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Sustainable Digital Payment Adoption in Rural and Semi-Urban India: Roles of AI Personalization, Security, Literacy and Trust

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Abstract: The present study aims to investigate the factors influencing the sustainable adoption of digital payment among consumers of rural and semi-urban India with a specific focus on perceived security, digital literacy and the broad digital financial inclusion. A mixed method approach was used and primary data was collected using a structured questionnaire from 150 respondents. Stratified random sampling was adopted to ensure a representation of the rural and semi-urban consumers. The perceived security and digital literacy were taken as the determinants and the sustainable use of digital payments was taken as the dependent variables. "Descriptive statistics, correlation and regression analysis were used for the data analysis". The results of the regression showed that perceived security has a significant impact on sustainable adoption of digital payments with a positive sign ($\beta = 0.186$, $p = 0.024$), which confirms the hypothesis H1. Additionally, the results of the correlation analysis indicated that digital literacy positively and significantly correlated with the sustainable digital payment adoption ($r = 0.321$, $p = 0.000$), which validates H2. "The study reconfirms the positive effect of enhancing security and digital skills in encouraging the adoption of digital payments in rural and semi-urban India with confidence, inclusion and sustainability".

Keywords: Sustainable Digital Payment Adoption; Perceived Security; Digital Literacy; UPI; Rural India; Financial Inclusion.

1. Introduction

Digital Financial Technologies (DFT) have revolutionised the way consumers make payments, transfer funds and access financial services. "This shift has been most pronounced in India with the rising prominence of Unified Payments Interface (UPI), mobile wallets, QR code payments, and other digital payment options (Hashi, A. I., 2025). The volume of retail digital payments has grown from 16,416.02 crore transactions in 2023-24 to 22,167.90 crore transactions in 2024-25, and UPI has accounted for about 81% of retail digital payments in 2024-25 (Government of India, 2026)". The Reserve Bank of India (RBI) also saw an ongoing increase in its Digital Payments Index (RBI, 2025a) which has been climbing to 465.33 in September 2024 due to the growth of payment infrastructure and performance (Hashi, A. I., et al., 2026). But growth of aggregates does not equal adoption of or sustainable adoption. There is evidence that there were still disparities in digital access, digital capabilities, awareness and confidence between the more digitally mature populations and the rural and semi-urban populations (RBI, 2024; Sindakis & Showkat, 2024). Hence, it becomes critical to identify factors that drive consumers to use digital payments not just to try but also to use them as a sustainable mode of payment.

The rural/semi-urban environment is important because digital payment uptake can help to enhance financial inclusion, reduce transaction costs, and increase access to the formal sector (Shanker, 2025). Mobile connectivity, internet access and digital safety are now critical factors shaping access to digital financial services, with mobile connectivity being the fastest-growing factor in recent years (World Bank, 2025). Empirical findings from rural India also show that variables related to socio-economic status, education, income and digital skills impact adoption of UPI (Haque et al., 2025). The researchers in rural India have also found that digital infrastructure, digital skills, geographical differences, awareness and dependence on cash are significant hurdles in the use of digital payments (Hussain, 2025). Further, findings based on studies conducted in the rural

areas of the NCR show that accessibility issues and functional challenges persist in digital payment experiences of consumers (Rana & Goel, 2025). The findings indicated that whilst the adoption of a new technology is a necessary precondition, it is not sufficient for sustainable adoption; the consumer needs to have the skills, confidence and sense of value to use digital payment services repeatedly and responsibly, to facilitate sustainable adoption.

In this ecosystem, AI personalisation is becoming a significant consumer engagement technological factor. Artificial intelligence can help financial service providers to study the patterns of transactions and preferences of their users to provide personalised recommendations, alerts on fraud, spending insights and personalised financial experiences. The latest studies suggest that AI personalization can enhance customer interaction and deepen the bond between customers and financial providers (Siji, 2025). Likewise, studies conducted in India on the role of AI in neo-banking have shown that the website design, personalization, and responsiveness can affect the quality of the service provided, and the quality of service is linked to customer trust and loyalty (Kumar et al., 2025). In this way, AI can help to make digital payment systems more relevant and user-friendly, making them more accessible for less tech-savvy customers. Personalisation, however, raises privacy, data usage, transparency and algorithmic decision-making concerns as well. Study on AI-driven financial services puts trust in the technology as essential as it ensures that the data and information personal to consumers are highly valued for personalized financial services (Kanaparthi, 2024; Gajapathy & Jain, 2025). So, while AI personalization can also be embraced and promote uptake, it can also introduce new considerations around trust.

The perceived security, digital literacy and consumer trust are complementary factors to support sustainable digital payment adoption (Hashi et al., 2025). Perceived security is particularly crucial as consumers' willingness to engage in financial transactions online is driven by their confidence in the security of payment systems in combating fraud and unauthorized access to personal and financial information. With the rise in cybersecurity threats, the RBI has emphasized that securing financial stability and consumer trust is essential for the broader adoption of digital payments (RBI, 2024). Recent studies also show that perceptions of security and privacy beyond initial adoption are also relevant for continued digital wallet use, highlighting that security perceptions can be a more enduring phenomenon than initial adoption (Kumar, 2024). Meanwhile, digital literacy is the key to the ability of consumers to successfully manage authentication, QR payments, transaction verification, fraud alerts, and privacy options. A study in India reveals that lack of smartphone skills and financial or digital literacy can pose a challenge to the adoption of digital financial services (DFS) (Yadav & Kalluru, 2024). Therefore, a technically stable platform cannot be considered for sustainable adoption if the users do not understand or feel confident in operating it.

2. Literature Review

Rashid et al., (2025) extended the Technology Acceptance Model (TAM) and explored the intention to use e-wallet services among consumers in rural areas of India. “Digital financial literacy and perceived financial risk were added to perceived usefulness and perceived ease of use”. The data collection method was done from 720 respondents from 18 administrative divisions of Uttar Pradesh and the analysis was done using the method of Structural Equation Modelling. The findings indicated that perceived financial risk had a negative impact and digital financial literacy had a positive impact on both constructs; perceived ease of use and perceived usefulness. Consumer perception of ease of use was more influential than perceived usefulness on consumers' attitude, and attitude was significantly influential on their intention to adopt.

Naroliya and Sharma (2025) conducted a study on the impact of Unified Payments Interface (UPI) on Financial Inclusion and Digital Trust in India. The study they carried out was on behavioural and structural reasons for continuation of UPI usage, especially among the different types of socioeconomic groups. The researchers pointed out that while UPI has opened up access to digital financial services, sustaining their use

over the long term is difficult. The study highlights the significance of trust, accessibility and consumer-focused digital infrastructure for maintaining digital payment behavior. It concludes that the growth of digital payments should go hand in hand with measures that build consumer trust and reliability in digital payments. This study is relevant in particular to the current investigation as it connects the use of digital payments to financial inclusion and digital trust, two key aspects of sustainable adoption.

Manikandan (2025) examined the factors influencing consumers' adoption of UPI in Kerala, analyzing primary data collected from 468 consumers. Probit regression along with logit and linear probability model was used to determine the factors influencing the adoption of digital payment. The results revealed that age was negatively associated with UPI adoption, whereas education, income, digital literacy, and trust in digital systems and smartphone usage positively related to the adoption of UPI. The effects of digital literacy, trust and the use of smartphones were particularly strong. The study implies that simply giving people a smartphone or even payment infrastructure is not enough for it to be adopted; they should also have the right digital skills and confidence in digital systems. “This confirms the importance of digital literacy and consumer trust in the adoption of digital payment in the rural and semi-urban India.

Shaw and Riyat (2025) conducted a study on digital banking behaviour of rural customers in Jharkhand with digital literacy, perceived ease of use, perceived risk and infrastructural accessibility were variables taken into consideration. The study revealed that mobile banking was more popular among the rural customers than internet banking and e-wallets based on the survey results as well as secondary literature”. Digital financial literacy and perceived ease of use were found to be important predictors of digital adoption, while poor connectivity and fear of online fraud kept people from engaging digitally. Adoption behaviour was also affected by demographic factors like age, education and income. The study found that digital literacy, digital infrastructure, and trust are key areas where rural digital banking can be enhanced. The results of this study are quite similar with the present study which is focussed on sustainable adoption in rural and semi-urban India.

Saibaba (2024) discussed the factors affecting continuance intentions for mobile banking applications in India using an extended Information Systems Success Model. “This study examined post-adoption behaviour and examined the influence of service quality, information quality, system quality, perceived risk and perceived trust on customer satisfaction and continuance intention”. The analysis of the 345 participants on the existing mobile banking was conducted based on structural modelling techniques. The results showed that service quality, information quality, system quality, perceived risk and perceived trust have significant impact on customer satisfaction. Satisfaction subsequently influenced users' intention to persist with using mobile banking applications. The study highlights the importance of trust and risk perceptions in sustaining digital financial service usage.

Anwar et al., (2024) studied the reasons behind consumer continued use of e-wallets, focusing on the perceived technology innovativeness and trust. The study was conducted on the basis of the data collected from the respondents who have used the e-wallet in India and used statistical methods to recognize the key determinants of behavioral intention. The results showed that perceived usefulness and perceived security were the most significant factors affecting consumers' willingness to continue using e-wallets. Trust and technological innovativeness further supported the adoption process. The study suggests that digital payment companies should offer both utility-based and robust security features and trustworthy technology to aid continued adoption. These results have direct implications for the significance of security and consumer trust in adopting sustainable payment methods.

➢ Research Gap

Digital payment adoption has been examined in the context of digital literacy, digital perceived risk, trust, security and ease of use in the previous studies. The significance of digital literacy and accessibility were

pointed out by Rashid et al. (2025), Manikandan (2025) and Shaw and Riyat (2025), whereas trust, security and user experience were discussed by Saibaba (2024), and Anwar et al. (2024). However, there is limited research which has examined the connection between perceived security and digital literacy as determinants for sustainable use of digital payment among the rural and semi-urban consumers in India. Most of the studies on the reported study related to the studies were on initial adoption and continuance intention but not on sustainable and long-term usage. To this end, this study addresses the link between perceived security and digital literacy and sustainable digital payment adoption of the rural and semi-urban consumers of India.

3. Methodology

The present study employs mixed method design that integrates qualitative and quantitative approaches in the realm of sustainable digital payments among the rural and semi-urban users in India. The study focuses on the digital payment user/people who have been exposed to digital payment services such as UPI, mobile banking, Digital wallet and QR code-based payments. The respondents will be selected through stratified random sampling technique and the estimated sample size of 150 respondents will ensure that the consumers from rural, semi urban areas and different demographic groups will be represented. Primary data will be gathered using structured questionnaire and secondary data will be gathered from journals, books, research articles, government reports and other credible institutional publications to acquire the in-depth information of digital payment adoption. The study is descriptive and analytical with independent variables of AI personalization, perceived security, digital literacy and consumer trust and dependent variable of sustainable digital payment adoption. The collected data will be analysed using statistical software like MS Excel and SPSS, which will involve various statistical techniques, including frequency, percentage, mean, standard deviation, correlation analysis, and regression analysis. These statistical methods will be used to explore the relationship between the independent and dependent variables, and to determine the impact of the independent variables (AI personalization, perceived security, digital literacy, and consumer trust) on the dependent variable (consumer sustained use of digital payment services in rural and semi-urban India).

4. Statistical Analysis

Table 1: Demographic profile of the respondents

S.No.	Demographic Variables	Category	N	%
1	Gender	Male	78	52.00%
		Female	72	48.00%
2	Age	Below 30 years	32	21.30%
		31–40 years	43	28.70%
		41–50 years	45	30.00%
		Above 50 years	30	20.00%
3	Place of Residence	Rural	82	54.70%
		Semi-Urban	68	45.30%
4	Educational	Up to Secondary	28	18.70%

	Qualification	Higher Secondary	35	23.30%
		Graduate	52	34.70%
		Postgraduate and Above	35	23.30%
5	**Monthly Household Income**	Below ₹20,000	38	25.30%
		₹20,001–₹40,000	47	31.30%
		₹40,001–₹60,000	38	25.30%
		Above ₹60,000	27	18.00%
6	**Frequency of Digital Payment Usage**	Rarely	25	16.70%
		Occasionally	34	22.70%
		Frequently	51	34.00%
		Very Frequently	40	26.70%

Table 1 shows the demographic details of the 150 respondents that formed the sample. As can be seen in the table 52.00% of respondents were male whereas 48.00% were female, which is a relatively balanced gender distribution. As to age, the largest numbers of respondents were in the 41-50 age groups (30.00%), 31-40 age group (28.70%) and below 30 age group (21.30%) with the 51-60 (19.30%) and above 50 (20.00%) age groups making up the remaining numbers. As far as the place of residence is concerned, 54.70% of the respondents were from the rural areas and 45.30% were from the semi urban areas, thus both the groups were represented. With respect to educational qualification, 34.70% were graduates followed by those who completed higher secondary and post-graduate and above education (23.30% each), respectively, and 18.70% had education up to secondary level. In terms of monthly household income, the largest proportion (31.30%) reported an income of ₹20,001–₹40,000, while 25.30% each belonged to the below ₹20,000 and ₹40,001–₹60,000 categories and 18.00% reported income above ₹60,000. Lastly, with regard to payment frequency, 34.00% of the respondents made digital payments often, and 26.70% very often, while 22.70% occasionally, and 16.70% rarely.

Objective 1: "To examine the relationship between perceived security and sustainable digital payment adoption among consumers in rural and semi-urban India".

H1: "There is a significant relationship between perceived security and sustainable digital payment adoption among consumers in rural and semi-urban India".

Table 2: Regression

Hypothesis	Regression Weights	Beta Coefficient	R2	F	t-value	p-value	Hypothesis Result
H1	Perceived Security → Sustainable Digital Payment Adoption	.186	.034	5.210	2.283	.024	**Supported**

Table 2 regression results imply that perceived security is positively and significantly related to the adoption of sustainable digital payment. The beta of 0.186 suggests that there is a positive correlation between perceptions of security and sustainable use of digital payment. The R^2 value is 0.034, indicating that about 3.4% of the variance in sustainable DP adoption can be explained by the perceived security. The F-value of 5.210 also shows that the regression model is statistically significant, and the t-value of 2.283 and the p-value of 0.024 show that the effect is statistically significant at 5% level. Thus, the null hypothesis is rejected and the alternative hypothesis accepted. This indicates that if the consumers feel digital payment systems are more secure they are more likely to embrace and sustain it in rural and semi-urban India.

Objective 2: "To determine the effect of digital literacy on sustainable digital payment adoption among consumers in rural and semi-urban India".

H2: "Digital literacy significantly influences sustainable digital payment adoption among consumers in rural and semi-urban India".

Table 3: Correlation

Hypothesis	Factor			Correlation		Hypothesis Result
		Mean	SD	Pearson Correlation (r)	Sig value	
H2	Digital Literacy	16.5405	4.45442	.321*	.000	**Supported**
	Sustainable Digital Payment Adoption	17.8851	3.51580			
*. Correlation is significant at the 0.05 level (2-tailed).						

The correlation between digital literacy and sustainable digital payment adoption amongst consumers in rural and semi-urban India is presented in Table 3. The mean score, on the other hand, for sustainable digital payment adoption was 17.8851 and the standard deviation was 3.51580, and for digital literacy, the mean score was 16.5405, and the standard deviation was 4.45442. The Pearson correlation coefficient (r) was 0.321, which means that there was a moderate and positive relationship between digital literacy and the adoption of sustainable digital payments. The significance value was 0.000, which is lower than the significance value 0.05 that means the relationship is statistically significant. Hence, it is accepted that the null hypothesis is rejected and the alternative hypothesis H2 is accepted. The study results indicate that digital literate consumers are more inclined towards sustainable usage and adoption of digital payment services in rural and semi-urban India.

5. Discussion

Based on the study findings, perceived security has significant and positive relationship with the sustainable digital payment adoption, which corroborates H1 (β = 0.186, p = 0.024). This means that consumers who feel digital payments are secure will continue to use them regularly. Aljaradat and Shukla (2025) and Shirsath et al. (2026) also emphasized the significance of Cyber Security, Trust, and protection against digital fraud. Digital literacy also positively correlated with sustainable adoption (r = 0.321, p = 0.000), with which H2 was supported. The same was observed by Manikandan (2025), Mandala et al. (2025) and Rajput and Thakral (2024) who highlighted digital literacy as a crucial determinant of digital payments adoption.

6. Conclusion

The present study concludes that both perceived security and digital literacy are influencing the adoption of sustainable digital payment among consumers in rural and semi-urban India. The analysis showed that perceived security has a significant positively influence on sustainable digital payment adoption, and digital literacy has a significant positively relationship to the adoption. The report shows that consumers are more inclined to continue using digital payment services if they are confident in the security of such services, and if they have the knowledge and skills to effectively use digital platforms. For sustainable adoption of digital payments, it is not just about the technological infrastructure, but also about raising consumer confidence and enhancing capabilities in digital payments, while mitigating doubts about fraud and transaction security. A more robust improvement of these factors would help expand financial inclusion and aid in building a secure, accessible, and sustainable digital payment system, in rural and semi-urban India.

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