



Digitalization of pawnshop services and financial inclusion in Indonesia's underdeveloped, outermost, and remote regions: A systematic literature review

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ABSTRACT

Background: Nearly 98 million Indonesians lack formal financial access, with severe gaps in 3T regions (frontier, outermost, disadvantaged areas). Traditional banks cannot serve remote communities profitably. State-owned PT Pegadaian offers an alternative through collateral-based lending requiring no credit history, functioning as community financial infrastructure rather than purely commercial service. Digitalization initiatives mobile apps, agent networks, cloud infrastructure promise expanded reach, yet questions remain whether technology alone bridges access gaps or requires addressing infrastructure, literacy, and trust barriers. **Methods:** Systematic review following PRISMA 2020 guidelines analyzed 60 sources from Scopus AI searches (January 2026). Two complementary strategies identified 136 initial records; after removing 14 duplicates, 122 sources underwent systematic relevance screening using five-dimension scoring criteria. Sixty sources underwent thematic synthesis and bibliometric network analysis (VOSviewer 1.6.19). **Findings:** Three causal pathways emerged. The technology pathway shows digitalization contributes to broader fintech infrastructure, improving operational efficiency and service reliability. The economic pathway demonstrates digital access facilitates MSME credit acquisition and poverty reduction. The social pathway connects services to inclusion through literacy and trust, requiring complementary community-level interventions. Bibliometric analysis revealed six thematic clusters with Indonesia as central hub, but specific pawnshop mechanisms received limited scholarly attention confirming the research gap this review addresses. **Conclusion:** Pawnshop digitalization offers viable community service pathways but requires integrated approaches addressing infrastructure, literacy, product design, and governance simultaneously. State enterprises like Pegadaian are positioned to lead given public service mandates and extensive community networks. **Novelty/Originality of this article:** This is among the first systematic reviews examining pawnshop digitalization in Indonesia's 3T regions within an ESG integration framework. The dual methodology thematic synthesis and bibliometric analysis surfaces operational and socio-cultural barriers offering evidence-grounded guidance for policymakers and practitioners.

KEYWORDS: digital transformation; ESG framework; financial access; pawnshop services; 3T regions Indonesia.

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1. Introduction

Access to basic financial services remains out of reach for millions of Indonesians. While the country enjoys impressive economic growth and expanding digital infrastructure, these headline numbers conceal stark disparities. In remote and disadvantaged regions, roughly 98 million adults still operate outside the formal financial system (Bokenchin et al., 2025; Kadir et al., 2025; Wurarah et al., 2025). For these communities, everyday tasks like saving money safely or accessing emergency credit involve significant cost, risk, and inconvenience.

The Indonesian government has long positioned financial access as a cornerstone of poverty reduction, embedding it within both national development strategies and broader commitments to the UN Sustainable Development Goals, particularly those addressing inequality and economic empowerment (Dawood et al., 2019; Effendi et al., 2025; Yang & Gong, 2025). Yet closing this gap in practice has proven far more difficult than setting targets on paper. Conventional banking models are structurally ill-suited to serve remote and low-income populations branch operations in thinly populated areas rarely generate returns that justify the investment, while requirements such as formal documentation, credit history verification, and minimum balance thresholds systematically exclude informal workers and small entrepreneurs from the outset (Ratnawati et al., 2025; Setiawan et al., 2021). In this context, state-owned financial institutions that carry an explicit public service mandate rather than purely commercial objectives occupy a distinctive and underexplored role as community service delivery mechanisms for marginalized populations.

Pawnshops occupy a fundamentally different position in this landscape. Unlike conventional banks, pawnshops bypass credit scoring and income verification entirely, instead accepting tangible assets most commonly gold jewelry, motorcycles, or electronics as collateral. This single design choice transforms the accessibility equation - a household with no formal credit history, no payslip, and no fixed address can still obtain emergency funds within hours, simply by pledging something they already own (Wulandari & Kassim, 2015). For informal sector workers, micro-entrepreneurs, and households living on irregular income, this often represents not just a convenient option but the only realistic pathway into formal credit. Indonesia's cultural familiarity with gold as a household savings instrument makes this model particularly well-suited to the local context, a dynamic observed across several developing economies in Asia (Borres, 2020). Crucially, state-owned pawnshop operators like PT Pegadaian carry an institutional mandate that extends beyond profit they are expected to serve communities that commercial lenders have no incentive to reach. This public service dimension distinguishes pawnshop digitalization from generic fintech expansion and grounds it firmly within the discourse of community-based financial service delivery.

Digital technology now offers opportunities to scale these services beyond physical branches. Recent years have witnessed rapid growth in mobile banking, digital wallets, and fintech platforms across Indonesia (Chatterjee, 2024; Loreño, 2024; Setiawan et al., 2021). Digital payment adoption expanded particularly among millennials and urban populations, though rural penetration remains limited (Li & Deniswara, 2024; Muat et al., 2025). Digital financial services expanded dramatically, particularly following disruptions that accelerated adoption timelines (Sari & Sulistyaningrum, 2025; Siddika et al., 2023). For pawnshop services specifically, digitalization could address longstanding barriers, such as traveling long distances to branches, time-consuming manual processes, and social stigma around visiting pawnshops in small communities where privacy is limited (Purnama Sari & Haryono, 2025).

State-owned pawnshop operators have moved into digital territory through multiple channels. Initiatives include mobile applications for gold savings and online pawning services, home-based pawn services, and extensive digital agent networks extending into remote villages (Timur et al., 2024). These digital platforms enable users to initiate transactions, receive preliminary loan offers, and schedule agent visits without traveling to physical branches. The model shows particular promise for reaching younger populations

who demonstrate greater comfort with digital interfaces and trust in technology-mediated financial services (Kirana & Havidz, 2020; Purnama Sari & Haryono, 2025).

Yet technology alone cannot solve the access problem. Infrastructure gaps persist in remote areas spotty mobile coverage, expensive data plans, unreliable electricity (Bokenchin et al., 2025; Utomo et al., 2025). Digital and financial literacy remains low, particularly in rural communities where educational opportunities have been limited (Musnadi & Agustina, 2025; Setiansah et al., 2024; Tandilino et al., 2025). Research consistently shows digital financial literacy serves as critical mediator between technology availability and actual usage, with effects on both individual access and broader MSME performance (Choiruddin et al., 2025; Ratnawati et al., 2025; Tandilino et al., 2025). Cultural factors matter too, including deep-rooted cash preferences, community-based lending traditions, and institutional distrust from historical experiences shape adoption patterns (Setiawan et al., 2021). Simply deploying technology without addressing these realities risks creating new exclusion forms rather than expanding access.

Environmental, Social, and Governance considerations add another dimension. Regulatory emphasis on ESG reporting has increased substantially, with growing recognition that financial service digitalization must integrate sustainability principles (Gutu et al., 2025; Roy & Vasa, 2025; Sundharesalingam et al., 2025). For pawnshop services serving vulnerable populations, ESG frameworks ensure technology serves development goals through environmental sustainability through reduced operational footprint, social equity through targeted access for marginalized groups, and robust governance ensuring transparency and accountability (Rokhlinasari et al., 2025). Without this framework, digitalization could prioritize efficiency over equity or profit over social mission.

Literature synthesis reveals pawnshop digitalization impacts development through multiple pathways (Figure 1). Three primary channels emerge from conceptual analysis. The technology pathway shows digitalization stimulates broader infrastructure development, enabling digital finance tools and payment systems that benefit users beyond direct pawnshop customers. The economic pathway demonstrates how improved access facilitates MSME capital acquisition, driving growth and economic participation (Choiruddin et al., 2025; Ratnawati, 2020). The social pathway connects digitalization to financial inclusion, contributing to income inequality reduction and economic resilience (Becha et al., 2025; Kadir et al., 2025). This multi-pathway framework positions pawnshop digitalization as catalyst for inclusive development rather than isolated service upgrade.

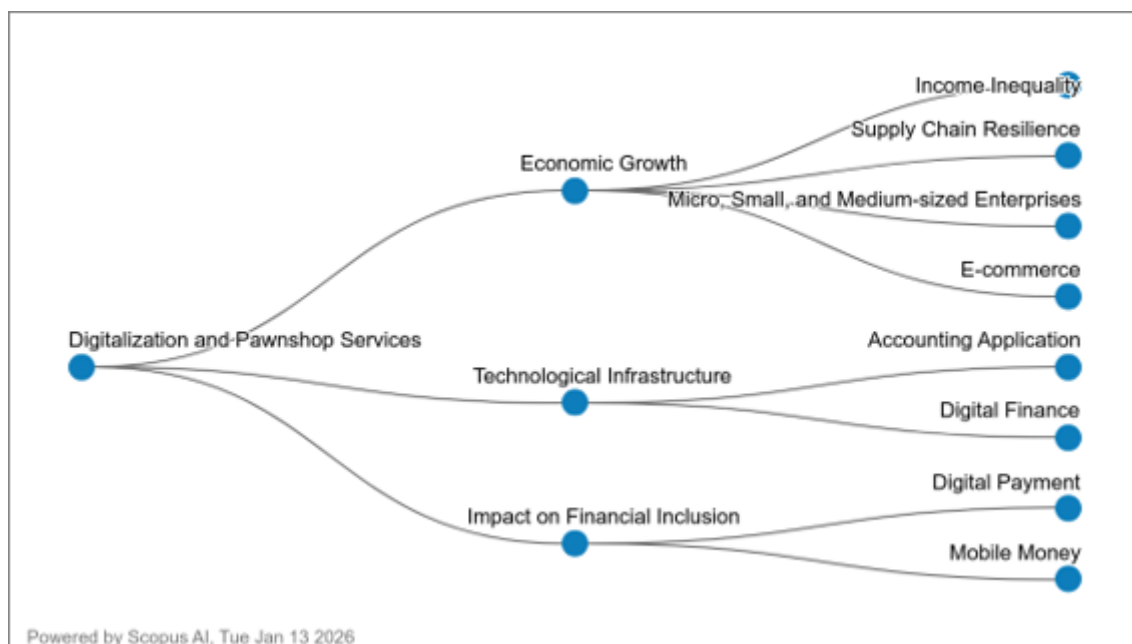


Fig. 1. Conceptual framework of pawnshop digitalization impact pathways

Existing research reveals important gaps. While microfinance and banking digitalization receive substantial attention, pawnshop services remain comparatively understudied despite their practical importance in many developing country contexts (Borres, 2020; Wulandari & Kassim, 2015). Most literature focuses on urban or peri-urban contexts rather than extreme remote areas where access challenges are most acute. The intersection of digital finance with ESG frameworks is emerging but not yet well-established, particularly for state-owned enterprises balancing commercial sustainability with social mandates (Gutu et al., 2025; Roy & Vasa, 2025). The pandemic's acceleration of digital adoption creates urgency for understanding which strategies produce sustainable, equitable outcomes rather than temporary technological fixes.

Despite its practical importance, pawnshop digitalization as a mechanism for reaching remote and disadvantaged communities remains surprisingly understudied. The bulk of existing literature on digital financial services concentrates on urban or peri-urban settings, on consumer-facing fintech applications, or on banking sector transformation contexts where infrastructure is reasonably reliable and users are already partially integrated into formal financial systems (Borres, 2020; Wulandari & Kassim, 2015). Studies that do examine financial inclusion in Indonesia's 3T regions tend to treat it as an outcome variable rather than investigating the specific service delivery models capable of producing that outcome. The result is a literature that is rich on what financial inclusion should achieve, but relatively sparse on how collateral-based, state-operated services can be redesigned digitally to function in environments defined by poor connectivity, low literacy, and deep institutional distrust. This gap is precisely what the present review sets out to address.

This systematic review addresses three questions. How does pawnshop digitalization affect financial access in Indonesia's remote and disadvantaged regions? What factors enable or constrain adoption of digital pawnshop services among marginalized populations? How can ESG frameworks guide digital strategies toward sustainable and equitable outcomes? By synthesizing peer-reviewed literature, policy analyses, and empirical studies from 2015-2026, we provide evidence-based guidance for policymakers designing inclusive finance initiatives and practitioners implementing digitalization in challenging contexts. The novelty lies in our specific focus on the convergence of pawnshop digitalization, remote regional contexts, and ESG considerations a nexus receiving limited scholarly attention despite its importance for inclusive development agendas.

2. Methods

2.1 Search strategy

We searched for relevant publications from January 2018 through December 2025 using Scopus AI (Elsevier) in January 2026. This seven-year window captures pre-pandemic baseline conditions and post-pandemic digital acceleration. The timeframe allows examining how COVID-19 affected digitalization trajectories while including sufficient foundational literature. Two complementary search strategies ensured comprehensive coverage. Search 1 employed keyword-based approach, combining terms related to financial inclusion, digital transformation, pawnshop services, and Indonesian context using Boolean operators. This strategy yielded 71 potentially relevant sources. Search 2 used title-focused approach, targeting publications explicitly addressing pawnshop digitalization and financial inclusion in developing countries. This yielded 65 sources. The dual strategy balanced breadth (keyword search capturing adjacent topics) with precision (title search ensuring direct relevance). Search terms were organized around four conceptual clusters. The first cluster addressed financial access using terms such as "financial inclusion," "financial access," "unbanked populations," and "microfinance." The second covered digital transformation through terms including "digitalization," "digital transformation," "fintech," "mobile banking," and "digital financial services." The third targeted pawnshop services specifically, using "pawnshop," "pegadaian," "collateral-based lending," and "gold banking." The fourth applied geographic focus through "3T regions," "remote areas," "rural

Indonesia," "frontier regions," and "disadvantaged areas," with Indonesian-language equivalents included where appropriate (e.g., "daerah tertinggal," "wilayah terpencil"). The full Boolean string used for Search 1 was constructed in the following manner. ("financial inclusion" OR "financial access" OR "unbanked" OR "microfinance") AND ("digitalization" OR "digital transformation" OR "fintech" OR "mobile banking") AND ("pawnshop" OR "pegadaian" OR "collateral lending") AND ("Indonesia" OR "3T regions" OR "remote areas" OR "rural" OR "developing countries"). Search 2 applied a title-focused variant, shown below. TITLE ("pawnshop" OR "pegadaian") AND TITLE ("digital" OR "fintech" OR "financial inclusion") AND ("Indonesia" OR "developing" OR "remote"). This dual-string approach was designed intentionally, as the broader keyword search captured adjacent and conceptually related literature, while the title-focused search ensured direct topical relevance was not diluted by tangential sources.

Scopus AI (Elsevier) was selected as the primary search platform due to its broad coverage of peer-reviewed literature in social sciences, economics, and information systems, as well as its AI-assisted relevance filtering capability which is particularly useful when navigating interdisciplinary topics. We acknowledge, however, that relying on a single database introduces the possibility of missing relevant sources indexed exclusively in Web of Science, Google Scholar, or regional repositories. To partially address this limitation, a supplementary verification search was conducted in Google Scholar using the same core terms, confirming that the most frequently cited works in the field were already captured in the Scopus results. Future systematic reviews on this topic are encouraged to adopt a multi-database approach for more exhaustive coverage.

2.2 Selection criteria

We included sources meeting the following criteria - published 2018-2025, focused on financial access or digital services or pawnshop operations or ESG frameworks, relevant to Indonesia or comparable developing countries or remote regions, available in English or Indonesian, employing empirical methods or providing substantial analytical frameworks. We excluded sources that focused solely on developed countries without transferable insights, addressed unrelated financial topics like investment banking, lacked methodological detail, or consisted only of opinion pieces without evidence.

2.3 Study selection process

Combined searches identified 136 records 71 from the keyword-based search and 65 from the title-focused search. After removing 14 duplicates, two reviewers independently screened the remaining 122 titles and abstracts using the structured scoring criteria described above. Each reviewer completed their assessment without prior discussion to ensure independence. Disagreements were subsequently resolved through deliberation, with consensus reached on all contested sources. To assess the consistency of the independent screening process, inter-rater reliability was calculated using Cohen's Kappa coefficient. The resulting value of $\kappa = 0.78$ indicates substantial agreement between reviewers (Landis & Koch, 1977), providing reasonable confidence in the reproducibility of the selection process. Each source received a systematic relevance score across five dimensions, with weights assigned a priori before screening commenced and validated through team discussion. The highest weight was assigned to explicit mention of pawnshop or microfinance services (weight = 20), reflecting the core subject matter of this review sources without this focus could not meaningfully contribute to its central questions regardless of their broader quality. The second highest weight was given to Indonesian context with a 3T regional focus (weight = 15), recognizing that the geographic specificity of this review is its primary distinguishing feature from general financial inclusion literature. Digital transformation themes received a weight of 12, as they represent the operational mechanism under examination rather than the outcome of interest. MSME orientation (weight = 8) and ESG frameworks (weight = 8) were assigned equal lower

weights because, while both are analytically relevant, they function as complementary lenses rather than core eligibility criteria. Additional points were awarded for publication recency (2023–2025) and confirmed DOI as a quality indicator. Sources scoring below the relevance threshold of 25 were excluded. Figure 2 shows the PRISMA flow diagram detailing selection process.

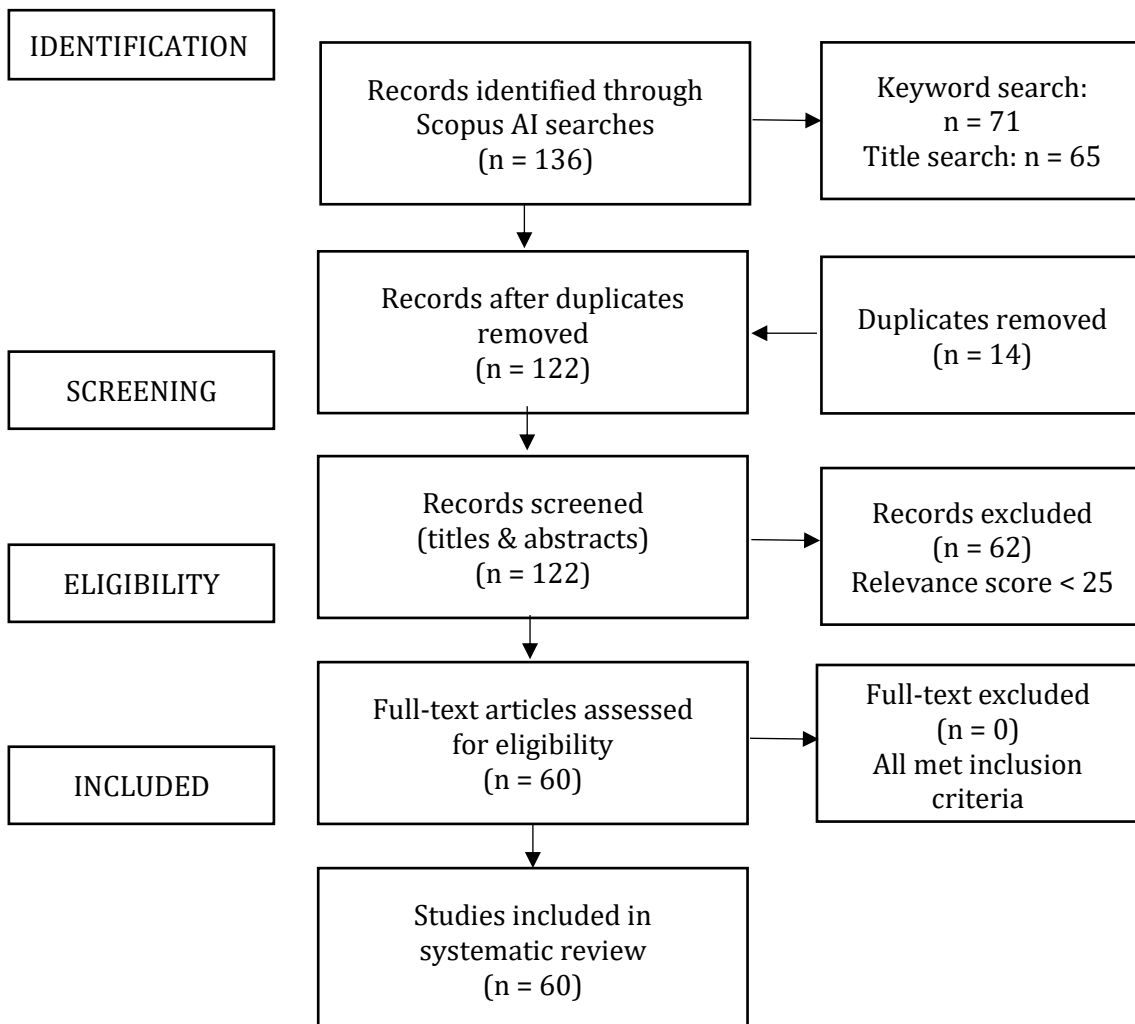


Fig. 2. PRISMA 2020 flow diagram

2.4 Data analysis

A structured matrix captured key information from each source, including publication details, methodology, findings related to financial access impacts, digital strategies, barriers and enablers, ESG considerations, and policy implications. We assessed quality using adapted Mixed Methods Appraisal Tool criteria for empirical studies. Given study heterogeneity, we used narrative synthesis with thematic analysis rather than meta-analysis. Codes were generated both deductively (from research questions) and inductively (from close reading). Four primary themes emerged, namely the current state of financial access in 3T regions, digital transformation trajectories, socio-technical adoption factors, and ESG frameworks. We complemented thematic analysis with bibliometric network analysis using VOSviewer 1.6.19 (Van Eck & Waltman, 2010). The 60 selected sources were exported in RIS format from Scopus and imported into VOSviewer. We performed co-occurrence analysis on author keywords with minimum threshold of 2 occurrences, generating network visualization showing thematic clusters. The analysis employed Fruchterman-Reingold force-directed layout algorithm (Fruchterman & Reingold, 1991), for node positioning and modularity-based community detection for cluster identification.

Network visualization revealed six thematic clusters, with node size representing keyword frequency and edge thickness indicating co-occurrence strength. We generated three views - network visualization showing cluster structure (Figure 3), overlay visualization using average publication year to show temporal trends, and density visualization identifying research maturity and gaps. This dual analytical approach thematic synthesis for conceptual depth and bibliometric analysis for empirical mapping provides comprehensive understanding of research landscape.

Additionally, we analyzed Scopus AI-generated conceptual framework from the 65 title-based search sources. This framework maps causal relationships between pawnshop digitalization and development outcomes, revealing three primary impact pathways - technology channel (infrastructure and fintech tools), economic channel (MSME growth and e-commerce), and social channel (financial inclusion and inequality reduction). The framework positions pawnshop digitalization as catalyst rather than endpoint, demonstrating multiplier effects across domains (Figure 1).

3. Results and Discussion

3.1 Thematic structure of literature

Analysis of 60 sources revealed four primary themes addressing different dimensions of pawnshop digitalization and financial inclusion. Table 1 summarizes these themes, key findings, and source distribution. The themes demonstrate comprehensive coverage across technical, social, economic, and governance domains, though not evenly distributed digital transformation received most attention (22 sources) while ESG frameworks received least (12 sources), suggesting emerging rather than mature research area.

Table 1. Thematic analysis summary

Theme	Key findings	Number of sources	Methodology
Financial Barriers	Geographic isolation, economic constraints, socio-cultural factors, institutional failures	18	Empirical (quantitative & qualitative), Conceptual
Digital Transformation	Mobile platforms, agent networks, cloud infrastructure, operational efficiency gains	22	Empirical (quantitative), Policy-based, Conceptual
Adoption Factors	Infrastructure gaps, literacy barriers, cultural preferences, institutional support needs	15	Empirical (qualitative), Conceptual
ESG Frameworks	Environmental sustainability, social equity, governance accountability, regulatory compliance	12	Conceptual, Policy-based

Note: Some sources contributed to multiple themes; total exceeds 60 due to overlap. Methodology classification reflects the dominant research approach among sources contributing to each theme.

Bibliometric network analysis using VOSviewer identified six distinct thematic clusters within the literature (Figure 3). Indonesia emerged as the central hub with largest node size, indicating substantial research attention to Indonesian context for financial inclusion and digital transformation. This centrality validates our geographic focus and confirms relevance of systematic synthesis for this region. Similar bibliometric approaches have proven effective for mapping research landscapes in financial inclusion and fintech domains (Carè et al., 2025; Gutu et al., 2025).

The two largest clusters in the network converge on financial inclusion (orange, center) and technology adoption (orange-pink, right), with strong co-occurrence patterns between

them. This pairing is intellectually coherent researchers studying financial inclusion almost invariably treat technology as an enabling mechanism, while those examining technology adoption frequently use financial access as their primary outcome measure. What is more analytically interesting, however, is the temporal dimension. The overlay visualization, which maps average publication year onto the network, shows that more recent studies (2022–2025) cluster progressively toward the right of the map. This suggests a discernible shift in research focus away from the foundational question of whether technology can improve financial inclusion, and toward the more operationally demanding question of how it works under specific conditions and for specific populations.

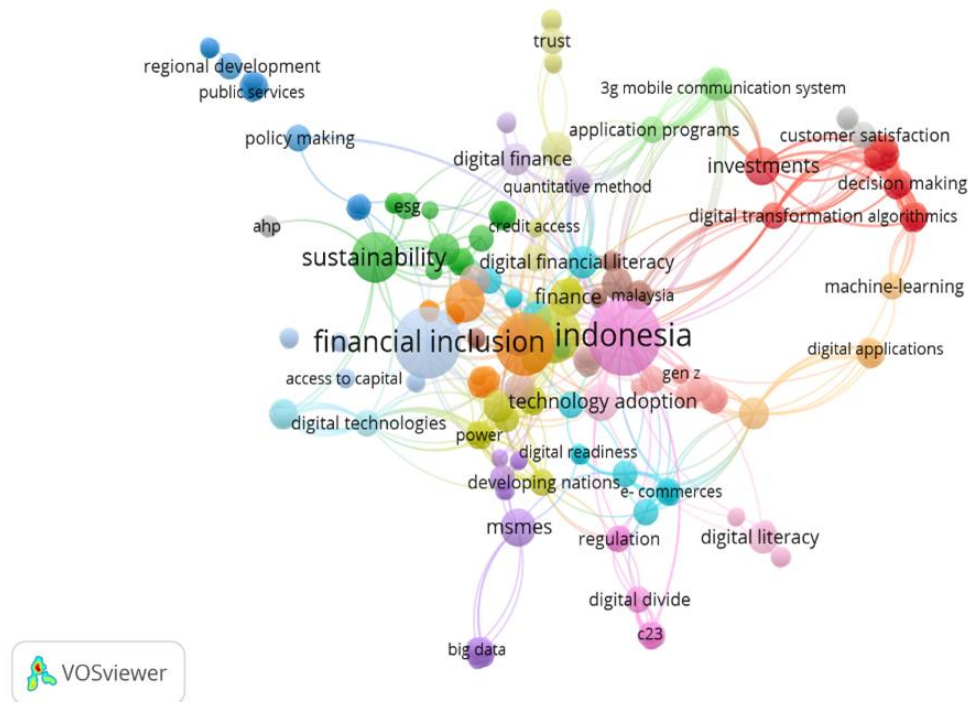


Fig. 3. Bibliometric network visualization of thematic clusters

The sustainability and ESG cluster (green, left) forms a distinct but connected grouping, linked to the central clusters through several bridge nodes, most notably digital financial literacy. The relative separation of this cluster from the core suggests that ESG considerations in financial services are still treated in the literature as an added layer rather than a foundational design principle. The average publication year of sources in this cluster is more recent than in the financial inclusion cluster, indicating an emerging rather than mature area of scholarship a gap that this review explicitly seeks to help fill.

Among all nodes in the network, digital financial literacy occupies the most strategically significant position appearing at the intersection of multiple clusters and serving as a conceptual bridge connecting financial inclusion, sustainability, and technology adoption. This positioning is not coincidental. In practice, digital literacy is frequently the variable that determines whether a financial technology is genuinely used or merely available. Ratnawati et. al (2025) found that improvements in digital financial literacy directly affect firm performance in Indonesia, even after controlling for infrastructure access variables. Tandilino et al. (2025) extended this finding by demonstrating that digital literacy mediates the relationship between government support programs and MSME performance outcomes meaning that well-intentioned government interventions that bypass literacy development tend to fall short of their intended impact. Choiruddin et al. (2025) and Mutamimah and Indriastuti (2023) further show that these literacy effects hold across contexts, applying to both individual users and small business operators alike. The implication for pawnshop digitalization in Indonesia's 3T regions is direct and consequential - investing in technology platforms without a parallel investment in user

literacy is, at best, half a solution and at worst, a mechanism for creating new forms of exclusion among the very populations the intervention was designed to serve.

MSMEs formed distinct cluster (purple, bottom) linked to digital readiness, regulation, and developing nations context. This separation suggests MSMEs face unique challenges requiring tailored interventions beyond general financial inclusion strategies. Small enterprises cannot simply adopt consumer-oriented digital financial tools; they need business-specific features like inventory tracking, receivables management, and supplier payments (Rokhlinasari et al., 2025; Widyastuti et al., 2023). Perhaps the most telling finding from the bibliometric analysis is not what appeared in the network, but what did not. Terms such as "pawnshop," "collateral lending," "agent networks," and "3T regions" were absent as distinct nodes, despite being central to the practical problem this review examines. This absence is not a minor technical gap in the visualization it reflects a genuine blind spot in the academic literature. Scholars appear more comfortable engaging with financial inclusion as a broad conceptual framework than with the specific operational models that communities on the ground actually rely on.

In the Indonesian context, the absence of "pegadaian" as a node is particularly striking. PT Pegadaian is one of the country's oldest and most widely distributed financial institutions, with over 4,000 outlets reaching areas that have never hosted a bank branch. Wulandari and Kassim (2015) demonstrated that customer satisfaction among low-income pawnshop users is strongly shaped by trust and ease of access two dimensions where pawnshops hold a genuine comparative advantage over formal banking. Borres (2020), drawing on the Philippine pawnshop industry, found that collateral-based lending models show remarkable resilience during economic uncertainty precisely because they do not depend on assumptions about borrower creditworthiness. Both observations translate directly to Indonesia's 3T context, where the majority of residents have no formal credit history to speak of.

Timur et al. (2024) bring a more contemporary lens to this discussion, using machine learning-based sentiment analysis to examine public perceptions of digital sharia pawnshop services in Indonesia. Their findings reveal a generally positive orientation toward digitalization in principle, but persistent concerns about data security and process complexity continue to surface as consistent barriers. This tells us something important—the challenge of digitalizing pawnshop services cannot be resolved simply by deploying an application. Trust must be actively constructed, and that requires an approach far more contextually grounded than a standard technology rollout. The present review was designed with precisely this gap in mind to examine systematically how pawnshop-specific mechanisms can be reimagined digitally to serve populations that remain furthest from the center of formal financial services.

3.2 Causal pathways of digitalization impact

Conceptual framework analysis revealed three primary pathways through which pawnshop digitalization shapes development outcomes (Figure 1). Before examining each pathway individually, it is worth stepping back to consider what kind of intervention pawnshop digitalization actually represents. Unlike private fintech companies whose primary obligation is to shareholders, state-owned pawnshop operators like PT Pegadaian carry an institutional mandate that is fundamentally about community service reaching populations that markets alone will not serve, delivering financial access in ways that protect rather than exploit vulnerable users, and doing so with enough consistency and transparency to build lasting trust. Digitalization, in this framing, is not an end in itself but a tool for extending and deepening that public service function. Understanding the three pathways below through this lens helps explain not only why technology-only interventions so often fall short, but also why the institutional character of the provider matters as much as the technology it deploys.

3.2.1 Technology pathway

Digitalization of pawnshop services stimulates broader technological infrastructure development beyond direct users. When pawnshops invest in digital platforms, they contribute to fintech ecosystem maturation developing payment rails, authentication systems, and data infrastructure that other financial service providers can leverage. This creates positive externalities justifying public support even when immediate commercial returns appear limited. Evidence shows digital finance expansion correlates with broader technological capability building in developing regions (Bokenchin et al., 2025; Nanda et al., 2026). The technology pathway operates through several mechanisms. Digital pawnshop platforms require reliable payment processing, necessitating partnerships with payment service providers and telecommunications companies. These partnerships drive infrastructure improvements in underserved areas. Agent networks need connectivity, creating demand that justifies telecommunications investment. Mobile money adoption for pawnshop transactions familiarizes users with digital finance more broadly, reducing barriers to other fintech services. Technical standards developed for pawnshop digitalization become available for other applications.

3.2.2 Economic pathway

Improved access to pawnshop services through digitalization facilitates MSME capital acquisition, stimulating economic growth and e-commerce participation. This pathway demonstrates financial inclusion's multiplier effects through entrepreneurship. Evidence from Indonesia shows digitalization accelerated credit access post-2020, particularly for household and micro-enterprise borrowing (Palaon et al., 2020; Sari & Sulistyaningrum, 2025). Digital access removes travel costs and time constraints that previously prevented many micro-entrepreneurs from using pawnshop services for working capital. Digital financial access demonstrates measurable poverty reduction effects in developing country contexts. Evidence from Indonesia shows financial inclusion significantly reduces household poverty incidence, with effects amplified when combined with digital literacy and mobile payment adoption (Dawood et al., 2019; Effendi et al., 2025; Kadir et al., 2025).

The economic effects cascade through interconnected mechanisms. Easier credit access enables MSMEs to purchase inventory during favorable pricing periods, improving margins. Capital availability allows equipment investments increasing productivity. Working capital reduces stockouts preventing lost sales. Credit during cash flow gaps prevents business closures during slow periods. As MSMEs strengthen, they generate employment, increase tax revenues, and contribute to supply chain resilience. Research demonstrates these effects are particularly strong when financial access combines with digital literacy and business training (Choiruddin et al., 2025; Edward et al., 2025; Rokhlinasari et al., 2025).

3.2.3 Social pathway

Digital pawnshop services enhance financial inclusion, contributing to income inequality reduction and economic resilience. This pathway connects micro-level access to macro-level equity outcomes. Financial inclusion literature consistently shows access to formal credit improves household resilience to shocks, enables consumption smoothing, and supports human capital investment in education and health (Becha et al., 2025; Kadir et al., 2025). Pawnshops uniquely serve populations excluded from conventional credit due to lacking credit histories or regular income documentation. The social pathway is not, however, without its risks and the literature is candid about this. When credit expands faster than consumer protection frameworks can keep pace, over-indebtedness becomes a genuine danger rather than a theoretical concern. Purnamasari and Anggraini (2025) found that digital lending channels, including paylater services and digital microfinance, are associated with heightened financial vulnerability among MSME operators in South Sumatra when not accompanied by adequate literacy support. Wulandari and Kassim

(2015) observed that the informal relationship-based screening traditionally provided by branch staff where a loan officer develops intuitive knowledge of a borrower's circumstances over time is difficult to replicate in digital environments. When that human layer disappears, the safeguard it provided disappears with it. These findings do not argue against digitalization, but they do argue strongly for embedding consumer protection and financial education directly into the design of digital pawnshop services, rather than treating them as optional add-ons to be addressed later.

The multi-pathway framework explains why single-dimensional interventions often fail. Technology infrastructure without digital literacy limits financial inclusion impact (literacy barrier blocks social pathway). MSME access to capital without e-commerce platforms constrains growth potential (economic pathway incomplete). Digitalization without ESG frameworks risks prioritizing efficiency over equity (social pathway undermined). Understanding these interdependencies guides integrated policy approaches addressing technology, literacy, and institutional dimensions simultaneously.

3.3 Digital transformation strategies and evidence

3.3.1 Mobile platform strategies

Digital platforms enable end-to-end services from loan application through disbursement and repayment. Research on Indonesian millennials' intentions to use digital pawnshop platforms reveals trust, perceived security, and ease of use as critical factors influencing adoption (Kirana & Havidz, 2020; Purnama Sari & Haryono, 2025). User experience factors trust, perceived security, ease of use critically determine adoption intentions, particularly among younger populations adopting digital financial services. Technical performance matters significantly errors, failures, and slow response times undermine trust and retention, especially among users new to digital financial services. However, digital platforms can create technostress anxiety and strain from technology use particularly when systems experience frequent errors or require excessive cognitive effort. Managing technostress becomes critical for sustained adoption (Basrul et al., 2025). Platform design must accommodate low digital literacy through intuitive interfaces, clear instructions, and accessible customer support.

Across the reviewed literature, several platform characteristics recur as meaningful predictors of adoption success in low-resource settings. Kirana and Havidz (2020) identified perceived ease of use and trust as the strongest determinants of digital pawnshop adoption intentions among Indonesian millennials, suggesting that interface simplicity is not merely a design preference but a functional prerequisite for inclusion. Basrul et al. (2025) introduced the concept of technostress the anxiety and cognitive strain that users experience when digital systems are confusing, unreliable, or demanding as an underappreciated barrier to sustained adoption, particularly among first-time users of digital financial services. Setiawan et al. (2021) further noted that user innovativeness moderates fintech adoption in Indonesia, meaning that platforms designed only for early adopters risk permanently excluding more cautious or less digitally confident users. Taken together, these findings suggest that platform design in the 3T context needs to be evaluated not against the standards of urban digital banking, but against the actual capabilities and comfort levels of the target population.

Security considerations take heightened importance for vulnerable populations with limited digital experience. Platform designers must balance security with usability overly complex authentication frustrates users, while inadequate security exposes them to fraud. Biometric authentication using fingerprints or facial recognition offers promising middle ground, though implementation requires careful consideration of device availability and user acceptance. Two-factor authentication provides additional security layers but must be implemented thoughtfully to avoid creating barriers for users with limited technical skills. Education about digital security risks and safe practices proves as important as technical security features themselves. Users need practical guidance on password management,

recognizing phishing attempts, and protecting personal information. Research shows security awareness training significantly reduces fraud victimization among new digital finance users, particularly when training uses culturally appropriate methods and local language delivery (Basrul et al., 2025; Setiawan et al., 2021).

Platform accessibility features warrant equal attention. Visual impairments, low literacy, and aging populations require specific design considerations. Voice-based interfaces, screen readers, adjustable text sizes, and simplified navigation benefit not just users with disabilities but all users facing complexity. Universal design principles creating accessible platforms for everyone prove more effective than retrofitting accessibility later. Evidence from other digital service domains demonstrates inclusive design improves user experience across all population segments while ensuring marginalized groups are not systematically excluded from digital transformation benefits.

3.3.2 Agent network models

Recognizing full digitalization remains inaccessible for many target users, agent-based delivery combines digital efficiency with human assistance. Agents typically shop owners or community figures receive tablets, card readers, and training to provide pawnshop services where branches don't exist. This model addresses literacy barriers through agent assistance while maintaining personal relationships facilitating trust. Evidence from other financial services shows agent networks effectively extend reach in remote areas when agents receive adequate compensation, comprehensive training, ongoing support, and community integration (Nurfaizal et al., 2025; Setiawan et al., 2021).

However, agent networks face sustainability challenges. Commission structures must balance agent income with service affordability for users. Agent retention requires reliable technical support and timely issue resolution. Liquidity management becomes complex agents need sufficient cash for disbursements without excessive idle capital. Quality control across distributed networks challenges consistency. Fraud risks require robust monitoring systems. Despite these challenges, agent models show promise for contexts where pure digital approaches face insurmountable barriers.

Geographic and demographic factors shape agent network effectiveness differently across contexts. Urban agents serve higher transaction volumes but face more competition and higher operating costs. Rural agents serve smaller populations but often achieve stronger community integration and trust. Women agents demonstrate particular effectiveness reaching women users who may feel more comfortable conducting financial transactions with female providers, especially in conservative communities where gender segregation norms persist. Youth agents connect well with younger users comfortable with technology but may lack credibility with older populations preferring experienced service providers. Multi-generational agent teams combining youth technology skills with elder community trust offer promising hybrid approaches.

The sustainability of agent networks over time is a concern that the literature addresses with some consistency. Setiawan et al. (2021) and Nurfaizal et al. (2025) both point to the fragility of agent-based delivery models when the supporting infrastructure technical, financial, and institutional is not maintained with the same intentionality as the initial deployment. Agents who experience repeated system failures, delayed commission payments, or inadequate training tend to disengage, and when they do, the communities they served lose their only point of access to formal financial services. This pattern is not unique to Indonesia; evidence from comparable agent banking models in Sub-Saharan Africa and South Asia shows that last-mile financial service delivery consistently requires active management rather than a set-and-forget approach. For state enterprises with public service mandates, this has a direct implication - the investment calculation for agent networks should not be evaluated purely on transaction volume or short-term cost recovery, but on the longer-term social return of maintaining reliable access in communities with no viable alternative.

3.3.3 Infrastructure and technical architecture

Backend digital infrastructure enables customer-facing innovations. Cloud-based systems provide scalability and reliability critical for trust-building. Open API architectures facilitate ecosystem connections with e-commerce platforms, digital wallets, and government systems. Automated operations reduce processing times and errors. Evidence suggests modern technical architectures substantially improve operational efficiency, though precise gains depend on implementation quality and organizational readiness (Bokenchin et al., 2025).

Infrastructure investments extend beyond internal systems. Telecommunications partnerships improve connectivity in service areas. Payment system integrations enable flexible disbursement and repayment options. Digital identity systems reduce documentation burdens while maintaining security. Data analytics improve risk assessment and customer service. Cybersecurity protections build confidence among populations justifiably concerned about digital fraud. These infrastructure elements work together; weakness in any component constrains overall effectiveness.

3.4 Barriers and enablers of adoption

3.4.1 Infrastructure constraints

Physical and digital infrastructure deficits constitute foundational barriers. Remote areas face intermittent mobile coverage, expensive data, unreliable electricity, and poor road connectivity creating compounding barriers to service delivery (Bokenchin et al., 2025; Hermanto et al., 2025; Utomo et al., 2025). These gaps affect both service delivery and user access. Infrastructure investment concentrates where commercial returns are highest, neglecting precisely those areas where public intervention could yield greatest social returns. Government programs aim to accelerate deployment, but progress lags need. Infrastructure challenges manifest differently across contexts. Island regions require maritime transport infrastructure and floating service models addressing unique geographic constraints (Hamzah & Caroles, 2025). Remote highland areas need telecommunications infrastructure deployment overcoming difficult terrain (Sutrisno et al., 2025). These context-specific challenges require tailored infrastructure solutions rather than one-size-fits-all approaches.

3.4.2 Regional variation in barrier severity

Barrier configurations vary substantially across Indonesia's diverse geography, requiring regionally-tailored intervention strategies. Java and Bali, with relatively developed infrastructure and high population density, face primarily demand-side barriers: digital literacy gaps, cultural preferences, and trust deficits rather than infrastructure absence. Interventions here should emphasize education, user experience optimization, and culturally-appropriate service design. Infrastructure exists; ensuring populations use it effectively takes priority. Eastern Indonesia presents contrasting challenges. Provinces like Papua, Maluku, and Nusa Tenggara face severe infrastructure deficits alongside demand-side barriers. Intermittent electricity, limited telecommunications coverage, poor road networks, and geographic fragmentation create compounding access barriers. Infrastructure investment must precede or accompany service deployment; launching digital services without reliable connectivity guarantees failure. Hybrid models combining periodic physical presence with digital channels between visits offer more realistic approaches than pure digital strategies.

Island communities require specialized solutions. Floating bank units visiting islands on regular schedules combine physical service delivery with digital capability building. Satellite internet connectivity, though expensive, may prove more viable than terrestrial infrastructure for small, scattered island populations. Solar power systems address

electricity gaps while demonstrating environmental sustainability. Maritime transport challenges demand flexible service models accommodating weather disruptions and seasonal access variations. Evidence from floating financial services demonstrates feasibility when designed around maritime realities rather than terrestrial assumptions (Hermanto et al., 2025). Infrastructure challenges create cascading effects. Intermittent connectivity causes transaction failures undermining trust. Expensive data limits service usage among price-sensitive populations. Unreliable electricity makes device charging difficult. Poor roads increase agent costs and travel times. Infrastructure interventions require coordinated action across telecommunications policy, energy policy, and transportation planning. Piecemeal approaches addressing one constraint while others remain create bottlenecks limiting overall effectiveness.

3.4.3 Literacy and capability gaps

Both digital and financial literacy significantly impede adoption and appropriate usage. Low literacy levels mean users struggle to understand product features, terms, interest calculations, and fees presented through digital interfaces. They fall victim to fraud lacking security awareness. They over-borrow or misuse products without adequate understanding of consequences. Research consistently identifies literacy as critical mediating variable between technology availability and successful outcomes (Choiruddin et al., 2025; Musnadi & Agustina, 2025; Ratnawati et al., 2025; Tandilino et al., 2025). Gender gaps in digital literacy prove particularly persistent, with women facing lower technology access, less autonomous decision-making, and fewer learning opportunities despite constituting majority of pawnshop users in many contexts (Setiansah et al., 2024). MSME owners require not just consumer financial literacy but business-specific capabilities understanding working capital management, inventory control, and cash flow planning alongside technical platform operation (Mutamimah & Indriastuti, 2023; Nurfaizal et al., 2025).

Effective literacy interventions share certain characteristics. They target specific skills relevant to target services rather than abstract general knowledge. They use trusted local institutions for delivery. They employ adult learning principles accommodating limited formal education. They combine classroom and experiential learning. They address both financial concepts and technical operation. They provide ongoing support rather than one-time training. They use culturally appropriate methods and languages. Without such interventions, digital service deployment may increase rather than decrease exclusion.

3.4.4 Cultural and social factors

Deep-rooted preferences and social structures shape financial behavior in ways technical solutions alone cannot address. Cash preferences reflect tangibility, universality, and anonymity digital money lacks. Traditional institutions like rotating savings groups provide financial services embedded in social relationships and reciprocity norms that formal services struggle to replicate. Religious considerations affect product acceptability ensuring Sharia compliance is essential, not optional, for Muslim-majority populations. Gender norms influence who controls household finances and accesses technology. Borrowing stigma persists despite widespread credit needs (Setiawan et al., 2021). Cultural factors require culturally-informed responses. Service design should accommodate rather than oppose existing practices where possible. Community engagement builds understanding and trust. Local champions and trusted endorsers facilitate adoption. Products respecting religious requirements serve rather than exclude devout populations. Gender-sensitive approaches recognize women's specific needs and constraints. Social marketing addresses stigma constructively. Ignoring cultural context guarantees failure regardless of technical sophistication.

3.4.5 Institutional and policy environment

Regulatory frameworks, government programs, and institutional capacities create enabling or constraining environments. Supportive regulation balances innovation encouragement with consumer protection. Tiered licensing reduces entry barriers for small players while maintaining oversight. Proportionate regulation avoids excessive compliance costs for low-margin services. Government programs providing subsidies, guarantees, or direct investment catalyze market development where commercial incentives alone prove insufficient (Edward et al., 2025; Palaon et al., 2020; Yang & Gong, 2025). Creating sustainable digital ecosystems for MSMEs requires multi-stakeholder collaboration addressing infrastructure, literacy, platform interoperability, and regulatory clarity simultaneously (Kilay et al., 2022; Widyastuti et al., 2023). However, institutional challenges persist. Regulations sometimes lag technological developments creating uncertainty. Know Your Customer requirements designed for fraud prevention can exclude populations lacking formal identity documents or fixed addresses. Data privacy rules, while essential for protection, increase compliance costs potentially reducing provider willingness to serve low-margin segments. Conversely, regulatory sandboxes enable experimentation. Government digital identity systems reduce documentation burdens. Universal service obligations ensure infrastructure reaches unprofitable areas. Public-private partnerships share risks and resources.

3.4.6 Individual and demographic factors

Characteristics like income, age, education, and gender mediate both access to and outcomes from digital services. Income determines smartphone and data plan affordability. Age correlates with technology comfort younger users adopt more readily while older users face steeper learning curves. Education predicts literacy levels. Gender intersects with all these factors women often face compounding disadvantages through lower incomes, less education, less technology ownership, and less autonomous decision-making. This heterogeneity within target populations demands segmented approaches rather than one-size-fits-all solutions (Muat et al., 2025; Purnama Sari & Haryono, 2025). Interaction effects matter substantially. Rural women in remote regions face simultaneous disadvantages poor infrastructure, low literacy, cultural restrictions, poverty creating intersectional barriers requiring integrated interventions. Conversely, positive reinforcement can occur: infrastructure improvement enables access that motivates literacy development that drives usage that generates demand supporting further infrastructure investment. Evidence suggests purely supply-side interventions prove insufficient without complementary demand-side work and enabling environment improvements.

3.5 ESG integration for sustainable digital finance

3.5.1 Environmental dimension

While digitalization seems inherently "green" by reducing paper and transport, reality is more complex. Digital infrastructure consumes substantial energy, and rapid device replacement generates e-waste. Responsible environmental practices include renewable energy transitions for infrastructure, device longevity design, emission offsetting programs, and responsible technology procurement considering full lifecycle impacts. Evidence suggests financial sector digitalization can support broader sustainability transitions when environmental considerations integrate into strategy and operations (Becha et al., 2025; Roy & Vasa, 2025). Integrating ESG considerations into infrastructure development ensures sustainability from project inception. Public-private partnerships can embed environmental and social criteria into design, procurement, and operations (Steelyana & Wahyuni, 2024). Emerging technologies like blockchain and IoT offer opportunities for transparent, efficient operations while requiring careful management of energy

consumption and e-waste (Varriale et al., 2021). Environmental benefits can be substantial with proper management. Reduced branch operations lower building energy consumption. Digital documentation eliminates paper waste. Remote services reduce customer travel emissions. However, these benefits only materialize with deliberate environmental integration default digitalization may simply shift environmental impacts rather than reducing them. State enterprises can lead through ambitious renewable energy commitments, green procurement policies, and transparency about environmental performance.

3.5.2 Social dimension

This constitutes the core rationale for financial inclusion efforts and requires careful attention to both benefits and potential harms. Positive impacts include expanding access for marginalized populations, enabling economic opportunity through credit, facilitating consumption smoothing and risk management, and supporting micro-enterprise development. However, microfinance literature documents serious over-indebtedness risks when credit expands without adequate consumer protection. Aggressive lending can trap vulnerable borrowers in debt cycles. Inadequate literacy exacerbates risks of inappropriate product usage. Digital channels can enable impulsive borrowing without traditional relationship-based screening, increasing over-indebtedness risks particularly among populations with limited financial literacy (Purnamasari & Anggraini, 2025).

Responsible social impact requires several elements. Robust assessment processes evaluate borrower capacity before extending credit. Transparent fee structures prevent hidden charges exploiting unsophisticated users. Financial education accompanies credit provision. Fair collection practices protect dignity during financial difficulties. Grievance mechanisms provide recourse when problems arise. Products designed for target populations reflect actual needs rather than what's easiest to deliver. Evidence shows these protections become even more important in digital contexts where personal relationships no longer provide informal screening and support (Wulandari & Kassim, 2015). Linking digital financial services with social assistance programs demonstrates effective pathways for reaching vulnerable populations while building digital capability and trust (Effendi et al., 2025).

3.5.3 Governance dimension

Strong governance ensures accountability, transparency, and ethical conduct. For state enterprises serving public interest alongside commercial objectives, governance takes particular importance. Excellence requires board-level ESG expertise, regular sustainability reporting following international standards, stakeholder engagement mechanisms, whistleblower protection, data governance ensuring privacy and ethical usage, risk management frameworks, and transparent disclosure of both achievements and challenges (Rokhlinasari et al., 2025). Governance challenges persist around balancing competing objectives, managing political influence on state enterprises, and ensuring accountability to marginalized stakeholders with limited voice. Digital services create new governance requirements around data management, algorithmic fairness, and cybersecurity that traditional governance structures may not address adequately. Leading practices include dedicated technology governance committees, regular algorithm audits, robust incident response protocols, and transparent communication about data usage.

Integrating ESG with digital services requires moving beyond separate reporting to fundamental embedding in strategy, operations, and culture. This includes ESG integration in product design, ESG criteria in technology selection, ESG metrics in performance management, stakeholder partnerships addressing systemic barriers, and continuous learning through monitoring outcomes and adjusting strategies. International frameworks like UN Principles for Responsible Banking and CGAP Responsible Digital Financial Services provide guidance, though adaptation for local contexts remains essential.

3.6 Policy implications and recommendations

Evidence synthesized across reviewed sources yields specific policy recommendations for advancing financial inclusion through pawnshop digitalization. Recommendations address multiple stakeholder groups recognizing that coordinated action across government, regulators, private sector, and civil society proves essential for sustainable progress. Government Priority Actions: Infrastructure acceleration in remote regions requires expanded universal service programs, operator incentives for unprofitable area deployment, and public infrastructure investment where commercial providers cannot sustain operations. Digital financial literacy should become national priority with dedicated budget allocation, curriculum integration from primary through adult education, and community-based programs leveraging trusted local institutions. Inter-ministerial coordination can align infrastructure, education, social protection, and financial inclusion initiatives currently operating in silos. State enterprise networks offer platforms for delivering both financial services and digital education, extending reach efficiently through existing infrastructure. Evidence-based policymaking requires improved data collection, rigorous impact evaluation, and research partnerships generating actionable insights (Edward et al., 2025; Palaon et al., 2020; Yang & Gong, 2025).

3.6.1 Regulatory recommendations

Proportionate, risk-based regulation enables innovation while maintaining consumer protection. Streamlined customer identification using tiered approaches and alternative verification reduces barriers for low-risk transactions without compromising security. Digital service quality standards covering availability, speed, transparency, and support protect consumers while creating accountability. Responsible lending practices including affordability assessment and fair collection prevent over-indebtedness harm. Standardized ESG disclosure with relevant metrics ensures accountability. Regulatory sandboxes allow controlled experimentation with innovative approaches while generating evidence about effectiveness and risks before full-scale deployment.

3.6.2 Practitioner guidance

Understanding target users through research, journey mapping, and participatory design ensures services meet genuine needs rather than assumed needs. Graduated offerings spanning fully digital to fully physical with hybrid options support progression toward digital independence while respecting current capabilities. Sustainable agent networks require fair compensation, comprehensive training, reliable technical support, and community integration. Financial education embedded in service delivery through contextual learning and personalized guidance improves outcomes. Robust ESG governance with impact measurement, stakeholder engagement, and transparent reporting demonstrates accountability while informing continuous improvement.

4. Conclusion

This systematic review examined pawnshop digitalization as a pathway for expanding financial access in Indonesia's remote and underserved regions, drawing on 60 peer-reviewed sources published between 2015 and 2026. Three causal pathways emerged from the analysis. The technology pathway shows that digital investment in pawnshop infrastructure generates broader fintech ecosystem benefits that extend beyond direct users. The economic pathway demonstrates that improved credit access through digital channels produces measurable effects on household income, MSME performance, and poverty reduction. The social pathway connects digital service expansion to financial inclusion outcomes, but only when complementary investments in literacy, trust-building, and consumer protection accompany the technology itself. Bibliometric analysis further

identified six thematic clusters with Indonesia as the central research hub, while revealing that pawnshop-specific mechanisms and 3T regional service delivery remain largely absent from the existing academic map a gap this review directly addresses. For state enterprises like PT Pegadaian, digitalization is not merely an efficiency upgrade but an extension of a public service mandate into underserved terrain, one that demands simultaneous action on infrastructure, literacy, culturally grounded product design, and robust ESG governance.

This review is not without limitations. Reliance on a single database, language restrictions to English and Indonesian sources, and the heterogeneity of reviewed studies limit the generalizability of findings. Future research should prioritize longitudinal studies tracking actual usage and impact of digital pawnshop services over time, experimental evaluations of specific interventions such as literacy programs and agent network designs, and comparative case studies examining how different state enterprise governance models shape digitalization outcomes. Ultimately, pawnshop digitalization in Indonesia's 3T regions is a community service challenge as much as a technological one getting it right demands not just better applications and stronger networks, but a sustained institutional commitment to the communities that formal finance has consistently failed to reach.

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Author Contribution

Wiwi Haryanti Lima: Conceptualization, Methodology, Investigation, Data Collection, Formal Analysis, Writing Original Draft Preparation, Writing, Review & Editing, Visualization. Fransina W. Ballo: Conceptualization, Validation, Writing, Review & Editing, Supervision, Project Administration. All authors have read and agreed to the published version of the manuscript.

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During manuscript preparation, the authors used Claude AI (Anthropic) to assist in organizing literature search results, improving academic writing clarity, and checking grammatical consistency. After using this tool, the authors reviewed and edited content as needed and take full responsibility for the publication content.

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References

- Basrul, S. J., Saputra, M., & Panduwiyasa, H. (2025). Technostress Impact in Digital Finance: A Measurement Model Validation for Gen Z's E-Wallet Adoption in Indonesia. 2025 *IEEE International Conference on Artificial Intelligence and Mechatronics Systems*, AIMS 2025. <https://doi.org/10.1109/AIMS66189.2025.11229696>
- Becha, H., Kalai, M., Houidi, S., & Helali, K. (2025). Digital financial inclusion, environmental sustainability and regional economic growth in China: insights from a panel threshold model. *Journal of Economic Structures*, 14(1). <https://doi.org/10.1186/s40008-025-00347-4>
- Bokenchin, K., Rakhmetova, A., Kalkabayeva, G., Serikova, G., & Glazunova, S. (2025). Digital financial technologies and their impact on sustainable development of regional markets. *Periodicals of Engineering and Natural Sciences*, 13(3), 771–784. <https://doi.org/10.21533/pen.v13.i3.596>
- Borres, I. L. (2020). Industry Analysis of Pawnshop in the Philippine. *International Journal of Business*, 6(2), 111–120. <https://doi.org/10.20469/IJBAS.6.10005-2>
- Carè, R., Boitan, I. A., Stoian, A. M., & Fatima, R. (2025). Exploring the landscape of financial inclusion through the lens of financial technologies: A review. *Finance Research Letters*, 72. <https://doi.org/10.1016/j.frl.2024.106500>
- Chatterjee, A. (2024). Digital finance: a developing country perspective with special focus on gender and regional disparity. *Digital Policy, Regulation and Governance*, 26(4), 394–419. <https://doi.org/10.1108/DPRG-10-2023-0149>
- Choiruddin, M. N., Pratikto, H., Murwani, F. D., & Restuningdiah, N. (2025). Financial Literacy, FinTech, and Contemporary Innovation in Islamic Economic Law: An Analysis of MSME Performance Sustainability in Indonesia and Malaysia. *MILRev: Metro Islamic Law Review*, 4(2), 976–1008. <https://doi.org/10.32332/milrev.v4i2.10164>
- Dawood, T. C., Pratama, H., Masbar, R., & Effendi, R. (2019). Does financial inclusion alleviate household poverty? Empirical evidence from Indonesia. *Economics and Sociology*, 12(2), 235–252. <https://doi.org/10.14254/2071-789X.2019/12-2/14>
- Edward, O. T., Mukti, A. H., Misman, F. N. B., & Sastrodiharjo, I. (2025). The Role of Financial Literacy and Technology Adoption in the Sustainability of MSMEs: Exploring the Mediating Effect of Government Support (Evidence from Indonesia and Malaysia Micro Small Medium Entities). In A. B. & H. A. (Eds.), *Lecture Notes in Networks and Systems*, 1572, 160–173. Springer. https://doi.org/10.1007/978-3-032-00441-3_16
- Effendi, J., Qoyum, A., Hasanah, I., Munawaroh, U., Thaker, H. M. T., & Hosen, M. (2025). Social securities scheme, financial inclusion, and its impact on poverty alleviation in indonesia: case of zakat recipients. *International Journal of Business and Society*, 26(2), 690–703. <https://doi.org/10.33736/ijbs.8887.2025>
- Steelyana, W. E., & Wahyuni, E. T. (2024). Environmental social governance integration for infrastructure development in public private partnership toll road sector. *IOP Conference Series: Earth and Environmental Science*, 1324(1), Article 012054. <https://doi.org/10.1088/1755-1315/1324/1/012054>
- Fruchterman, T. M. J., & Reingold, E. M. (1991). Graph drawing by force-directed placement. *Software: Practice and Experience*, 21(11), 1129–1164. <https://doi.org/10.1002/spe.4380211102>
- Gutu, T. G., Máté, D., & Hágén, I. Z. (2025). Mapping the Evolution of Sustainable Financial Inclusion: A Bibliometric Analysis of Global Trends (2007–2025). *Journal of Risk and Financial Management*, 18(9). <https://doi.org/10.3390/jrfm18090472>

- Hamzah, B., & Caroles, L. (2025). Infrastructure Challenges for Innovative Floating Bank Service Implementation in Outer Island Areas. *SSRG International Journal of Civil Engineering*, 12(8), 105–116. <https://doi.org/10.14445/23488352/IJCE-V12I8P109>
- Hermanto, F. F., Hermawan, G., & Atmojo, R. N. P. (2025). Indonesian People's Readiness for Blockchain Adoption in E-Commerce. *ICADEIS 2025 - 2025 International Conference on Advancement in Data Science, E-Learning and Information System: Integrating Data Science and Information System*, Proceeding. <https://doi.org/10.1109/ICADEIS65852.2025.10932994>
- Kadir, R. D., Tri Wahyudi, S., Maski, G., & Devia Sagita Sumantri, V. (2025). The role of financial inclusion in reducing household poverty: insights from Eastern Indonesia. *Cogent Economics and Finance*, 13(1). <https://doi.org/10.1080/23322039.2025.2588925>
- Kilay, A. L., Simamora, B. H., & Putra, D. P. (2022). The Influence of E-Payment and E-Commerce Services on Supply Chain Performance: Implications of Open Innovation and Solutions for the Digitalization of Micro, Small, and Medium Enterprises (MSMEs) in Indonesia. *Journal of Open Innovation: Technology, Market, and Complexity*, 8(3). <https://doi.org/10.3390/joitmc8030119>
- Kirana, M. Y., & Havidz, S. A. H. (2020). Financial literacy and mobile payment usage as financial inclusion determinants. *Proceedings of 2020 International Conference on Information Management and Technology, ICIMTech 2020*, 905–910. <https://doi.org/10.1109/ICIMTech50083.2020.9211157>
- Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, 33(1), 159–174. <https://doi.org/10.2307/2529310>
- Li, M., & Deniswara, K. (2024). Key Factors Driving Use of Digital Payment in Kalimantan Island: UTAUT Model. *Proceedings - 6th International Conference on Informatics, Multimedia, Cyber and Information System, ICIMCIS 2024*, 435–441. <https://doi.org/10.1109/ICIMCIS63449.2024.10957229>
- Loreño, D. T. (2024). Fintech revolutionizes financial inclusion in the evolving Philippine landscape. In S. A. Salman and A. Bhaumik (Eds.), *New practices for entrepreneurship innovation*, 157–190. IGI Global. <https://doi.org/10.4018/979-8-3693-5426-1.ch008>
- Muat, S., Mahdzan, N. S., Sukor, M. E. A., Fachrurrozi, F., & Sari, N. (2025). The role of financial inclusion, financial literacy and digital payment adoption in Indonesian millennials' financial well-being. *International Journal of Bank Marketing*, 1–31. <https://doi.org/10.1108/IJBM-01-2024-0022>
- Musnadi, S., & Agustina, M. (2025). Enhancing Financial Literacy through Fintech: A Study on Aceh's Millennials with Gender and Education as Moderators. *Iranian Economic Review*, 29(2), 527–556. <https://doi.org/10.22059/ier.2025.358272.1007699>
- Mutamimah, M., & Indriastuti, M. (2023). Fintech, financial literacy, and financial inclusion in Indonesian SMEs. *International Journal of Entrepreneurship and Innovation Management*, 27(1–2), 137–150. <https://doi.org/10.1504/IJEIM.2023.129331>
- Nanda, B., Pareek, A., & Marndi, S. (2026). Bridging the financial divide: the transformative power of digital payment systems in fostering financial inclusion. In *Navigating Digital Disruption: Strategies for sustainable business management*, 1, 45–50. Taylor and Francis. <https://doi.org/https://doi.org/10.4324/9781003716617-7>
- Nurfaizal, Y., Kurniawan, A. A., Hermawan, H., Saputra, D. I. S., Amalina, S. N., & Hafshah, L. N. (2025). Digital Platform Utilization and ICT Literacy on Global Market Access among MSMEs: The Mediating Role of Digital Business Readiness and the Moderating Effect of Government Support. *Journal of Applied Data Sciences*, 6(4), 2391–2406. <https://doi.org/10.47738/jads.v6i4.893>
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-wilson, E., McDonald, S., McGuinness, L. A., Thomas, J., Tricco, A. C., Whiting, P., & Moher, D. (2021). *The PRISMA 2020 statement: an updated guideline for reporting systematic reviews Systematic reviews and Meta-Analyses*. <https://doi.org/10.1136/bmj.n71>

- Palaon, H., Wiryono, S. K., & Faturohman, T. (2020). Boosting financial inclusion through social assistance reform: Evidence-based approach in selecting a payment system. *Enterprise Development and Microfinance*, 31(4), 284–299. <https://doi.org/10.3362/1755-1986.20-00013>
- Purnama Sari, D., & Haryono, S. (2025). Understanding the intentions of Indonesian millennials using sharia digital pawnshops to save gold: expanding meta-UTAUT with perceived risk, security attitude and trust. *Journal of Science and Technology Policy Management*. <https://doi.org/10.1108/JSTPM-05-2024-0180>
- Purnamasari, E. D., & Anggraini, L. D. (2025). Influence of FinTech Paylater, Financial Well Being, Behavioral Finance, and Digital Financial Literacy on MSME Sustainability in South Sumatera. *Journal of Risk and Financial Management*, 18(12). <https://doi.org/10.3390/jrfm18120682>
- Ratnawati, K. (2020). The Influence of Financial Inclusion on MSMEs' Performance Through Financial Intermediation and Access to Capital. *Journal of Asian Finance, Economics and Business*, 7(11), 205–218. <https://doi.org/10.13106/jafeb.2020.vol7.no11.205>
- Ratnawati, K., Rokhim, R., Wati, C. R., & Dewanta, P. P. (2025). The impact of enhancing digital financial literacy on firm performance: evidence from digitalisation in Indonesia. *International Journal of Technology Intelligence and Planning*, 14(1), 78–106. <https://doi.org/10.1504/IJTIP.2025.150737>
- Rokhlinasari, S., Widagdo, R., & Irwandi, S. A. (2025). Ethical finance and MSME resilience: Shariah banking contribution to Indonesia's economic growth. *Banks and Bank Systems*, 20(3), 91–104. [https://doi.org/10.21511/bbs.20\(3\).2025.07](https://doi.org/10.21511/bbs.20(3).2025.07)
- Roy, J. K., & Vasa, L. (2025). Financial technology and environmental, social and governance in sustainable finance: a bibliometric and thematic content analysis. *Discover Sustainability*, 6(1). <https://doi.org/10.1007/s43621-025-00934-2>
- Sari, C. P., & Sulistyanningrum, E. (2025). Digitalization and access to household credit in indonesia: pre- and post-covid-19 pandemic (2019 and 2021). *Journal of Indonesian Economy and Business*, 40(3), 363–381. <https://doi.org/10.22146/jieb.v40i3.8766>
- Setiansah, M., Santoso, E., & Ayu, K. R. (2024). Women's Digital Literacy in Village Information System Use. *International Journal of Media and Information Literacy*, 9(2), 453–462. <https://doi.org/10.13187/ijmil.2024.2.453>
- Setiawan, B., Nugraha, D. P., Irawan, A., Nathan, R. J., & Zoltan, Z. (2021). User innovativeness and fintech adoption in indonesia. *Journal of Open Innovation: Technology, Market, and Complexity*, 7(3). <https://doi.org/10.3390/joitmc7030188>
- Siddika, A., Sarwar, A., & Bakar, R. B. (2023). Digital Financial Inclusion: Covid-19 Pandemic as a Catalyst for Adoption. *Journal of System and Management Sciences*, 13(5), 88–106. <https://doi.org/10.33168/JSMS.2023.0506>
- Sundharesalingam, P., Somasundaram, R., Sushmitha, S. S. S., Rithanya, R., & Archana, M. (2025). AI enhanced FinTech strategies for driving ESG investments in sustainable finance. In B. A., A. A., M. K. R., & C. O. (Eds.), *Lecture Notes in Networks and Systems* (Vol. 1247, pp. 221–228). Springer. https://doi.org/10.1007/978-3-031-81086-2_24
- Sutrisno, P. A., Zulfah, S., & Njatrijani, R. (2025). Analysis of Sustainable Investment Regulation For Indonesia's 3T Regions: Underdeveloped, Frontier, and Outermost. In N. A., H. W.N., & R. D.A. (Eds.). *IOP Conference Series: Earth and Environmental Science*, 1537(1). Institute of Physics. <https://doi.org/10.1088/1755-1315/1537/1/012035>
- Tandilino, C., Pontoh, G. T., Darmawati, D., & Indrijawati, A. (2025). Digital Financial Inclusion as a Mediator of Digital Financial Literacy and Government Support in MSME Performance. *International Journal of Financial Studies*, 13(4). <https://doi.org/10.3390/ijfs13040199>
- Timur, Y. P., Ridlwan, A. A., Fikriyah, K., Susilowati, F. D., & Rofiqo, A. (2024). Understanding public perceptions of digital sharia pawnshops in Indonesia: A sentiment analysis with machine learning. In *2024 International Conference on Sustainable Islamic Business and Finance (SIBF)* (pp. 177–185). IEEE. <https://doi.org/10.1109/SIBF63788.2024.10883859>

- Utomo, S., Gesmi, I., & Othman, Z. (2025). Public Services Amid Infrastructure Inequities: A Case Study of Indonesia's Outer Islands. *International Journal of Sustainable Development and Planning*, 20(5), 2213–2223. <https://doi.org/10.18280/ijstdp.200536>
- Van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523–538. <https://doi.org/10.1007/s11192-009-0146-3>
- Varriale, V., Cammarano, A., Michelino, F., & Caputo, M. (2021). Sustainable supply chains with blockchain, IoT and RFID: A simulation on order management. *Sustainability (Switzerland)*, 13(11). <https://doi.org/10.3390/su13116372>
- Widyastuti, D. A. R., Wahyuni, H. I., & Wastutiningsih, S. P. (2023). Creating a digital ecosystem for sustainable development: Insights from Indonesian micro, small and medium enterprises. *Kasetsart Journal of Social Sciences*, 44(1), 27–38. <https://doi.org/10.34044/j.kjss.2023.44.1.04>
- Wulandari, P., & Kassim, S. H. (2015). Islamic marketing at the bottom of the pyramid: Factors affecting customer's satisfaction among the poor in Islamic pawnshop in Indonesia. *International Journal of Business and Globalisation*, 15(3), 331–348. <https://doi.org/10.1504/IJBG.2015.071899>
- Wurarah, R. N., Sangadji, M., & Awom, S. B. (2025). Poverty reduction and digitalization in Indonesia: The conditional role of human capital and economic growth in an underdeveloped province. *Asian Journal of Economic Modelling*, 13(3), 419–436. <https://doi.org/10.55493/5009.v13i3.5577>
- Yang, Y., & Gong, B. (2025). Digital financial inclusion and public service equalization. *Finance Research Letters*, 71. <https://doi.org/10.1016/j.frl.2024.106440>

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