



Adoption of Digital Payment Systems and Its Impact on Financial Inclusion of Informal Workers: A Case Study of the Vindhya Region

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Keywords

Digital Payment Systems; Financial Inclusion; Informal Sector Workers; Unified Payments Interface (UPI); Vindhya Region; Madhya Pradesh; PMJDY; e-Shram

Abstract

Purpose: This paper examines the extent to which the diffusion of digital payment systems principally the Unified Payments Interface (UPI), mobile and Aadhaar-enabled banking, and the Pradhan Mantri Jan Dhan Yojana (PMJDY) banking infrastructure has advanced financial inclusion among informal sector workers in the Vindhya region of Madhya Pradesh, India, and identifies the structural and behavioural factors that continue to constrain deeper, sustained usage.

Design/methodology/approach: The study follows a descriptive-analytical, secondary-data-based research design rather than a primary field survey. Data were compiled from the Reserve Bank of India's Financial Inclusion Index (FI-Index), the World Bank's Global Findex Database 2025, National Payments Corporation of India (NPCI) transaction statistics, PMJDY district-wise records compiled by the State Level Bankers' Committee (SLBC) Madhya Pradesh, the e-Shram unorganised-workers database of the Ministry of Labour and Employment, the Periodic Labour Force Survey (PLFS) 2023-24 of the National Statistical Office, and the District Financial Inclusion Index constructed by AIGGPA for Madhya Pradesh. These official indicators are triangulated with the empirical and theoretical literature on technology adoption (TAM, UTAUT/UTAUT2, Meta-UTAUT) to build a composite, district-level reading of digital-payment penetration among informal workers across the Rewa and Shahdol revenue divisions.

Findings: India's composite FI-Index rose from 43.4 in 2017 to 70.0 in March 2026, and UPI's national monthly transaction volume grew more than tenfold between September 2020 and October 2025; yet Madhya Pradesh remains among the states with the lowest per-capita UPI usage, and the Vindhya districts despite comparatively favourable PMJDY average-balance figures relative to several other Madhya Pradesh districts continue to show a gap between account access and active usage. Adoption among informal workers appears to be access-led rather than usage-led: bank-account ownership and RuPay card issuance have expanded rapidly, but sustained productive use for savings, credit access and digital merchant payment lags behind. Trust deficits, intermittent network connectivity,

limited digital and financial literacy, and the cash-dependent, piece-rate character of informal earnings emerge as the principal behavioural constraints consistent with UTAUT-based findings reported for comparable informal-economy settings elsewhere in India and abroad.

Research limitations/implications: Because the paper relies entirely on secondary, largely state- and district-aggregated data, it cannot capture individual-level psychological or household-level determinants of adoption with the granularity that a primary survey would allow; findings for the Vindhya districts specifically should therefore be read as an evidence-based situational analysis rather than as causal, worker-level estimates.

Practical implications: The findings suggest that banking-sector and policy interventions in Vindhya-type semi-urban and rural regions should shift emphasis from account-opening targets toward usage-deepening interventions: vernacular-language and low-bandwidth UPI interfaces, denser banking-correspondent and micro-ATM networks, and integration of e-Shram registration with digital-payment onboarding, so that formal account access converts into functional, everyday financial inclusion for informal workers.

Originality/value: While digital-payment adoption and financial inclusion have been studied extensively at the national and cross-country level, and increasingly for specific informal-worker sub-groups such as street vendors, district-level secondary evidence specific to the Vindhya region a historically under-banked, resource-rich but economically lagging part of central India remains scarce. This paper consolidates dispersed official data sources into a single regional evidence base and offers a replicable analytical template for other data-scarce regions of India.

JEL Classification: G21, O16, O33, I38, R11

Citation

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1. INTRODUCTION

India's payments landscape has undergone one of the most rapid transformations of any large economy in the world over the past decade. The demonetisation of high-value currency notes in November 2016, the roll-out of the Unified Payments Interface (UPI) by the National Payments Corporation of India (NPCI) in the same year, the near-universal spread of Aadhaar-linked identity verification, and the steady fall in the price of mobile data together created the conditions for a cash-heavy economy to begin shifting, transaction by transaction, toward digital rails. By 2024, UPI alone processed over 17,221 crore transactions worth approximately ₹246.8 lakh crore, up from 1,079 crore transactions worth ₹18.4 lakh crore in 2019, and by October 2025 the platform was routinely clearing more than 2,000 crore transactions every month, worth in excess of ₹27 lakh crore (NPCI, as summarised in Kotak Mutual Fund, 2025; Business Standard, 2025).

This growth has not been evenly distributed. National averages conceal wide variation across states, and within states, across districts. A recent state-wise disaggregation of NPCI data found that low-income and lower digital-density states Bihar, Uttar Pradesh, Madhya Pradesh, Rajasthan, Jharkhand and Chhattisgarh among them trail significantly in per-capita UPI usage even as urbanised, better-connected states pull further ahead (LSQUARE, 2025). Madhya Pradesh, the state within which the Vindhya region is situated, sits squarely among this trailing group. The gap matters because it is precisely in these lagging states, and within them in their more remote divisions, that the largest concentrations of informal workers are found workers for whom the promise of digital financial inclusion, if realised, would carry the greatest welfare benefit.

Financial inclusion defined by the Reserve Bank of India (RBI) as the process of ensuring access to appropriate financial products and services needed by all sections of society, delivered in a fair, transparent and equitable manner at affordable cost has long been recognised as both an end in itself and an instrument for broader development. The RBI's own composite Financial Inclusion Index (FI-Index), which aggregates 97 indicators across the dimensions of Access (weight 35%), Usage (45%) and Quality (20%), rose from a base value of 43.4 in 2017 to 53.9 in 2021, 60.1 in March 2023, 64.2 in March 2024, 67.0 in March 2025 and 70.0 in

March 2026 (RBI, 2021, 2024; C4S Courses, 2026; drishtiiias.com, 2024). This steady rise is frequently cited as evidence of policy success. Less frequently examined is the composition of that success: how much of the improvement reflects genuine, productive usage of financial services as opposed to the mechanical opening of dormant accounts.

Informal workers those engaged in agriculture, construction, domestic work, street vending, small-scale manufacturing, transport and a wide array of own-account and casual occupations without formal employment contracts, social security coverage or regular documented income constitute the overwhelming majority of India's workforce. Estimates place the informal sector's share of total employment above 90 percent, even as it contributes close to half of the country's gross domestic product (PWOnlyIAS, 2023, drawing on PLFS 2022-23 data). The launch of the e-Shram portal in August 2021, envisaged as India's first Aadhaar-authenticated National Database of Unorganised Workers, has since registered 31.89 crore workers as of August 2026, of whom 54.28 percent are women (Blitz India Media, 2026; PIB, 2024). Madhya Pradesh, with 1.84 crore registrations, ranks fourth among all Indian states (PIB, 2024). For this population, the question of whether digital payment adoption translates into genuine financial inclusion — rather than remaining a matter of formal, underused account ownership — is not an academic abstraction but a determinant of income security, savings capacity and resilience to shocks.

The Vindhya region of Madhya Pradesh comprising, in its commonly understood administrative sense, the Rewa and Shahdol revenue divisions (the districts of Rewa, Satna, Sidhi and Singrauli, together with Shahdol, Umaria and Anuppur) offers a particularly instructive setting in which to examine this question. It is a region with a distinct historical identity (it constituted the separate state of Vindhya Pradesh between 1948 and 1956 before merging into Madhya Pradesh), a substantial tribal and Scheduled Caste population, an economy still heavily dependent on agriculture and, in districts such as Singrauli, on coal mining and thermal power, and comparatively limited exposure to the kind of urban digital infrastructure that has driven UPI adoption in metropolitan India. It is also, as this paper will show, a region for which comparatively little dedicated secondary research exists on digital financial inclusion specifically most available district-level financial inclusion indices and NPCI disaggregation's stop at the state level, leaving the Vindhya districts visible only indirectly, through occasional district-wise banking statistics compiled by bodies such as the State Level Bankers' Committee (SLBC) of Madhya Pradesh.

Against this backdrop, the present paper pursues two related objectives. First, it consolidates the available official secondary data spanning national, state and, where obtainable, district-level sources into a single, coherent evidence base on digital payment adoption and financial inclusion as they pertain to the Vindhya region and its informal workforce. Second, it interprets this evidence base through the lens of established technology-adoption theory (the Technology Acceptance Model, the Unified Theory of Acceptance and Use of Technology, and their subsequent extensions) to explain why the region's pattern of access-led but usage-lagging financial inclusion is consistent with, rather than an anomaly within, the broader literature on digital-payment adoption among informal workers. The remainder of the paper is organised as follows. Section 2 profiles the Vindhya region. Section 3 reviews the relevant literature. Section 4 sets out the study's objectives. Section 5 details the research methodology. Section 6 presents the data analysis. Section 7 discusses the findings. Section 8 draws out practical and policy implications. Section 9 notes the study's limitations, and Section 10 concludes.

2. Regional Profile: The Vindhya Region and Its Informal Workforce

The term "Vindhya region" is used in this paper, consistent with common administrative and popular usage in Madhya Pradesh, to refer to the Rewa and Shahdol revenue divisions of the state. The Rewa division comprises the districts of Rewa, Satna, Sidhi and Singrauli; the Shahdol division comprises Shahdol, Umaria and Anuppur. The region takes its name from the Vindhya mountain range that traverses central India, and it possessed a brief but distinct political identity of its own: between 1948 and 1956, the princely states of Baghelkhand and neighbouring areas were consolidated into the state of Vindhya Pradesh, which was subsequently merged into the reorganised Madhya Pradesh under the States Reorganisation Act of 1956. This administrative history continues to shape how the region is understood — economically and socially somewhat distinct from Malwa or Mahakoshal, and historically less industrialised and less urbanised than either.

Singrauli district, the easternmost district of the Rewa division, illustrates both the region's economic potential and its structural challenges. Formed in 2008 out of parts of the erstwhile Sidhi district, Singrauli is home to a concentration of coal mines and thermal power stations that make it one of the energy hubs of India, yet its 2011 Census literacy rate of 62.36 percent and a skewed sex ratio of 916 females per 1,000 males (Wikipedia, citing Census of India 2011) point to persistent human-development gaps typical of much of the wider region. Across the seven Vindhya districts more broadly, the workforce remains heavily agrarian, supplemented by seasonal construction labour, small trade, and increasingly, as labour-market researchers have noted out-migration.

Migration is, in fact, a defining feature of the region's informal labour market. Commenting on the sharp rise in e-Shram registrations in Madhya Pradesh, Sudhir Katiyar of the Centre for Labour Research and Action observed that workers from districts including Rewa are moving in large numbers to other states for low-paid construction and manual labour, and that neither migration flows nor the e-Shram portal itself adequately capture this mobile workforce (Free Press Journal, 2026). This has a direct bearing on digital financial inclusion: a migrant construction worker who opens a bank account in his home district but earns and spends primarily in a destination state has a materially different relationship to digital payments than a settled shopkeeper or farmer, and aggregate district-level banking statistics can understate or overstate financial activity depending on how such flows are recorded.

At the same time, the Vindhya districts do not present a uniformly bleak picture on conventional banking-access indicators. As the data analysis in Section 6 will show, several Vindhya districts notably Singrauli, Satna, Sidhi and Rewa rank among the higher-average-balance districts of Madhya Pradesh under the PMJDY scheme, a somewhat counter-intuitive finding that likely reflects both direct benefit transfer (DBT) flows into these accounts (including, in Singrauli's case, compensation and royalty-linked payments associated with the mining and power sector) and lower account-churn than in some more urbanised districts. This combination comparatively healthy formal banking balances alongside a still-developing digital-payments culture is precisely the tension this paper sets out to examine.

3. REVIEW OF LITERATURE

3.1 Digital Payment Systems: Global and Indian Context

The global literature on digital payment systems has expanded rapidly alongside the technologies themselves. A recent systematic literature review covering studies published between 2019 and 2025 notes that the global digital-payments market reached an estimated transaction value of approximately USD 14.2 trillion, growing at an average annual rate of 17.4 percent, driven by smartphone penetration, internet accessibility and consumer preference for contactless transactions (Damanik et al., 2026). The same review observes that in emerging economies digital payments play a particularly critical role in promoting financial inclusion and reducing reliance on informal, cash-based systems, even as disparities in digital literacy and infrastructure continue to produce uneven adoption, particularly among rural populations (Damanik et al., 2026).

Within this global picture, India's UPI is repeatedly cited as a distinctive success story of publicly governed digital infrastructure. UPI's Merchant Discount Rate has been set at zero since January 2020, removing the cost barrier that discouraged small merchants and informal traders from accepting digital payments, while integration with Aadhaar-based identity verification and the PMJDY banking rollout created the underlying account infrastructure needed for adoption to scale (Kotak Mutual Fund, 2025). By August 2025, UPI accounted for roughly 85 percent of all digital retail payments by volume in India (Kotak Mutual Fund, 2025). Analysis of NPCI's more granular, merchant-category-disaggregated data released from June 2025 onward shows a dual-use structure: within person-to-merchant (P2M) transactions, 86 percent were valued under ₹500 indicating high-frequency, low-ticket micro-payments typical of everyday informal-economy transactions such as grocery and local transport purchases while only 4 percent exceeded ₹2,000 in value, yet these accounted for 66 percent of total transaction value (IIMB, 2025; LSQUARE, 2025). This pattern is directly relevant to informal workers, whose earnings and expenditures are typically small, frequent and irregular rather than large and scheduled.

3.2 Theoretical Foundations: TAM, UTAUT and Meta-UTAUT

Much of the empirical literature on digital-payment adoption, including among informal-sector populations, is grounded in technology-acceptance theory. The Technology Acceptance Model (TAM) and its successor, the Unified Theory of Acceptance and Use of Technology (UTAUT), remain the dominant frameworks (Damanik et al., 2026). UTAUT identifies performance expectancy, effort expectancy, social influence and facilitating conditions as the principal determinants of behavioural intention to adopt a technology, with actual use behaviour following from that intention. Extensions of the model UTAUT2 and, more recently, "Meta-UTAUT" formulations add constructs such as trust, personal innovativeness, perceived risk and hedonic motivation that later researchers have found especially relevant in low-resource, informal-economy contexts.

A qualitative UTAUT-based study of informal business owners in Cape Town, South Africa, drawing on semi-structured interviews with fourteen informal business owners, found that limited resources constrain both the ability and willingness of informal operators to adopt digital financial technology, even where formal infrastructure for adoption exists (South Africa informal-sector FinTech study, 2024). In the Indian context, a study of Quick-Response (QR) code mobile payment adoption among marginalised women street vendors extended the Meta-UTAUT framework by incorporating personal innovativeness,

perceived trust and convenience as additional constructs, and positioned attitude and user satisfaction as mediating variables linking pre-adoption beliefs to post-adoption, sustained engagement (Discover Sustainability / Springer, 2025). The study's authors argue that QR-based mobile payment technologies function not merely as transactional tools but as instruments of financial inclusion and economic empowerment for women operating at the grassroots of the informal economy (Discover Sustainability / Springer, 2025) a framing directly applicable to the informal traders, vendors and daily-wage workers of the Vindhya region.

3.3 Digital Payments and the Financial Inclusion Nexus

A systematic literature review of mobile-payment-driven financial inclusion synthesises a number of country-specific empirical studies with direct relevance to the present paper. Fall, Orozco and Akim (2020), studying the adoption and use of mobile banking among low-income individuals in Senegal, and Akinyemi and Mushunje (2020), examining determinants of mobile-money technology adoption in rural Africa, both find that facilitating conditions network reliability, agent density and affordability are decisive for rural and low-income adoption, echoing UTAUT's core prediction. Closer to the present study's geography, Mohapatra, Moirang them and Vishwakarma (2020) examine mobile-banking adoption among rural consumers in India and similarly identify infrastructural and trust-related barriers as binding constraints, even where awareness of mobile banking is reasonably high. Thaker, Thaker, Khaliq, Allah Pitchay and Hussain (2022), applying UTAUT2 to internet-banking adoption among clients of Islamic banks in Malaysia, extend the model with religiosity and perceived risk constructs, underscoring that context-specific factors beyond the original UTAUT variables often carry substantial explanatory weight. The broader review concludes that customer empowerment, digital-literacy promotion and mass awareness campaigns are consistently identified across country contexts as necessary complements to infrastructure investment if mobile-payment-led financial inclusion is to be realised in practice rather than merely in account-opening statistics (Springer Nature systematic review, 2025).

A separate, broader systematic review of the financial-inclusion and fintech literature similarly concludes that fintech adoption exerts a measurable positive effect on financial inclusion outcomes, but that the strength of this relationship is moderated by the depth of a country's or region's existing financial and digital infrastructure (Ha, Le and Nguyen, 2025). This moderating effect is precisely what the Vindhya region's data, examined in Section 6, appear to illustrate: infrastructural access (bank accounts, RuPay cards) has expanded rapidly, while the infrastructure and behavioural conditions needed for deep, productive usage have expanded more slowly.

3.4 Informal Workers and Digital Financial Behaviour

Research focused specifically on informal-sector actors as opposed to the general population consistently finds a gap between formal financial access and productive financial usage. A study of digital-payment-platform adoption among informal firms in Ghana, using World Bank Enterprise Survey data and a recursive bivariate probit model, found that while 49.6 percent of surveyed informal firms used digital payment platforms for business transactions, only 13.83 percent received trade credit from suppliers and 26.89 percent extended trade credit to customers evidence that digital-payment adoption, while beneficial for transaction efficiency and convenience, does not automatically or fully translate into the deeper financial relationships (such as credit access) that constitute a fuller measure of financial inclusion (Adoption of digital payment platforms and trade credit activities among informal firms in Ghana, PMC, n.d.).

A systematic review focused specifically on the socio-cultural determinants of digital-payment adoption among informal-sector workers concludes that community norms, trust and privacy concerns, prevailing economic behaviours, and prevailing levels of digital literacy jointly shape perceptions, behaviours and willingness to adopt digital-payment technologies among this population, and that these socio-cultural factors often outweigh purely technical or infrastructural considerations in explaining observed adoption gaps (Journal of Information Systems Engineering and Management, 2025). This is a useful corrective to purely infrastructure-centric policy narratives: expanding mobile-network coverage and banking-correspondent density, while necessary, may not by itself be sufficient to close the usage gap observed among informal workers in regions such as Vindhya.

3.5 Research Gap

Taken together, the literature reviewed above establishes three points of consensus: first, that digital-payment infrastructure in India (principally UPI) has scaled with extraordinary speed at the national level; second, that this national-level scaling masks substantial state- and district-level variation, with states such as Madhya Pradesh trailing in per-capita usage; and third, that among informal-sector workers specifically, technology-adoption theory (UTAUT and its extensions) and empirical country studies consistently find an access-usage gap driven by trust, facilitating conditions and socio-cultural factors rather than by

account availability alone. What remains comparatively underexplored is the district-level, region-specific evidence for historically lagging regions within large states precisely the gap this paper addresses for the Vindhya region of Madhya Pradesh, by assembling and interpreting the available official secondary data through the lens of this established theoretical and empirical literature.

4. OBJECTIVES OF THE STUDY

Building on the research gap identified above, the study is guided by the following specific objectives:

- ❖ To examine national- and state-level trends in digital payment adoption (UPI transaction volume and value, RBI's Financial Inclusion Index, and Global Findex account-ownership indicators) as the macro backdrop against which the Vindhya region's experience must be read.
- ❖ To compile and analyse the available district-level secondary indicators of banking access and usage principally PMJDY average balances, Aadhaar-seeding rates and zero-balance-account proportions for the districts of the Vindhya region.
- ❖ To assess the scale and composition of the informal workforce in Madhya Pradesh and the Vindhya region using e-Shram registration data and Periodic Labour Force Survey (PLFS) estimates.
- ❖ To interpret the resulting access-versus-usage pattern through the lens of technology-adoption theory (TAM/UTAUT/Meta-UTAUT) and comparable empirical studies of informal-worker digital-payment behaviour.
- ❖ To draw out practical and policy implications for deepening, rather than merely widening, digital financial inclusion among informal workers in the Vindhya region and comparable semi-urban and rural regions of India.

Correspondingly, the paper seeks to answer the following research questions: (RQ1) How has digital payment adoption evolved at the national and Madhya Pradesh state level, and where does the state stand relative to other Indian states? (RQ2) What do the available district-level secondary indicators suggest about the state of banking access and, where inferable, usage in the Vindhya region specifically? (RQ3) What does the informal-worker registration and employment data suggest about the population for whom financial inclusion outcomes matter most in this region? (RQ4) What behavioural and structural factors, as identified in the wider literature, most plausibly explain the observed access-usage gap in a region such as Vindhya?

5. RESEARCH METHODOLOGY

5.1 Research Design

This study adopts a descriptive-analytical research design based entirely on secondary data. This design choice is deliberate and is stated transparently: no primary survey of informal workers in the Vindhya region was conducted for this paper, and the study does not present primary field data, questionnaire responses or interview transcripts as if they were original fieldwork. Instead, the paper's contribution lies in the systematic compilation, cross-validation and theoretically-informed interpretation of dispersed official secondary data sources that, to the authors' knowledge, have not previously been assembled together with specific reference to the Vindhya region. This approach follows an established tradition of secondary-data-based regional financial-inclusion analysis in the Indian context, of which the AIGGPA District Financial Inclusion Index for Madhya Pradesh (2022) is itself an example.

5.2 Data Sources

Data for this study were drawn from the following official and institutional sources, each identified explicitly so that figures can be independently verified and updated by future researchers:

- ❖ Reserve Bank of India (RBI) annual Financial Inclusion Index (FI-Index) press releases and RBI Bulletin publications (RBI, 2021, 2024, 2025, 2026), providing the national composite index of Access, Usage and Quality of financial services.
- ❖ World Bank Global Findex Database 2025, the fifth edition of the world's most comprehensive demand-side survey of financial inclusion, covering approximately 145,000 adults across 141 economies, including India-specific account-ownership and digital-payment-usage indicators (World Bank, 2025).

- ❖ National Payments Corporation of India (NPCI) UPI product statistics and district-wise NFS (National Financial Switch) statistics, supplemented by contemporaneous reporting of monthly transaction volumes and values (NPCI, 2025; Business Standard, various dates).
- ❖ State Level Bankers' Committee (SLBC), Madhya Pradesh the Financial Inclusion Agenda Note, which compiles district-wise PMJDY statistics including average account balance, Aadhaar-seeding percentage and zero-balance-account percentage for all districts of Madhya Pradesh, including the seven Vindhya-region districts.
- ❖ Pradhan Mantri Jan Dhan Yojana (PMJDY) national portal and Press Information Bureau (PIB) releases, providing state-wise and national account-opening, deposit and RuPay-card statistics (PIB, 2025).
- ❖ e-Shram portal statistics, Ministry of Labour and Employment, Government of India, providing state-wise registration counts and demographic composition of registered unorganised workers (PIB, 2024; Blitz India Media, 2026).
- ❖ Periodic Labour Force Survey (PLFS) 2023-24, National Statistical Office (NSO), Ministry of Statistics and Programme Implementation (MoSPI), providing Labour Force Participation Rate, Worker Population Ratio and informal-sector employment-share estimates (MoSPI, 2024).
- ❖ AIGGPA (Atal Bihari Vajpayee Institute of Good Governance and Policy Analysis) District Financial Inclusion Index for Madhya Pradesh (2022), the only publicly available district-granularity financial-inclusion index for the state, constructed across Access, Usage and Barriers dimensions using 16 indicators for all 52 districts.

All figures reported in this paper are reproduced, computed or visualised directly from these named sources; no financial or usage figures have been invented, estimated without disclosure, or extrapolated without an explicit statement that they are estimates.

5.3 Analytical Framework

The analysis proceeds in three concentric layers. The outermost layer establishes the national context using RBI FI-Index and Global Findex trends (Section 6.1). The intermediate layer narrows to Madhya Pradesh as a state, using NPCI's state-wise UPI disaggregation and the AIGGPA District Financial Inclusion Index (Section 6.2). The innermost layer focuses on the Vindhya region's constituent districts specifically, using SLBC PMJDY district data and e-Shram state-level data as the closest available proxies for district- and region-level informal-worker financial behaviour (Section 6.3). Each layer is read for what economists term an access-usage gap: the difference between indicators of formal access (accounts opened, cards issued) and indicators of active, productive usage (transaction volume and value, account balances, digital merchant payments). This access-usage framing follows directly from the RBI FI-Index's own three-dimensional structure (Access, Usage, Quality) and from the UTAUT-derived distinction, prominent in the literature reviewed in Section 3, between behavioural intention/adoption and sustained use behaviour.

5.4 Scope and Period of Study

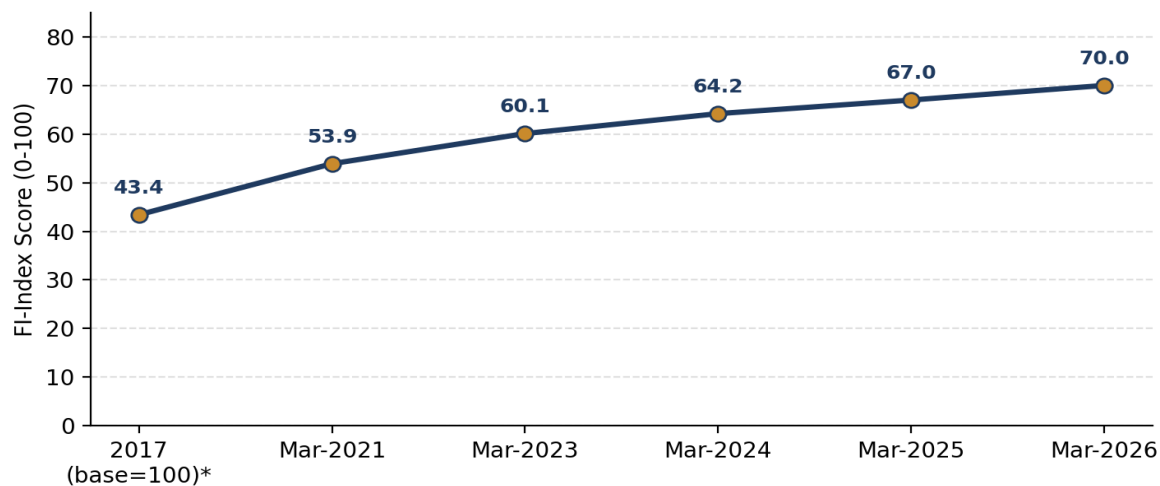
The study covers national- and state-level data primarily for the period 2017 to 2026, reflecting the availability window of the RBI FI-Index (first published for reference year 2017) and recent NPCI/UPI statistics through October 2025. District-level PMJDY data for the Vindhya region are drawn from the most recent SLBC Madhya Pradesh Financial Inclusion Agenda Note available at the time of writing. e-Shram and PLFS data are reported as of their most recent official release. Where a data series has multiple vintages (for instance, UPI monthly figures), the specific month and year are stated alongside each figure to avoid ambiguity.

6. DATA PRESENTATION AND ANALYSIS

6.1 National-Level Trends in Financial Inclusion and Digital Payments

India's composite FI-Index has risen steadily and without interruption since its introduction, moving from a base value of 43.4 for 2017 to 53.9 in 2021, 60.1 in March 2023, 64.2 in March 2024, 67.0 in March 2025 and 70.0 in March 2026 (RBI, 2021, 2024, 2025, 2026). Figure 1 plots this trajectory.

Figure 1: India's Composite Financial Inclusion Index (FI-Index), 2017-2026

Figure 1: India's Composite Financial Inclusion Index (FI-Index), 2017-2026

Source: Reserve Bank of India, Annual FI-Index Press Releases (2021-2026); *2017 base value as reported by RBI Bulletin

Source:

RBI Annual FI-Index press releases (2021-2026).

The RBI has attributed recent increases largely to growth in the Usage sub-index, which carries the highest weight (45 percent) in the composite score (drishtias.com, 2024). This is a meaningful distinction: it suggests that, at the national level at least, the more recent phase of financial-inclusion growth is being driven less by new account opening (the Access dimension, which had already reached comparatively high levels) and more by increased use of existing accounts and services. Whether this national pattern holds at the Vindhya-district level is precisely the question examined in Section 6.3.

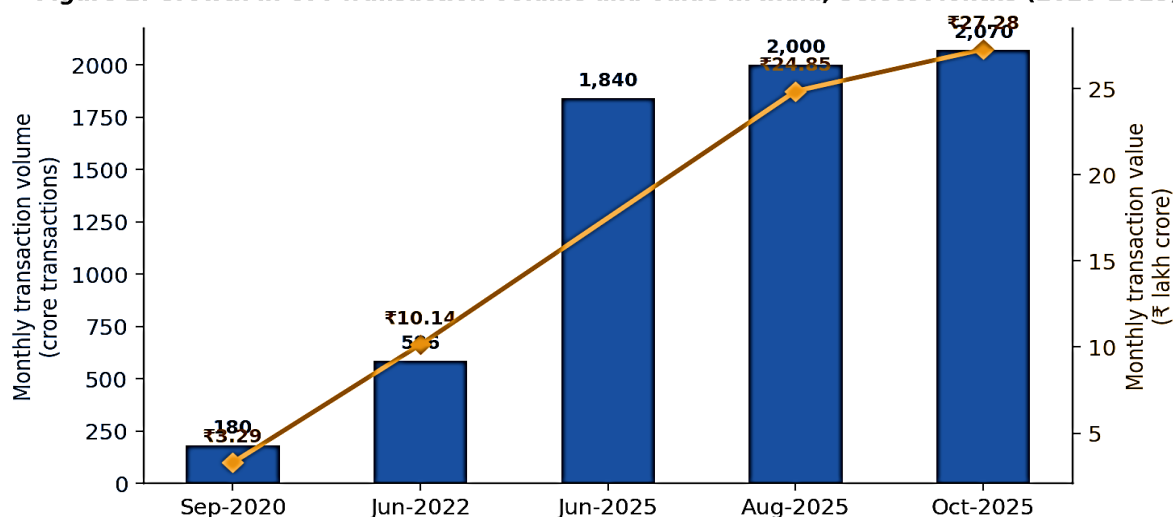
Alongside the FI-Index, UPI transaction data provide the clearest available window into actual digital-payment usage. Table 1 and Figure 2 summarise verified monthly UPI transaction figures reported by NPCI at different points between 2020 and 2025.

Table 1: UPI Monthly Transaction Volume and Value in India, Select Months (2020-2025)

Month	Transaction Volume (crore/month)	Transaction Value (₹ lakh crore/month)
September 2020	180	3.29
June 2022	586	10.14
June 2025	1,840	(P2M alone: ₹6.83 lakh crore)
August 2025	> 2,000	24.85
October 2025	2,070	27.28

Source: National Payments Corporation of India (NPCI) monthly data, as reported by Business Standard (2020, 2022) and PIB/News on Air (2025).

Figure 2: Growth in UPI Transaction Volume and Value in India, Select Months (2020-2025).

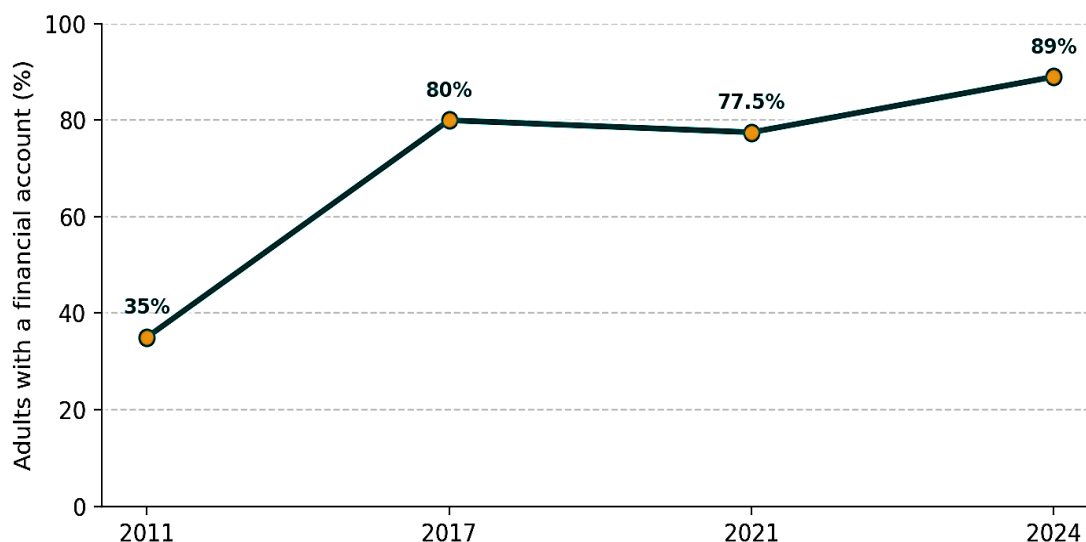
Figure 2: Growth in UPI Transaction Volume and Value in India, Select Months (2020-2025)

Source: National Payments Corporation of India (NPCI), monthly press data as reported by Business Standard and PIB (2020-2025)

Source:

NPCI monthly data as reported by Business Standard and PIB.

Between September 2020 and October 2025, monthly UPI transaction volume grew more than eleven-fold, and monthly transaction value grew more than eight-fold. NPCI reported that UPI transactions surged 35 percent year-on-year to reach 106.36 billion transactions in the first half of 2025 alone, and that November 2025 recorded average daily transaction amounts of ₹87,721 crore (News on Air, 2025). Complementing NPCI's own data, the World Bank's Global Findex Database 2025 provides internationally comparable, demand-side survey evidence on account ownership and digital-payment usage. Figure 3 traces India's financial account ownership trajectory as captured across successive Global Findex survey rounds.

Figure 3: Financial Account Ownership in India, 2011-2024.**Figure 3: Financial Account Ownership in India, 2011-2024**

Source: World Bank, Global Findex Database 2025 (and prior rounds), as reported in India Strategic / AffairsCloud summaries of the World Bank report

Source:

World Bank, Global Findex Database 2025 and prior survey rounds.

Financial account ownership in India rose from 35 percent of adults in 2011 to approximately 80 percent by 2017, to 77.5 percent in 2021 (a dip attributable in part to survey-methodology and pandemic-period effects), and to 89 percent in 2024 a level that places India well above the low- and middle-income-economy average of 75 percent (World Bank, 2025; AffairsCloud, 2025). Critically, however, the Global Findex 2025 report also finds that only 54 percent of Indian account owners used digital

payments, and that digital merchant payments payments made by retail customers to businesses in stores or online reached only 42 percent of all adults across low- and middle-income economies in 2024, with South Asia's share at just 15 percent, well below the global low- and middle-income average (AffairsCloud, 2025; Better Than Cash Alliance, 2025). This is the clearest available quantitative expression, at the national level, of the access-usage gap that motivates this paper: even where account ownership approaches universal levels, active digital-payment usage among account holders trails substantially behind.

6.2 State-Level Trends: Madhya Pradesh in National Perspective

Disaggregated NPCI data covering approximately 55.26 percent of total UPI transaction volume, released in June 2025 and subsequently used to estimate per-capita transaction levels across all Indian states, found that Delhi, Puducherry and Chandigarh topped the per-capita UPI usage rankings, while "many low-income or lower digital-density states such as Bihar, Uttar Pradesh, Madhya Pradesh, Rajasthan, Jharkhand, and Chhattisgarh trailed significantly in per capita usage, exposing a digital divide that echoes India's broader economic disparities" (LSQUARE, 2025). This state-level finding is the essential backdrop against which Vindhya-region data must be interpreted: the region sits within a state that is itself among the lagging group nationally, meaning that any within-state lag specific to Vindhya compounds, rather than offsets, a pre-existing state-level disadvantage.

At the same time, Madhya Pradesh's own district-level financial-inclusion picture, as captured by the AIGGPA District Financial Inclusion Index (2022) the only publicly available index of its kind for the state shows substantial intra-state variation. That index, built on sixteen indicators spanning Access, Usage and Barriers dimensions for all 52 districts, found Bhopal (0.640) and Indore (0.619) leading the state, with Hoshangabad, Harda, Dhar, Jabalpur, Sehore, Ujjain, Ratlam, Gwalior, Neemuch and Dewas rounding out the higher-performing districts (AIGGPA, 2022). None of the seven Vindhya-region districts appear among this top-performing group, consistent with the broader pattern of urbanised, commercially developed districts leading on composite financial-inclusion measures while the more agrarian, historically under-invested divisions including Vindhya lag on the same composite scale.

6.3 The Vindhya Region: District-Level Secondary Evidence

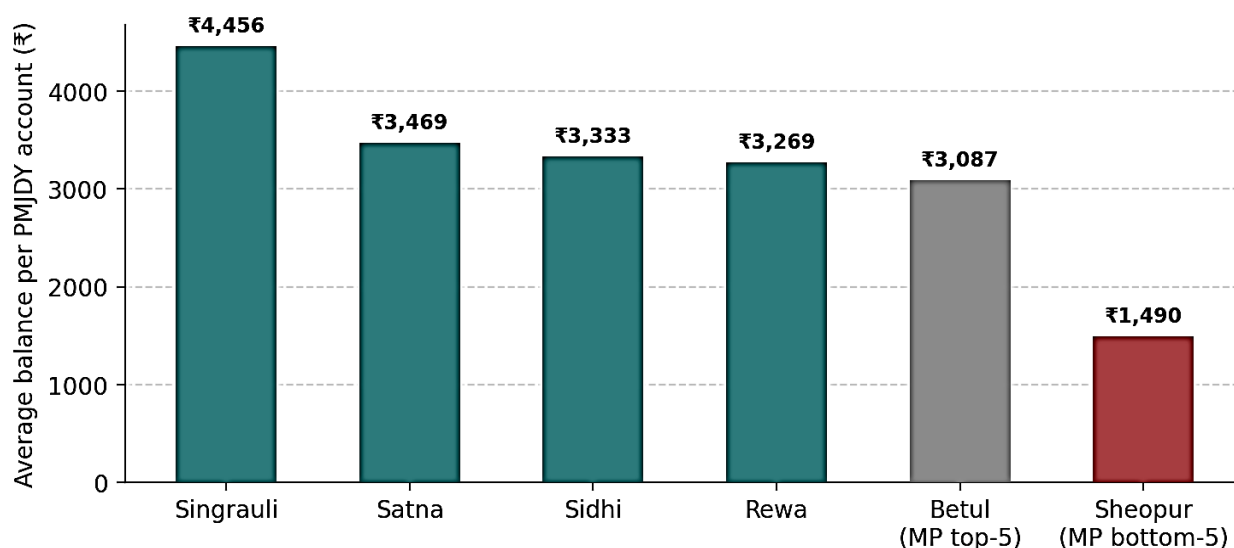
Direct, dedicated digital-payment usage data at the district level for the Vindhya region are not separately published by NPCI or the RBI; this itself is a notable data gap, discussed further in Section 9. The most granular reliable indicator available is PMJDY district-wise banking data compiled by the SLBC of Madhya Pradesh, which reports, among other metrics, the average balance held per PMJDY account by district. Table 2 and Figure 4 present this data for the four Rewa-division Vindhya districts for which figures are available, alongside comparator districts representing the state's highest- and lowest-average-balance districts.

Table 2: Average PMJDY Account Balance Vindhya Region Districts vs Madhya Pradesh Reference Districts

District	Region	Average PMJDY Account Balance (₹)
Singrauli	Vindhya (Rewa division)	4,456
Satna	Vindhya (Rewa division)	3,469
Sidhi	Vindhya (Rewa division)	3,333
Rewa	Vindhya (Rewa division)	3,269
Betul	Non-Vindhya (MP top-5 reference)	3,087
Sheopur	Non-Vindhya (MP bottom-5 reference)	1,490

Source: State Level Bankers' Committee (SLBC), Madhya Pradesh Financial Inclusion Agenda Note (district-wise PMJDY statistics).

Figure 4: Average PMJDY Account Balance Vindhya Region Districts vs Madhya Pradesh Reference Districts.

Figure 4: Average PMJDY Account Balance — Vindhya Region Districts vs Madhya Pradesh Reference Districts

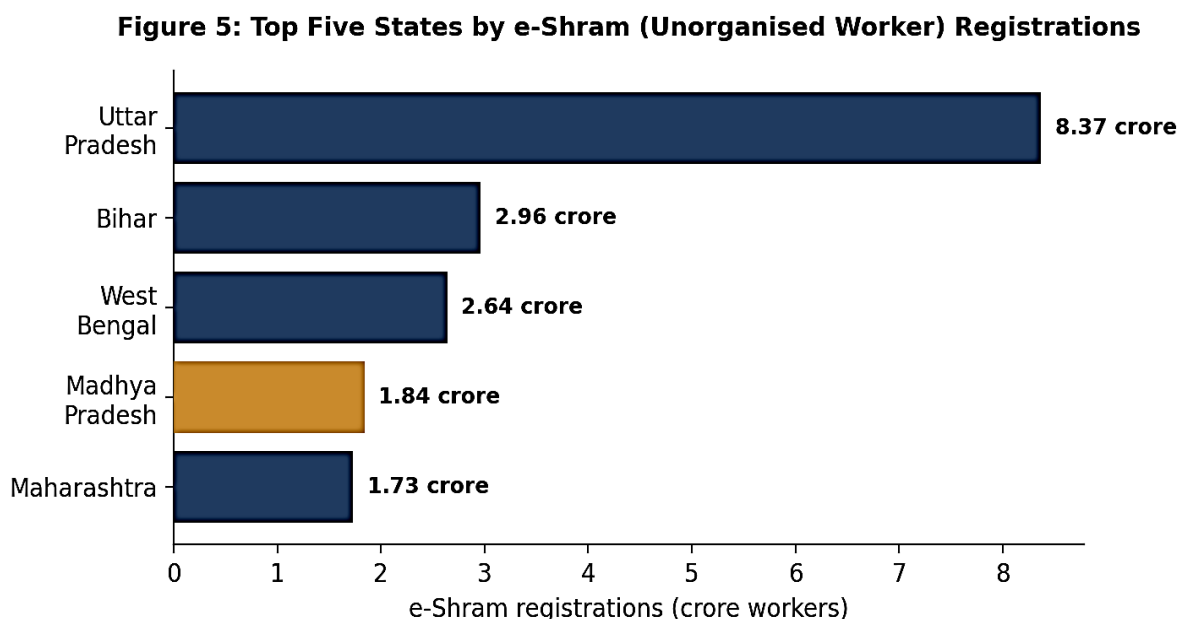
Source: State Level Bankers' Committee (SLBC), Madhya Pradesh — Financial Inclusion Agenda Note (compiled district-wise PMJDY data)

Source: SLBC Madhya Pradesh.

The finding that Singrauli, Satna, Sidhi and Rewa hold average PMJDY balances above several more urbanised or commercially prominent Madhya Pradesh districts and well above the state's lowest-balance districts such as Sheopur is, at first glance, counter-intuitive given the region's lower composite AIGGPA financial-inclusion ranking. Two explanations are consistent with both the data and the wider literature. First, Singrauli's comparatively high average balance plausibly reflects direct benefit transfers and formal-sector wage and compensation flows linked to its coal-mining and thermal-power economy, which would raise average account balances without necessarily indicating broad-based, informal-worker-driven digital transaction activity. Second, and consistent with the Global Findex finding that account balance and active usage are distinct dimensions of financial inclusion, a relatively high average balance can coexist with low transaction frequency if accounts are used predominantly as passive stores of DBT receipts rather than as active instruments for everyday digital payment — precisely the access-without-usage pattern identified at the national level in Section 6.1.

The SLBC Financial Inclusion Agenda Note also reports Aadhaar-seeding percentages (a precondition for UPI and DBT functionality) and zero-balance-account percentages by district. Among the figures available, Shahdol district records one of the lowest zero-balance-account percentages in the state at 5.30 percent indicating comparatively active account usage in at least this one Vindhya district while Harda (outside the Vindhya region) records the highest zero-balance percentage among the districts reported, at 14.20 percent. This single data point should be read cautiously given the limited district coverage available in the source note, but it is at minimum consistent with the possibility that account dormancy is not uniformly worse across the Vindhya region than elsewhere in the state, even though composite usage indicators (AIGGPA index) place the region behind the state's leading districts.

Turning to the informal workforce itself, the e-Shram portal provides the most current national picture of unorganised-worker registration. As of August 2026, the portal recorded 31.89 crore total registrations nationally, of which women constituted 54.28 percent and men 45.72 percent; workers aged above 50 accounted for 20.53 percent (approximately 6.55 crore workers), and agriculture, domestic and household work, construction and apparel work accounted for the largest occupational shares (Blitz India Media, 2026). Madhya Pradesh ranks fourth among all states with 1.84 crore registrations, behind Uttar Pradesh (8.37 crore), Bihar (2.96 crore) and West Bengal (2.64 crore), and just ahead of Maharashtra (1.73 crore) (PIB, 2024). Figure 5 presents this state ranking.

Figure 5: Top Five States by e-Shram (Unorganised Worker) Registrations.

Source: Press Information Bureau (PIB), Ministry of Labour and Employment — e-Shram Portal statistics

Source: Press Information Bureau (PIB), Ministry of Labour and Employment.

While e-Shram registration data are not published at the district level in the public domain, contemporaneous reporting specifically identifies Rewa, alongside Jhabua, Alirajpur and Morena, as a district from which large numbers of workers migrate to other states for low-paid construction and manual labour, and notes that even the e-Shram portal does not adequately capture this migrant population (Free Press Journal, 2026). This qualitative evidence reinforces the earlier point that digital financial inclusion for Vindhya's informal workers cannot be fully assessed through district-of-registration banking statistics alone, since a meaningful share of the workforce transacts, earns and potentially uses digital payments outside the district or even the state in which their formal financial records are held.

At the national level, the scale of informality that this regional picture sits within is considerable. Periodic Labour Force Survey data for 2023-24 recorded a Labour Force Participation Rate of 60.1 percent (up from 57.9 percent in 2022-23) and a Worker Population Ratio reflected in a workforce structure where, as of PLFS 2022-23, 74 percent of non-farm workers were in proprietorships and partnerships classified as informal-sector enterprises, and more than 90 percent of the overall workforce was employed in the informal economy even as that economy contributed close to half of GDP (dristiiias.com, 2024; PWOnlyIAS, 2023). Notably, PWOnlyIAS (2023) reports, citing e-Shram portal data, that over 94 percent of informal-sector workers enrolled on the platform earn less than ₹10,000 per month a figure that underscores both the economic vulnerability of this population and the correspondingly high stakes of ensuring that digital financial inclusion, where it exists on paper, functions in practice.

6.4 Composite Reading of the Evidence

Reading Sections 6.1 through 6.3 together, a consistent three-layer pattern emerges. At the national layer, formal financial access (account ownership, FI-Index Access sub-index) has reached near-saturation levels, while active usage though improving continues to trail access, as evidenced by the gap between India's 89 percent account-ownership rate and the 54 percent of account owners who actually use digital payments (World Bank, 2025). At the state layer, Madhya Pradesh sits among the states with the lowest per-capita UPI usage nationally, even as its own composite district financial-inclusion index shows wide internal variation, with urbanised districts leading and agrarian, peripheral divisions including Vindhya trailing. At the district layer, the Vindhya region's PMJDY average-balance figures are, perhaps surprisingly, not uniformly the weakest in the state; several Vindhya districts outperform other Madhya Pradesh districts on this single metric, even though the region as a whole does not appear among the state's leading districts on the composite AIGGPA index, and even though a substantial share of the region's informal workforce migrates outward for work in ways that district-level banking data cannot fully capture. The overall picture, in short, is one of adequate and in some respects comparatively strong formal banking access in the Vindhya region, combined with a usage and

behavioural gap that is consistent with and explicable through the theoretical and empirical literature on informal-worker technology adoption reviewed in Section 3.

7. Discussion of Findings

The evidence assembled in Section 6 supports three interlinked interpretive claims. The first is that financial inclusion in the Vindhya region, as in India more broadly, is currently access-led rather than usage-led. This mirrors precisely the theoretical distinction, drawn out in Section 3.2, between behavioural intention to adopt a technology and sustained use behaviour under UTAUT and its extensions. Bank accounts have been opened at scale under PMJDY; RuPay cards have been issued; Aadhaar seeding, which is a technical precondition for UPI functionality, has proceeded substantially across Madhya Pradesh's districts. Yet the Global Findex finding that only 54 percent of Indian account holders actively use digital payments, together with the qualitative evidence of DBT-driven rather than transaction-driven account balances in districts such as Singrauli, suggests that a comparable gap is likely to characterise the Vindhya region's informal workforce specifically, even if district-disaggregated UPI usage data do not yet exist to confirm this directly.

The second claim concerns the specific drivers of this gap as they apply to informal workers. The literature reviewed in Section 3.3 and 3.4 spanning Senegal, rural Africa, rural India, Malaysia, Ghana and South Africa converges on a consistent set of explanatory factors: facilitating conditions (network reliability, banking-correspondent and agent density), trust and perceived risk, digital and financial literacy, and socio-cultural norms around cash versus digital transacting. Several of these factors plausibly bind more tightly in the Vindhya region than in India's more urbanised states. Network connectivity in agrarian and forested tracts of Shahdol, Umaria and Anuppur is likely to be less consistent than in urban Madhya Pradesh; literacy rates in parts of the region remain below state averages (as Singrauli's 62.36 percent 2011 Census figure illustrates); and the region's substantial tribal and Scheduled Caste population may, consistent with the socio-cultural-factors literature (Journal of Information Systems Engineering and Management, 2025), exhibit adoption patterns shaped as much by community trust networks and local social norms as by the mere availability of digital-payment infrastructure.

The third claim concerns the specific vulnerability of migrant informal workers within the region's digital-inclusion picture. The qualitative evidence that workers from Rewa and other Vindhya-adjacent districts migrate substantially for construction and manual labour elsewhere in India (Free Press Journal, 2026) implies that a meaningful share of the population whose formal financial records sit within the Vindhya region may in practice transact, save and remit money across district and state lines in ways that district-of-registration banking statistics cannot capture. This is consistent with the Ghana study's finding (PMC, n.d.) that digital-payment adoption among informal actors does not automatically extend to deeper financial relationships such as credit access; for a migrant worker, a home-district bank account used chiefly to receive and periodically withdraw remittances is a materially different form of financial inclusion from an actively used transaction and savings instrument.

These findings should be read alongside a genuinely positive signal in the data: the Vindhya region's PMJDY average-balance performance relative to other Madhya Pradesh districts indicates that the foundational banking infrastructure the precondition for any subsequent digital-payment usage growth is not, on this metric, the region's binding constraint. This reframes the policy problem discussed in Section 8: the priority for the Vindhya region is less about further expanding basic account access, which appears reasonably advanced, and more about the usage-deepening interventions that the reviewed literature consistently identifies as necessary complements to infrastructure digital and financial literacy, trust-building, and facilitating conditions such as banking-correspondent density and reliable connectivity.

8. Practical Implications and Policy Recommendations

Drawing on the findings above and on the intervention, priorities identified across the reviewed literature, the paper offers the following practical and policy recommendations for banks, financial regulators, state and district administrations, and civil-society organisations operating in the Vindhya region:

- ❖ Shift monitoring metrics from account-opening counts to usage-depth indicators. District and block-level financial-inclusion monitoring in the Vindhya region should track active-transaction rates, digital-merchant-payment penetration among informal traders, and zero-balance-account trends, rather than relying primarily on cumulative account-opening figures, which the evidence shows can mask substantial dormancy.
- ❖ Invest in vernacular-language, low-bandwidth and voice-assisted UPI interfaces. Given the region's lower literacy rates and less consistent network connectivity relative to urban Madhya Pradesh, interface design that accommodates Hindi and regional-dialect voice prompts, and that functions reliably on low-bandwidth or intermittent connections

(including USSD-based UPI access, which does not require a smartphone or continuous internet connectivity), would directly address the facilitating-conditions barrier identified throughout the UTAUT-based literature.

- ❖ Deepen banking-correspondent (BC) and micro-ATM density in the Rewa and Shahdol divisions, with explicit targeting of blocks with high e-Shram registration density and known outward-migration patterns, so that families of migrant workers who may be the primary local users of a migrant's home-district account have reliable, low-friction access points.
- ❖ Integrate e-Shram registration with digital-payment onboarding and financial-literacy modules, so that the moment of e-Shram registration which already captures occupation, income and location data for the informal workforce becomes an opportunity for guided UPI activation, RuPay card linkage confirmation, and basic digital-safety training, rather than a purely administrative data-collection exercise.
- ❖ Design trust-building and community-anchored outreach, informed by the socio-cultural-factors literature, that works through existing community and self-help-group networks rather than relying solely on top-down bank or government messaging, given the documented importance of community trust and social influence in informal-worker technology adoption.
- ❖ Address the migrant-worker data gap directly, by exploring mechanisms potentially linked to e-Shram's Universal Account Number architecture for portable, destination-state-recognised digital-payment and financial-service access for Vindhya-origin migrant workers, so that financial inclusion travels with the worker rather than remaining tied to a home-district account that may see only intermittent use.

Collectively, these recommendations reflect the paper's central interpretive finding: that the Vindhya region's digital financial inclusion challenge is now predominantly a usage-and-behaviour challenge layered on top of a reasonably functional access infrastructure, rather than primarily an access challenge in itself.

9. Limitations of the Study and Directions for Future Research

This study is subject to several limitations that should be borne in mind when interpreting its findings and that point toward productive directions for future research. First and most fundamentally, the study relies entirely on secondary, officially published data; it does not include primary survey, interview or field-observation data collected directly from informal workers in the Vindhya region. As a result, while the paper can document patterns in formal banking-access and, indirectly, likely usage gaps, it cannot establish individual-level causal mechanisms for instance, the precise relative weight of trust, literacy and connectivity barriers for a given category of informal worker with the precision that a purpose-designed primary survey would allow.

Second, district-level digital-payment usage data (as distinct from account-access data) are not published by NPCI or the RBI for the Vindhya districts specifically; the study has therefore relied on the closest available proxy PMJDY average-balance and related banking statistics compiled by the SLBC Madhya Pradesh which measures banking-account status rather than digital-transaction activity directly. Future research that gains access to NPCI's district-wise transaction data, or that commissions primary transaction-diary or survey research among Vindhya-region informal workers, would substantially strengthen the evidentiary basis for the usage-gap claims advanced here.

Third, the paper's regional definition of "Vindhya region" as the Rewa and Shahdol revenue divisions, while consistent with common administrative usage, is not the only possible delineation; some historical and cultural definitions of the Vindhya region extend further, and future studies might usefully test whether findings are sensitive to alternative regional boundaries.

Fourth, the migrant-worker dimension of the region's informal workforce identified qualitatively in Section 6.3 as significant but not separately quantified in available official statistics represents a specific and important data gap. Future research combining e-Shram Universal Account Number data (which is, in principle, portable across states) with destination-state banking-usage data could offer a more complete picture of how digital financial inclusion functions for Vindhya-origin migrant workers specifically.

Finally, because several of the underlying data sources (notably NPCI's state-wise disaggregation and the World Bank's Global Findex 2025) are themselves recent releases, and because RBI FI-Index and PMJDY figures are updated periodically, some figures reported in this paper will be superseded by more recent releases within a relatively short time; researchers building on this work should verify the most current figures from the primary sources cited.

10. CONCLUSION

This paper set out to examine how the rapid national diffusion of digital payment systems in India has translated or has yet to translate into deepened financial inclusion for informal workers in the Vindhya region of Madhya Pradesh. Working entirely from official secondary data sources spanning the RBI's Financial Inclusion Index, the World Bank's Global Findex Database 2025, NPCI transaction statistics, SLBC Madhya Pradesh's district-wise PMJDY records, e-Shram registration data and PLFS employment estimates, the study finds a consistent pattern across national, state and district layers of analysis: formal financial access has expanded rapidly and, in the Vindhya region's case, has reached levels on at least one key metric (PMJDY average account balance) that are comparable to or better than several other Madhya Pradesh districts, while active, productive digital-payment usage continues to lag behind access, consistent with the broader Indian and international literature on informal-worker technology adoption.

This access-usage gap is not, on the evidence reviewed here, best explained by inadequate banking infrastructure in the Vindhya region. It is better explained by the behavioural and structural factors that the UTAUT-grounded literature on informal-sector digital-payment adoption identifies consistently across very different country contexts facilitating conditions such as connectivity and agent density, trust and perceived risk, digital and financial literacy, and socio-cultural norms around cash and digital transacting compounded, in the Vindhya region's specific case, by substantial outward labour migration that complicates any purely district-based reading of financial-inclusion statistics.

The practical implication is that policy and banking-sector attention in the Vindhya region, and in comparable semi-urban and rural regions of central India, should now shift decisively from account-opening targets where progress has been substantial toward usage-deepening interventions: vernacular and low-bandwidth digital interfaces, denser last-mile banking access points, trust-building through community networks, and closer integration between the e-Shram unorganised-worker database and digital-payment onboarding. Doing so would help ensure that the considerable public investment already made in extending formal financial access to the Vindhya region's informal workers translates into the tangible welfare gains savings capacity, credit access, transaction efficiency and resilience to income shocks that financial inclusion is ultimately intended to deliver. Future research that gains access to district-level digital-transaction data and that undertakes primary fieldwork among the region's informal workforce would substantially advance the evidence base this paper has sought to establish.

Declarations

Funding: The authors received no external funding for this study.

Conflict of Interest: The authors declare no conflict of interest.

Data Availability: All data used in this study were obtained from publicly available secondary sources cited in the article.

Ethical Approval: Not applicable, as the study did not involve human participants or primary data collection.

Author Contributions: All authors contributed to the study and approved the final manuscript.

Declaration on the Use of AI: AI-assisted tools were used solely for language editing and improving readability. The authors reviewed and approved the final manuscript and assume full responsibility for its content. No AI-generated images were used.

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