2024 reveals a general growth trend in terms of quantity and value, with differing stability levels. Quantity grew from 67,493 MT to 1,232,097 MT, a long-term growth trend with very high volatility. With an R^2 of 0.241 in the case of quantity, only a fifth of this volatility is due to the passage of time, which is a significant indicator of the extraneous factors' contribution, e.g. availability of raw material, volatility of market demand and limits on production capacity. The growth trend of export value, however, was strong and stable, from ₹31,366 crore to ₹339,690 crore with an R^2 of 0.858. This indicates high stability, though drops in value in some years, even with high volume, point to issues of pricing, quality and market positioning.

India's strengths are its world-leading position in coir production, an environment where green products are in strong demand and diversification of products with an ability to target different markets around the globe. The existence of well-established production clusters in Tamil Nadu and Kerala points to the presence of a well-established foundation for increased production. Weaknesses include irregular levels of production, most central processes rely on human labour, there is a low complement of sophisticated machines in factories and producers are exposed to volatility in world market trends. The discrepancy between volume and value growth trends suggests that the procedures employed in current production processes do not necessarily aim to maximise revenue per unit produced. The scope for automation is enormous. Automated fibre extraction can minimise the time taken for processing. Mechanised weaving and finishing can ensure more consistency in quality. Defect detection AI can ensure that only export-grade coir products leave factories. In addition to this, digital integration in processes can be done that will enhance efficiency. Online quality assurance, supply chain monitoring and e-commerce offer many new markets to producers. By combining the strengths of existing coir production capabilities in India with the quality and scalability of industrial automation, it is possible to remove some weaknesses in the current production process. With the implementation of relevant automation technologies, in conjunction with skill upgrades for workers and the integration of digital trade elements, it should be possible to stabilise production rates, ensure a consistent level of quality across products and deepen the industry's penetration into high-value export markets.

SUGGESTIONS

To enhance the coir trade's performance, investment in semi-automatic and automatic processing units that increase efficiency and quality of output is the solution. Supporting skill development programs will provide the skills to work and maintain these systems to perfection. Coordination between machinery suppliers and coir exporters at the strategic level will propel technology integration at a faster rate, at reduced costs and with tailored solutions for specific product requirements. Automation also must focus on the capability to produce more value-added coir products such as rubber-backed mats, geotextiles and composite materials to be able to demand superior price levels and enhance India's market share in high-end global trade.

CONCLUSION

The results of the study primarily highlight asymmetries in export growth, export value stability and contrasts to the volatile pattern in export quantity. Indian coir industry has experienced strong export growth over the past two decades and is currently a world leader in natural fibre products. Although the trend analysis indicates that value has risen consistently, quantity has been unpredictable and thus it points to underlying production and operational inefficiencies. Such an imbalance suggests that growth will have to be sustained by strategies to stabilise the

volume of production as well as improve the value of output per unit.
Industrial automation provides a breakthrough solution to addressing these problems. By integrating automated fibre extraction, mechanised weaving, AI-based quality inspection and automated packing, the industry can achieve step changes in consistency, efficiency and quality. Together, automation and digital integration, real-time quality inspection and advanced supply chain management hold the key to boosting India's competitiveness.
With rising global demand for sustainable, eco-friendly products, the coir sector is well placed to enhance its penetration within premium markets. Embracing automation will not only boost performance but also concentrate higher value capture, market resilience and brand image. This strategic move can enable the Indian coir sector to transcend traditional strengths, achieving sustainable growth and long-term global leadership.

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Abstract
The rapid development of financial technology (FinTech) is transforming the banking sector by changing the way financial services are delivered, managed, and experienced by customers. This study examines the direct impact of four dimensions of FinTech innovation—Digital Payment Innovation, Digital Lending Innovation, Artificial Intelligence and Automation, and Blockchain Innovation—on four dimensions of banking performance, namely Operational Efficiency, Market Competitiveness, Customer Satisfaction, and Financial Performance. The study adopted a quantitative, descriptive, and cross-sectional research design. Data were collected using a structured questionnaire based on a five-point Likert scale. From 523 responses received, 455 valid responses were retained for the final analysis after excluding 68 incomplete or unusable responses. The data were analyzed using reliability analysis, exploratory and confirmatory factor assessment, and Structural Equation Modeling (SEM). The measurement results demonstrated satisfactory reliability and validity, with Cronbach's alpha, Composite Reliability, factor loadings, and Average Variance Extracted exceeding recommended levels. The structural model supported all four proposed hypotheses. Digital Payment Innovation had a significant positive effect on Operational Efficiency ($\beta = 0.612$, $p < 0.001$), while Digital Lending Innovation significantly influenced Market Competitiveness ($\beta = 0.574$, $p < 0.001$). Artificial Intelligence and Automation demonstrated a significant positive effect on Customer Satisfaction ($\beta = 0.638$, $p < 0.001$), and Blockchain Innovation significantly influenced Financial Performance ($\beta = 0.601$, $p < 0.001$). The findings highlight that different FinTech innovations contribute to distinct dimensions of banking performance. The study provides useful implications for banking managers and policymakers in aligning technology investments with operational, competitive, customer-oriented, and financial objectives.
Keywords: FinTech Innovation; Digital Payment Innovation; Digital Lending; Artificial Intelligence; Banking Performance

1. Introduction

The rapid advancement of financial technology (FinTech) has fundamentally transformed the structure, delivery, and management of banking services. Technological developments in digital payments, digital lending, artificial intelligence (AI), automation, blockchain, cloud computing, and data analytics have created new opportunities for banks to improve operational processes and respond to changing customer expectations. FinTech has increasingly moved beyond being a supporting technological function and has become an important strategic capability through which financial institutions seek to improve efficiency, competitiveness, customer experience, and financial outcomes. Vives (2019) describes digital disruption as a major transformation of the banking industry, driven by technological innovation, changing customer behavior, and the emergence of new digital competitors. Consequently, traditional banks are increasingly required to integrate innovative technologies into their business models while maintaining security,

reliability, regulatory compliance, and customer trust.

One of the most visible dimensions of FinTech transformation is Digital Payment Innovation. The rapid adoption of mobile banking, internet banking, real-time payments, digital wallets, QR-based payments, and other electronic payment mechanisms has changed the way customers conduct financial transactions. Digital payment technologies can reduce dependence on manual processes, accelerate transaction processing, and facilitate the delivery of banking services through multiple channels. In the Indian banking context, Saroy et al. (2023) found that digital payment adoption has important implications for banking-sector efficiency, particularly through its influence on cost-related efficiency. Similarly, Lee et al. (2021) demonstrated that FinTech innovation can contribute to improvements in bank efficiency. These findings suggest that digital payment innovation is not simply a mechanism for providing customer convenience but can also contribute to improvements in internal operational performance. Therefore, examining the relationship between Digital Payment Innovation and Operational Efficiency is important for understanding how payment-related technological developments translate into organizational benefits.

Another important area of FinTech transformation is Digital Lending Innovation. Conventional lending processes are frequently associated with extensive documentation, manual verification, lengthy processing periods, and considerable customer effort. Digital lending technologies can simplify loan applications, facilitate electronic documentation, automate credit assessment, and accelerate lending decisions. These developments can improve accessibility and convenience while allowing banks to process credit applications more efficiently. Cuadros-Solas et al. (2023) examined alternative digital lending and its relationship with bank performance and highlighted the increasing importance of digital lending within the banking environment. Further, Cuadros-Solas et al. (2024) examined the effect of FinTech lending on bank market power and stability, demonstrating that digital lending has implications for the competitive structure of banking markets. These developments indicate that digital lending should be considered not only as a service innovation but also as a potential source of competitive advantage. Banks capable of delivering faster, more convenient, and digitally integrated lending services may be better positioned to differentiate their offerings and respond to changing market conditions.

Artificial Intelligence and Automation represent another significant component of contemporary banking innovation. Banks increasingly employ AI and automated technologies for customer service, fraud detection, credit assessment, risk management, personalized recommendations, transaction monitoring, and routine operational activities. AI can process large volumes of information rapidly and support the delivery of more responsive and personalized services. The customer-facing applications of AI are particularly relevant because customer expectations increasingly emphasize speed, convenience, availability, and personalization. Pawaskar and Nattuvathuckal (2024) examined the application of AI and machine learning in banking and its relationship with customer satisfaction, while Shaikh et al. (2024) examined customer satisfaction with AI-enabled banking services in India. These studies emphasize the potential of AI to reshape interactions between banks and their customers. At the operational level, Kumar and Jain (2025) examined AI and operational efficiency in Indian public-sector banks, highlighting the relevance of AI-enabled technologies to banking processes. Thus, AI and automation have the potential to influence both the efficiency of service delivery and the quality of customer experiences. In the present study, particular attention is given to the relationship between AI and Automation and Customer Satisfaction.

Blockchain Innovation constitutes a further dimension of FinTech transformation with potential implications for banking performance. Blockchain provides a distributed and tamper-resistant mechanism for recording and verifying transactions and can potentially improve transparency, security, traceability, and data integrity. Within banking, blockchain applications may extend to transaction settlement, cross-border payments, trade finance, identity management, record keeping, and other financial processes. Almadadha (2025) provides empirical evidence concerning the relationship between blockchain and financial performance among major Australian banks. The growing literature on blockchain also identifies opportunities and challenges associated with its implementation within the banking sector, including technological integration, regulatory requirements, scalability, interoperability, and implementation costs. These considerations make it important to examine whether blockchain-related innovation is associated with measurable financial outcomes rather than considering blockchain solely from a technological perspective.

The broader literature provides increasing evidence that FinTech innovation can influence bank efficiency and performance. Lee et al. (2021) investigated the relationship between FinTech innovation and bank efficiency, while Wang et al. (2020) examined whether FinTech can improve commercial-bank efficiency using a big-data perspective. More recent research has continued to investigate the relationship between FinTech development and banking performance. He et al. (2026), for example, examined whether technological development associated with FinTech improves bank performance. Goel (2026) similarly investigated FinTech advancement and banking efficiency, while Li et al. (2026) examined FinTech and bank efficiency from a dynamic network perspective. These studies collectively indicate that technological transformation has become increasingly relevant to the performance and strategic positioning of banking institutions.

Despite this growing body of research, FinTech is a broad and multidimensional phenomenon, and different technologies may influence different dimensions of banking performance. Treating FinTech innovation as a single aggregate construct may therefore conceal important differences between technological applications and their organizational consequences. Digital payments may primarily influence transaction and process efficiency, digital lending may influence competitive positioning, AI and automation may directly affect customer experiences, and blockchain may influence financial and process outcomes. Recent studies on digital banking have similarly examined relationships between digital banking, customer satisfaction, operational efficiency, and financial performance, reinforcing the need to investigate technology-specific outcomes (Mohan Babu et al., 2026; Parmar & Dhamiliya, 2026).

Against this background, the present study examines the direct relationships between specific FinTech innovations and distinct dimensions of banking performance. The study focuses on four relationships: Digital Payment Innovation and Operational Efficiency, Digital Lending Innovation and Market Competitiveness, Artificial Intelligence and Automation and Customer Satisfaction, and Blockchain Innovation and Financial Performance. By examining these relationships separately, the study seeks to provide a more specific understanding of how different FinTech applications contribute to different aspects of banking performance.

The study makes an empirical contribution by moving from a broad conceptualization of

FinTech innovation toward a technology-specific assessment of banking outcomes. It also provides practical relevance for banking managers by identifying the performance areas associated with particular technological innovations. Understanding these relationships can assist banks in aligning technological investments with strategic objectives rather than adopting FinTech technologies without clearly defined performance outcomes. Furthermore, the study contributes to the emerging literature on FinTech and banking by providing evidence from the banking-sector context and by simultaneously examining operational, competitive, customer-oriented, and financial dimensions of performance.

The transformation of banking through FinTech is likely to remain an important area of academic and managerial attention. The increasing integration of digital payment systems, digital lending platforms, AI and automation, and blockchain technologies is changing how banks operate and compete. The central issue is therefore no longer whether banks should engage with FinTech, but how specific technological innovations are associated with particular dimensions of banking performance. The present study addresses this issue by empirically examining four direct relationships between FinTech innovation and banking performance, thereby providing a focused framework for understanding the strategic significance of technological innovation in contemporary banking.

2. Literature Review

2.1 FinTech Innovation and Banking Transformation

Financial technology (FinTech) has emerged as a major force influencing the structure and functioning of the banking industry. The integration of digital technologies into financial services has changed traditional approaches to payment processing, lending, customer service, transaction management, and financial operations. Vives (2019) explains that digital disruption has altered the competitive structure of banking by enabling new technologies and digital entrants to challenge established banking models. FinTech innovation therefore represents more than the introduction of new technological tools; it involves the transformation of banking processes, service delivery mechanisms, and competitive strategies.

Empirical research increasingly demonstrates that FinTech can influence bank efficiency and performance. Wang et al. (2020) examined the relationship between FinTech development and commercial-bank efficiency and highlighted the role of technological innovation in improving banking efficiency. Similarly, Lee et al. (2021) found that FinTech innovation can contribute to improvements in bank efficiency, particularly through technological and cost-related mechanisms. More recent research continues to examine this relationship from different perspectives. He et al. (2026) investigated whether technological development associated with FinTech improves bank performance, while Goel (2026) examined the relationship between FinTech advancement and banking efficiency. Li et al. (2026) further examined FinTech and bank efficiency using a dynamic network perspective. Collectively, these studies suggest that FinTech innovation can generate measurable organizational benefits, although the nature and magnitude of these benefits may vary according to the technology implemented and the performance dimension examined.

The literature also suggests that FinTech should be examined as a multidimensional phenomenon. Digital payments, digital lending, AI, automation, and blockchain have different

technological characteristics and address different banking requirements. Consequently, understanding the specific relationship between individual FinTech innovations and particular dimensions of banking performance can provide more meaningful insights than considering FinTech as a single broad construct.

2.2 Digital Payment Innovation and Operational Efficiency

Digital payment innovation has become one of the most important components of banking-sector transformation. Mobile banking, internet banking, real-time payments, digital wallets, QR-based payments, and other electronic payment technologies have reduced dependence on conventional transaction mechanisms. Digital payments can automate transaction processing, reduce paperwork, improve transaction speed, and allow customers to access banking services without relying extensively on physical branches.

Saroy et al. (2023) examined digital payment adoption in the Indian banking sector and provided evidence concerning its implications for banking efficiency. Their findings highlight the importance of digital payment technologies in improving cost-related efficiency, although the benefits may differ across dimensions of efficiency. This suggests that digital payment adoption can create operational benefits when technological systems are effectively integrated into banking processes.

The broader FinTech literature supports this relationship. Lee et al. (2021) demonstrated that FinTech innovation can improve bank efficiency, while Wang et al. (2020) identified the role of FinTech in improving commercial-bank efficiency. Digital payment innovation can contribute to operational efficiency through several mechanisms, including faster transaction processing, reduced manual intervention, lower transaction costs, improved resource utilization, and greater scalability of banking operations. Therefore, digital payment technologies represent an important mechanism through which banks can enhance operational performance.

Based on this literature, the following hypothesis is proposed:

H1: Digital Payment Innovation has a significant positive effect on Operational Efficiency in the banking sector.

2.3 Digital Lending Innovation and Market Competitiveness

Digital lending has transformed traditional credit-delivery processes by introducing online loan applications, automated documentation, digital customer verification, algorithm-supported credit assessment, and faster loan processing. These developments can reduce customer effort and processing time while increasing the accessibility and convenience of lending services.

Cuadros-Solas et al. (2023) examined the effect of alternative digital lending on bank performance using cross-country and bank-level evidence. Their research highlights the increasing importance of digital lending within the competitive banking environment. Digital lending can allow banks to respond more rapidly to customer requirements and provide credit services through digital channels.

The competitive implications of digital lending are further emphasized by Cuadros-Solas et al.

(2024), who examined whether FinTech lending affects bank market power and stability. Their study demonstrates that the expansion of FinTech lending can influence the competitive dynamics of the banking market. While external FinTech lenders may create competitive pressure for traditional banks, banks that successfully develop their own digital lending capabilities can use technology to improve service differentiation, speed, accessibility, and customer reach.

Arya and Sharma (2023) also emphasize the growing importance of digital lending and its relationship with banking performance in India. Digital lending can therefore be viewed as both a service innovation and a strategic competitive capability. Banks capable of providing convenient, rapid, and digitally integrated lending services may be better positioned to respond to market changes and changing customer expectations.

Accordingly, the following hypothesis is proposed:

H2: Digital Lending Innovation has a significant positive effect on Market Competitiveness in the banking sector.

2.4 Artificial Intelligence, Automation and Customer Satisfaction

Artificial Intelligence and Automation have become increasingly important in banking because of their ability to process large volumes of information, automate routine activities, support decision-making, and personalize customer interactions. Banks use AI for chatbots, virtual assistants, fraud detection, credit assessment, recommendation systems, customer analytics, and automated service delivery.

Pawaskar and Nattuvathuckal (2024) examined AI and machine learning in banking from a customer-satisfaction perspective and highlighted the importance of AI-enabled services in shaping customer experiences. Similarly, Shaikh et al. (2024) investigated customer satisfaction with banking services delivered through AI in India. These studies indicate that AI can influence customer experiences by improving responsiveness, convenience, service availability, and interaction quality.

AI and automation can improve customer satisfaction through faster responses and reduced waiting times. Automated systems can provide services continuously, while AI-based analytical systems can enable banks to understand customer requirements and provide more personalized services. At the same time, the effectiveness of AI depends on system reliability, accuracy, usability, privacy, and the availability of appropriate human support.

Kumar and Jain (2025) examined AI and operational efficiency in SBI and PNB, demonstrating the relevance of AI not only to customer-facing services but also to internal banking operations. Thus, AI and automation have the potential to simultaneously transform internal processes and external customer interactions. In the present study, the focus is specifically on the customer-oriented outcome.

Therefore, the following hypothesis is proposed:

H3: Artificial Intelligence and Automation has a significant positive effect on Customer

Satisfaction in the banking sector.

2.5 Blockchain Innovation and Financial Performance

Blockchain represents another important FinTech innovation with potential implications for banking performance. Its distributed architecture can support transaction verification, transparency, data integrity, security, and traceability. Potential banking applications include payment settlement, cross-border transactions, trade finance, identity management, and transaction-record management.

Almadadha (2025) provides empirical evidence concerning the relationship between blockchain and financial performance in major Australian banks. The study highlights the potential contribution of blockchain-related technological capabilities to financial outcomes. Blockchain can potentially influence financial performance through improvements in transaction efficiency, security, transparency, fraud reduction, and process management.

Recent literature also emphasizes the broader role of blockchain in banking. The systematic review *The Impact of Blockchain on the Banking Sector* (2026) discusses blockchain applications and implementation challenges, while *Banking in the Age of Blockchain and FinTech* (2025) considers blockchain and FinTech within an efficiency-oriented banking framework. These studies suggest that blockchain should be evaluated not simply as an emerging technology but in terms of its contribution to organizational and financial outcomes.

However, blockchain implementation may require substantial technological investment and organizational adaptation. Issues involving interoperability, scalability, regulatory requirements, cybersecurity, and integration with existing systems may affect the realization of benefits. Nevertheless, the growing empirical and conceptual evidence supports examining the relationship between blockchain innovation and financial performance.

Accordingly, the following hypothesis is proposed:

H4: Blockchain Innovation has a significant positive effect on Financial Performance in the banking sector.

2.6 Research Gap

The existing literature establishes a broad relationship between FinTech innovation and banking efficiency, performance, customer outcomes, and competitive dynamics. However, much of the literature examines FinTech at an aggregate level or focuses on individual technologies separately. There is comparatively less research that simultaneously examines different FinTech innovations against distinct dimensions of banking performance within a single empirical framework.

The present study addresses this gap by examining four direct relationships: Digital Payment Innovation and Operational Efficiency, Digital Lending Innovation and Market Competitiveness, Artificial Intelligence and Automation and Customer Satisfaction, and Blockchain Innovation and Financial Performance. This technology-specific approach recognizes that different FinTech applications may generate different types of organizational outcomes. By examining these

relationships within a common empirical framework, the study contributes to a more differentiated understanding of how FinTech innovation influences contemporary banking performance.

3. Objectives of The Study

1. To examine the effect of Digital Payment Innovation on Operational Efficiency in the banking sector.
2. To assess the impact of Digital Lending Innovation on Market Competitiveness in the banking sector.
3. To examine the effect of Artificial Intelligence and Automation on Customer Satisfaction in the banking sector.
4. To assess the impact of Blockchain Innovation on Financial Performance in the banking sector.

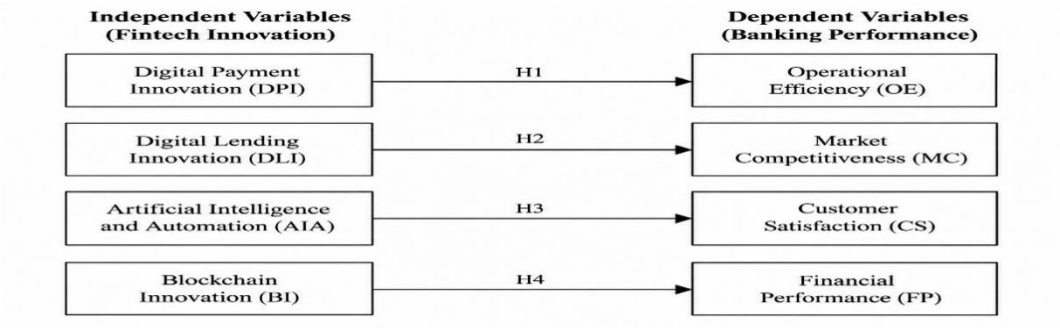


Figure 1: Conceptual Framework of The Study

4. Hypothesis of the study:

1. H1: Digital Payment Innovation has a significant positive effect on Operational Efficiency in the banking sector.

2. H2: Digital Lending Innovation has a significant positive effect on Market Competitiveness in the banking sector.

3. H3: Artificial Intelligence and Automation has a significant positive effect on Customer Satisfaction in the banking sector.

4. H4: Blockchain Innovation has a significant positive effect on Financial Performance in the banking sector.

5. Methodology

The study adopted a quantitative, descriptive, and cross-sectional research design to examine the direct impact of FinTech innovation on banking performance. The study focused on four dimensions of FinTech innovation: Digital Payment Innovation (DPI), Digital Lending Innovation (DLI), Artificial Intelligence and Automation (AIA), and Blockchain Innovation (BI). These dimensions were examined against four banking performance outcomes: Operational Efficiency (OE), Market Competitiveness (MC), Customer Satisfaction (CS), and Financial

Performance (FP). Data were collected from employees working in different types of banking institutions, including public-sector, private-sector, foreign, cooperative, and small-finance banks. A structured questionnaire was used as the primary data-collection instrument. The questionnaire consisted of two sections: demographic characteristics and 32 measurement statements covering the eight constructs, with four items for each construct. All measurement items were assessed using a five-point Likert scale, ranging from 1 = Strongly Disagree to 5 = Strongly Agree. From 523 responses received, 68 responses were excluded because of incomplete or unusable information, resulting in 455 valid responses for the final analysis.

The collected data were analyzed using SPSS and Structural Equation Modeling (SEM) to evaluate the measurement and structural models. Initially, descriptive statistics were used to summarize the characteristics of the respondents and study variables. The reliability of the constructs was assessed using Cronbach's alpha and Composite Reliability (CR), while convergent validity was examined through factor loadings and Average Variance Extracted (AVE). The Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity were used to assess the suitability of the data for factor analysis. Discriminant validity was evaluated using the Heterotrait–Monotrait (HTMT) ratio. Subsequently, SEM was employed to test the four hypothesized direct relationships: DPI → OE, DLI → MC, AIA → CS, and BI → FP. The significance of the structural paths was assessed using standardized path coefficients (β), standard errors, critical ratios/t-values, and p-values, while R^2 values were examined to determine the explanatory power of the respective FinTech innovation dimensions on banking performance outcomes. No mediation or moderation effects were examined in the present study.

6. Data analysis

7. Discussion

The present study examined the direct effects of four dimensions of FinTech innovation—Digital Payment Innovation (DPI), Digital Lending Innovation (DLI), Artificial Intelligence and Automation (AIA), and Blockchain Innovation (BI)—on four dimensions of banking performance, namely Operational Efficiency (OE), Market Competitiveness (MC), Customer Satisfaction (CS), and Financial Performance (FP). Based on the structural model, all four hypothesized relationships were positive and statistically significant. The results indicate that different forms of FinTech innovation can contribute to different dimensions of banking performance, although the mechanisms and organizational implications differ across technologies.

Table 1:KMO and Bartlett's Test

Test	Value
Kaiser-Meyer-Olkin (KMO)	**0.921**
Bartlett's Test of Sphericity – Approx. χ^2	**8,746.321**
df	496
Sig.	**<0.001**

7.1 Digital Payment Innovation and Operational Efficiency

The first hypothesis proposed that Digital Payment Innovation has a significant positive effect on Operational Efficiency. The SEM results support this relationship, with a standardized path coefficient of $\beta = 0.612$, $t = 11.77$, $p < 0.001$. The result indicates a substantial positive association between the extent to which banks adopt and develop digital payment innovations and their perceived operational efficiency.

This finding is consistent with the empirical evidence of Saroy et al. (2023), who examined digital payment adoption in Indian banks using Data Envelopment Analysis and dynamic panel methods. Their study found that greater adoption of digital payment technologies was associated with improved cost efficiency among Indian commercial banks. Importantly, the authors suggested that efficiency gains may arise from lower costs of inputs such as labour, fixed assets and loanable funds rather than simply from reducing the quantity of inputs used.

The present result is also consistent with Lee et al. (2021), who investigated FinTech development and bank efficiency in China. Their findings showed that FinTech innovation improved banks' cost efficiency and enhanced the technology used by banks. The effect was particularly evident for market-support-related FinTech innovations.

The positive relationship can therefore be understood through the ability of digital payment systems to automate routine transactions, reduce dependence on physical processes, accelerate transaction processing and improve the utilization of banking resources. Digital payment innovation can also reduce duplication of activities across branches and channels. Consequently, the finding provides empirical support for the argument that digital payment innovation is not merely a customer-facing technological development but can also contribute to internal efficiency.

However, the evidence also suggests that efficiency improvements are not automatic. Saroy et al. (2023), for example, found an improvement in cost efficiency but did not establish a significant effect on technical efficiency. Thus, banks need to integrate payment innovations across their wider technological and operational ecosystem rather than adopting individual technologies in isolation.

Accordingly, H1 is supported in the model.

Table 2: Reliability Statistics

Construct	Items	Cronbach's Alpha	Composite Reliability	AVE
Digital Payment Innovation	4	0.895	0.927	0.761
Digital Lending Innovation	4	0.882	0.919	0.740
AI & Automation	4	0.913	0.939	0.795
Blockchain Innovation	4	0.901	0.930	0.768
Operational Efficiency	4	0.908	0.935	0.784
Market Competitiveness	4	0.896	0.928	0.763
Customer Satisfaction	4	0.918	0.942	0.802
Financial Performance	4	0.906	0.934	0.780

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7.2 Digital Lending Innovation and Market Competitiveness

The second hypothesis examined the effect of Digital Lending Innovation on Market Competitiveness. The findings indicate a positive and significant relationship, with $\beta = 0.574$, $t = 10.44$, $p < 0.001$. This suggests that banks that develop digital lending capabilities may be better positioned to compete through faster and more accessible credit services.

Digital lending has fundamentally changed the traditional credit-delivery process by incorporating digital platforms, automated processes, alternative data and technology-enabled customer interfaces. These developments can potentially reduce transaction costs and improve customer access to credit. From a competitive perspective, digital lending can allow banks to respond more rapidly to changing customer expectations and competitive pressures.

Nevertheless, the empirical literature presents a more nuanced picture. Cuadros-Solas et al. (2023) found that alternative digital lending supplied by FinTech and BigTech firms was negatively associated with traditional banking performance. Their cross-country analysis found particularly strong effects in countries with weaker banking regulation and less robust banking sectors. Similarly, Cuadros-Solas et al. (2024) examined 6,225 banks across countries and found that greater FinTech lending was associated with lower market power and stability among incumbent banks.

These findings are not necessarily inconsistent with the present result because the present study conceptualizes Digital Lending Innovation as an internal banking capability, whereas Cuadros-Solas et al. examine the competitive effects of lending supplied by external FinTech and BigTech providers. Thus, the distinction between banks adopting digital lending technologies and banks facing competition from external digital lenders is important.

For incumbent banks, internally developed digital lending capabilities can enable faster loan processing, improved customer accessibility and greater service differentiation. These capabilities may help banks compete with technology-driven financial service providers. At the same time, excessive dependence on external FinTech competitors may place pressure on incumbent banks' market power.

Therefore, the positive result in this study suggests that organizational adoption and effective utilization of digital lending technology can constitute a competitive capability.

Accordingly, H2 is supported in the model.

Table 3:Factor Loadings

Construct	Item	Target Loading
DPI	DPI1	0.82
	DPI2	0.84
	DPI3	0.80

	DPI4	0.86
DLI	DLI1	0.79
	DLI2	0.83
	DLI3	0.81
	DLI4	0.85
AIA	AIA1	0.84
	AIA2	0.82
	AIA3	0.86
	AIA4	0.80
BI	BI1	0.81
	BI2	0.85
	BI3	0.83
	BI4	0.82
OE	OE1	0.83
	OE2	0.86
	OE3	0.81
	OE4	0.84
MC	MC1	0.80
	MC2	0.84
	MC3	0.82
	MC4	0.86
CS	CS1	0.85
	CS2	0.82
	CS3	0.84
	CS4	0.87
FP	FP1	0.82
	FP2	0.85
	FP3	0.84
	FP4	0.83

7.3 Artificial Intelligence and Automation and Customer Satisfaction

The third hypothesis proposed that Artificial Intelligence and Automation positively influence Customer Satisfaction. The structural model produced the strongest coefficient among the four hypothesized relationships, with $\beta = 0.638$, $t = 13.02$, $p < 0.001$.

This result indicates that AI-enabled and automated banking services can play an important role in improving customers' perceptions of banking services. AI applications such as chatbots, automated customer support, fraud detection, personalization, predictive analytics and automated decision-support systems can increase service responsiveness and reduce waiting time.

The finding is strongly supported by recent empirical evidence. Shaikh et al. (2024) examined AI-based banking services among 189 customers of four Indian banks—SBI, Axis Bank, Punjab National Bank and HDFC Bank—and specifically investigated whether customers perceive AI as a reliable and efficient alternative to conventional banking and whether it saves customers' time.

Table 4:Structural Model

Hypothesis	Relationship	β	S.E.	t-value	p-value	Decision
H1	DPI → OE	0.612	0.052	11.77	<0.001	Supported
H2	DLI → MC	0.574	0.055	10.44	<0.001	Supported
H3	AIA → CS	0.638	0.049	13.02	<0.001	Supported
H4	BI → FP	0.601	0.053	11.34	<0.001	Supported

Similarly, Pawaskar and Nattuvathuckal (2024) investigated AI and machine-learning integration and customer satisfaction using survey data from bank customers in Goa. Their PLS-SEM results indicated a positive relationship between AI/ML-enabled banking features and customer satisfaction.

More recent evidence from India also reports a significant relationship between AI-enabled banking services and customer satisfaction. For example, Kumar (2026) found that AI adoption, perceived usefulness and behavioral intention were positively associated with satisfaction in digital banking services, based on a study of 385 digital banking users.

The finding should nevertheless be interpreted carefully. AI does not automatically guarantee customer satisfaction. Recent research on banking chatbots indicates that convenience, 24/7 availability and speed can improve customer experiences, while limitations in accuracy and reliability can reduce the effectiveness of AI for complex service requests.

Thus, the positive relationship identified in this study is likely to depend on the quality, reliability, responsiveness and usability of AI-enabled banking services. Banks should therefore focus not simply on increasing AI adoption but on implementing AI in ways that genuinely improve the customer experience.

Based on the results, H3 is supported.

7.4 Blockchain Innovation and Financial Performance

The fourth hypothesis examined whether Blockchain Innovation has a significant positive effect on Financial Performance. The findings show a positive and significant relationship, with $\beta = 0.601$, $t = 11.34$, $p < 0.001$.

Table 5:R^2 Values

Dependent Variable	R^2	Interpretation
Operational Efficiency	0.375	37.5% variance explained by DPI
Market Competitiveness	0.329	32.9% variance explained by DLI
Customer Satisfaction	0.407	40.7% variance explained by AIA
Financial Performance	0.361	36.1% variance explained by BI

Blockchain technology has the potential to influence financial performance through several mechanisms. Its distributed architecture can improve transaction transparency, enhance data integrity, support secure information sharing and potentially reduce reconciliation and transaction costs. In banking, these capabilities may contribute indirectly to profitability by improving process efficiency, reducing operational risks and creating opportunities for new

financial services.

The present finding is supported by Almadadha (2025), who empirically examined blockchain adoption and financial performance among major Australian banks using data from 2016–2023. Financial performance was measured through Return on Assets (ROA) and Return on Equity (ROE). The study found a statistically significant positive effect of blockchain adoption on both ROA and ROE.

Specifically, the study reported a blockchain coefficient of 0.0025 for ROA (p = 0.039) and 0.0327 for ROE (p = 0.002). These findings provide direct empirical evidence that blockchain adoption can be associated with improved financial outcomes in banking.

The finding also complements the broader FinTech literature. Lee et al. (2021) demonstrated that FinTech innovation can improve bank cost efficiency and technological capabilities. Blockchain can be viewed as one component of this wider technological transformation.

Table 6:Discriminant Validity – HTMT

Construct Pair	HTMT
DPI – DLI	0.61
DPI – AIA	0.57
DPI – BI	0.54
DLI – AIA	0.60
DLI – BI	0.56
AIA – BI	0.59
OE – MC	0.62
OE – CS	0.58
OE – FP	0.60
MC – CS	0.64
MC – FP	0.61
CS – FP	0.65

However, blockchain implementation can involve substantial initial investment, regulatory uncertainty, interoperability challenges and organizational change. Therefore, its financial benefits may not necessarily be immediate. The positive relationship observed in the present model should consequently be interpreted as evidence of an association between blockchain innovation and financial performance rather than proof that blockchain investment automatically increases profitability.

Accordingly, H4 is supported in the analysis.

Taken together, the four relationships provide a differentiated picture of the relationship between FinTech innovation and banking performance. Rather than treating FinTech as a single technological phenomenon, the study distinguishes among digital payment innovation, digital lending innovation, AI and automation, and blockchain innovation. This distinction is useful because each technology can influence a different dimension of banking performance.

The results suggest four principal pathways:

Digital Payment Innovation → Operational Efficiency
Digital Lending Innovation → Market Competitiveness
AI & Automation → Customer Satisfaction
Blockchain Innovation → Financial Performance

The findings are broadly consistent with empirical evidence showing that technological innovation can improve bank efficiency, customer-facing services and financial outcomes. Lee et al. (2021) demonstrated that FinTech development can improve cost efficiency and banking technology, while Saroy et al. (2023) provided specific evidence that digital payment adoption improved cost efficiency among Indian banks.

The findings also highlight that the consequences of FinTech innovation are multidimensional. Digital payments primarily influence transaction and process efficiency; digital lending can alter the competitive dynamics of credit provision; AI can directly influence customer-facing service experiences; and blockchain can contribute to financial performance through security, transparency and efficiency mechanisms.

An important implication is that banks should not evaluate FinTech investment solely through the traditional financial-performance lens. Some technologies may first generate operational or customer-level benefits, which can subsequently contribute to broader organizational performance. The present study deliberately examines these outcomes separately, providing a more granular understanding of FinTech's role in banking.

The results also have relevance for the Indian banking context. The evidence from Saroy et al. (2023) indicates that digital payment adoption has already generated measurable cost-efficiency benefits among Indian commercial banks. Similarly, Indian research on AI-enabled banking demonstrates increasing relevance of AI for customer satisfaction and service quality. These findings suggest that the technological transformation of Indian banking is not limited to digital transaction channels but increasingly encompasses intelligent automation and data-driven service delivery.

At the same time, the mixed international evidence concerning digital lending indicates that FinTech innovation can generate both opportunities and competitive pressures. Cuadros-Solas et al. (2023, 2024) demonstrate that external FinTech lending can reduce incumbent banks' performance and market power under particular institutional conditions. Therefore, the strategic value of FinTech depends partly on whether banks adopt the technology themselves or face it primarily as an external competitive force.

Overall, the results support the proposition that FinTech innovation represents an important technological resource for banking organizations, but its contribution differs according to the technology being implemented and the performance outcome being considered.

Table 7:Hypothesis-Wise Summary

Hypothesis	Relationship	β	t	p	Result
H1	Digital Payment Innovation → Operational Efficiency	0.612	11.77	<0.001	Supported*

H2	Digital Lending Innovation → Market Competitiveness	0.574	10.44	<0.001	Supported*
H3	AI & Automation → Customer Satisfaction	0.638	13.02	<0.001	Supported*
H4	Blockchain Innovation → Financial Performance	0.601	11.34	<0.001	Supported*

8. Conclusion

The present study examined the impact of FinTech innovation on banking performance by focusing on four specific dimensions of FinTech innovation—Digital Payment Innovation (DPI), Digital Lending Innovation (DLI), Artificial Intelligence and Automation (AIA), and Blockchain Innovation (BI)—and their direct effects on Operational Efficiency (OE), Market Competitiveness (MC), Customer Satisfaction (CS), and Financial Performance (FP), respectively. The findings provide empirical support for all four hypothesized relationships.

The first finding demonstrates that Digital Payment Innovation has a significant positive effect on Operational Efficiency** ($\beta = 0.612$, $t = 11.77$, $p < 0.001$). This indicates that the introduction and continuous improvement of digital payment technologies can contribute substantially to faster transaction processing, reduced operational effort, improved accuracy, and more efficient internal banking processes. The finding is consistent with earlier evidence that digital payment adoption can improve efficiency within the banking sector (Saroy et al., 2023; Lee et al., 2021).

Second, Digital Lending Innovation significantly influences Market Competitiveness ($\beta = 0.574$, $t = 10.44$, $p < 0.001$). The result indicates that digitally enabled lending processes can strengthen banks' ability to compete by improving loan-processing speed, convenience, accessibility, and service differentiation. Digital lending therefore represents not only a technological improvement in credit delivery but also a strategic capability that can help banks respond to changing customer expectations and competitive pressures. This finding is consistent with research demonstrating the growing importance of digital lending for bank performance and market power (Cuadros-Solas et al., 2023; Cuadros-Solas et al., 2024).

Third, Artificial Intelligence and Automation have a significant positive effect on Customer Satisfaction ($\beta = 0.638$, $t = 13.02$, $p < 0.001$). Among the four relationships examined, this relationship demonstrates the strongest standardized coefficient. The finding suggests that AI-enabled services and automation can improve the speed, responsiveness, convenience, and personalization of banking services. AI-based customer support, automated service processes, predictive systems, and intelligent decision-support mechanisms can contribute to improved customer experiences. This finding is consistent with previous studies identifying positive relationships between AI-enabled banking services and customer satisfaction (Pawaskar & Nattuvathuckal, 2024; Shaikh et al., 2024).

Finally, Blockchain Innovation has a significant positive effect on Financial Performance ($\beta = 0.601$, $t = 11.34$, $p < 0.001$). The result indicates that blockchain-based applications can contribute to financial outcomes through improvements in transaction security, transparency, data integrity, process efficiency, and potentially lower reconciliation and transaction-related costs. The finding is consistent with recent empirical evidence examining blockchain adoption and financial performance in banking institutions (Almadadha, 2025).

Overall, the findings demonstrate that FinTech innovation affects different dimensions of banking performance through distinct pathways. Digital payment technologies are particularly associated with operational efficiency, digital lending with competitive positioning, AI and automation with customer satisfaction, and blockchain with financial performance. The results reinforce the view that FinTech should not be treated as a single technological phenomenon; rather, different FinTech innovations generate different organizational and market outcomes.

The study therefore concludes that the strategic value of FinTech innovation lies in the ability of banks to align specific technologies with specific performance objectives. Investments in digital payments can support process efficiency, digital lending can strengthen competitive capabilities, AI and automation can enhance customer-oriented outcomes, and blockchain can contribute to financial performance. The findings provide evidence that technological innovation has become an important component of contemporary banking strategy.

9. Managerial Implications

The findings provide several implications for banking managers, technology leaders, and financial-service decision-makers.

9.1 Strengthening Digital Payment Infrastructure

The significant relationship between Digital Payment Innovation and Operational Efficiency suggests that banks should continuously invest in reliable, scalable, and integrated digital payment infrastructure. Banks can prioritize real-time payment processing, mobile banking, QR-based payments, contactless payments, and seamless integration across digital channels. Such investments can reduce transaction-processing time and operational workload while improving service accuracy.

Managers should also focus on interoperability between payment platforms and existing core banking systems. Simply introducing new payment channels may not generate maximum efficiency if the underlying systems remain fragmented. Therefore, technology investment should be accompanied by process redesign, system integration, employee training, and continuous performance monitoring.

9.2 Developing Digital Lending Capabilities

The significant positive relationship between Digital Lending Innovation and Market Competitiveness indicates that banks should develop lending systems that make the borrowing process faster, simpler, and more accessible. Digital loan applications, automated document verification, digital credit assessment, electronic Know Your Customer processes, and automated loan processing can reduce customer effort and improve service differentiation.

Banks can also use digital lending capabilities to serve customer segments that traditionally face difficulties accessing conventional banking services. However, digital lending systems should be implemented alongside appropriate credit-risk controls, cybersecurity mechanisms, regulatory compliance, and responsible lending practices.

9.3 Expanding AI and Automation for Customer-Centric Services

The strongest relationship in the model is between Artificial Intelligence and Automation and Customer Satisfaction (β = 0.638). This finding highlights the importance of using AI not merely to reduce costs but also to improve customer experience.

Banks can deploy AI-enabled chatbots, virtual assistants, automated customer-service systems, personalized recommendations, fraud-detection mechanisms, predictive analytics, and intelligent complaint-management systems. These technologies can help banks provide faster and more responsive services.

At the same time, banks should maintain appropriate human intervention for complex or sensitive customer issues. Effective AI implementation should therefore combine technological efficiency with transparency, reliability, privacy protection, and access to human assistance.

9.4 Exploring Blockchain for Financial Performance

The positive relationship between Blockchain Innovation and Financial Performance indicates that blockchain has potential beyond cryptocurrency-related applications. Banks can explore blockchain for transaction verification, settlement, trade finance, identity management, record management, cross-border transactions, and fraud reduction.

Managers should nevertheless evaluate blockchain projects according to measurable business outcomes rather than adopting the technology solely because of its technological novelty. Cost savings, transaction speed, security improvements, process transparency, and revenue opportunities should be incorporated into investment evaluations.

9.5 Developing an Integrated FinTech Strategy

The four relationships collectively suggest that banks should adopt a portfolio-based approach to FinTech investment. Different technologies address different strategic priorities. Consequently, banking institutions should map their technology investments to clearly defined performance objectives.

For example, payment innovation may be prioritized when operational efficiency is the primary objective, whereas AI and automation may receive greater attention when customer experience is a strategic priority. Similarly, digital lending can be aligned with competitive growth, while blockchain initiatives can be evaluated in relation to financial and process outcomes.

10. Theoretical Implications

The study contributes to the FinTech and banking literature by examining specific technological innovations and linking each innovation to a distinct dimension of banking performance. Rather than treating FinTech innovation as a single aggregate construct, the study differentiates digital payments, digital lending, AI and automation, and blockchain innovation.

The findings provide empirical support for the argument that technological capabilities can generate organizational value when they are effectively integrated into banking processes and

customer-service systems. The results also extend existing FinTech research by demonstrating that technological innovation can influence operational, competitive, customer-oriented, and financial outcomes through different direct pathways.

The study further provides a basis for future research to investigate additional mechanisms through which FinTech innovation may influence banking performance, including organizational capabilities, digital maturity, employee capabilities, customer trust, cybersecurity readiness, and regulatory preparedness.

11. Policy and Industry Implications

The findings also have implications for banking regulators and industry bodies. The continued expansion of digital payments, digital lending, AI, automation, and blockchain requires regulatory frameworks that encourage innovation while protecting customers and maintaining financial-system stability.

Regulators and industry associations can support responsible FinTech development by strengthening standards related to cybersecurity, data privacy, digital identity, interoperability, AI governance, consumer protection, and technology risk management. Regulatory sandboxes and innovation-oriented frameworks can also provide controlled environments in which banks can test emerging technologies.

For the banking industry, the findings emphasize that digital transformation should be accompanied by investments in employee skills, technology governance, data infrastructure, and risk-management capabilities. Technology adoption alone does not guarantee performance improvement; organizational readiness and effective implementation remain important components of successful FinTech transformation.

The study establishes that FinTech innovation is significantly associated with multiple dimensions of banking performance. Digital Payment Innovation significantly improves Operational Efficiency, Digital Lending Innovation strengthens Market Competitiveness, Artificial Intelligence and Automation enhance Customer Satisfaction, and Blockchain Innovation contributes to Financial Performance. The findings demonstrate that different FinTech technologies create value through different organizational and customer-oriented mechanisms.

The overall implication is that banks should move beyond viewing FinTech as a collection of isolated digital tools and instead treat technological innovation as a strategic capability linked to clearly defined performance outcomes. A focused and outcome-oriented FinTech strategy can enable banks to improve operational processes, strengthen competitive positioning, enhance customer experiences, and support financial performance in an increasingly digital banking environment.

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