

Opportunities and Challenges in Decentralised Finance: A Scoping Review of Governance, Security and Adoption Constraints (2020–2025)

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Dates

Received: 4th March 2025
Accepted: 28th May 2025
Published: 22nd December 2025

Digital identifier



<https://doi.org/10.70727/3134-6332/2025/v1i1a4>

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Abstract

Decentralised finance (DeFi) is transforming modern finance by enabling enable peer-to-peer, automated and programmable financial services. While DeFi is widely associated with transparency, efficiency and financial inclusion, the literature also highlights substantial risks that may undermine trust, stability and mainstream adoption. This article presents a scoping review of DeFi research published between 2020 and 2025, mapping its key opportunities and challenges. The review identifies opportunities related to transparency and fraud reduction through immutable ledgers, expanded accessibility via disintermediated services, efficiency gains through smart contract automation, user empowerment through non-custodial participation, and innovation through tokenisation and new financial products. However, the evidence consistently emphasises challenges linked to regulatory ambiguity, legal enforceability and compliance constraints, cyber and smart contract vulnerabilities, market volatility and contagion risks, scalability and interoperability limitations, governance and accountability gaps, consumer protection concerns, and user literacy barriers, including tensions between privacy and anti-money laundering (AML) and combating the financing of terrorism (CFT) obligations.

Keywords: Decentralised finance (DeFi); blockchain; smart contracts; financial inclusion; regulation; cybersecurity.

Introduction

Traditional banking and financial systems continue to underpin economic activity by enabling deposit-taking, credit provision, investment intermediation and payment processing, while operating within centralised and highly regulated monetary structures (Abdulgaffar et al., 2024; Melnyk et al., 2022; Sharipova & Asadova, 2023; Zolea, 2023). Although these arrangements have historically supported stability and trust, they have also been criticised for structural constraints, including inefficiencies, high transaction costs and persistent gaps in access to formal financial services in underserved settings

(Rachmad, 2025). Such limitations have intensified interest in alternative models that can reduce dependence on central intermediaries while expanding participation in financial markets.

Blockchain technology has emerged as a key enabler of these alternative models by providing a distributed ledger that can support secure, transparent and tamper-resistant transactions across multi-party networks. In blockchain-enabled environments, smart contracts can encode and automatically execute transaction rules, thereby reducing reliance on manual verification and centralised gatekeeping (Hassanein et al., 2022). Building on this foundation, decentralised finance (DeFi) refers to blockchain-based financial services delivered through automated protocols that operate without traditional intermediaries such as banks (Doerr et al., 2021; Kurniawan et al., 2025). DeFi has been associated with potential benefits such as improved transparency, operational efficiency and expanded accessibility, particularly for individuals and communities historically excluded from conventional financial systems (Kurniawan et al., 2025).

At the same time, the rapid expansion of DeFi has been accompanied by a growing body of concerns regarding regulatory ambiguity, consumer protection, governance accountability, cybersecurity vulnerabilities and systemic market risks. The literature highlights persistent challenges linked to smart-contract exploits, oracle manipulation, protocol interdependencies and limited recourse mechanisms, alongside uncertainty about compliance obligations in permissionless and pseudonymous environments (Igor & Antoinette, 2022; Mishra & Phansalkar, 2025). These tensions underline the need to examine DeFi not only as a technological innovation, but also as an evolving financial ecosystem with material implications for institutions, users and regulators.

Against this backdrop, this article presents a scoping review that maps existing evidence (2020–2025) on DeFi's role, opportunities and challenges. This review contributes by providing a structured, thematically organised evidence map that can inform future research agendas and support policy and practice discussions on how DeFi may be integrated responsibly alongside or in interaction with traditional financial systems. The remainder of the article proceeds with a literature background on traditional finance and DeFi, followed by the scoping methodology, synthesis of results and concluding sections that interpret implications and outline recommendations.

Literature Review

Traditional Banking and Financial Systems

Traditional banking and financial systems have long served as the backbone of economic activity, providing essential services such as savings, loans, credit and payment processing (Abdulgaaffar et al., 2024). They are essential to our daily lives because they facilitate the exchange of goods and services through the use of money (Sharipova & Asadova, 2023). The core functions of traditional banks include accepting deposits, offering loans, providing investment services and issuing credit cards. By maintaining a high level of trust and stability, traditional financial systems ensure that capital flows smoothly within the economy (Melnyk et al., 2022; Zolea, 2023). Banks work closely with central banks to implement monetary policy. Centralisation allows these institutions to monitor the flow of money, enforce regulations and mitigate systemic risks (Sharipova & Asadova, 2023). The stability and effectiveness of the banking system are essential for maintaining a healthy economy and ensuring the smooth functioning of the monetary system.

However, traditional financial systems are not without limitations. These include inefficiency, high transaction costs and lack of access to banking services in some regions (Rachmad, 2025). This has led to the emergence of financial solutions that can reduce reliance on centralised intermediaries. For

instance, these limitations have encouraged investments in decentralised finance that run on blockchain technology.

Blockchain Technology and Decentralised Finance

Blockchain is used to support transactional services within a multi-party business network. The aim is to enable a significant reduction in cost and risk for all involved parties through the creation of novel and enhanced business models. Data maintained within the distributed ledger can only be accessed through the execution of a smart contract that governs a transaction with rules (Hassanein et al., 2022).

Consequently, this decentralised structure reduces risks associated with data manipulation and single points of failure. Decentralised Finance (DeFi) provides financial services without centralised intermediaries, by operating through automated protocols on blockchains (Doerr et al., 2021). This creates an open and permissionless financial system that operates without the need for traditional intermediaries such as banks and financial institutions (Kurniawan et al., 2025). Furthermore, it provides financial services that are transparent, efficient and accessible. The democratisation of financial services is a cornerstone of DeFi, offering opportunities for individuals and communities that have been historically excluded from traditional financial systems due to barriers such as high fees, lack of infrastructure, or restrictive regulations (Kurniawan et al., 2025).

DeFi Infrastructure and Platforms (2025 Perspective)

Decentralised Finance (DeFi) facilitates transparent, efficient and automated transactions without reliance on traditional intermediaries. DeFi's operational framework is primarily composed of smart contracts, decentralised applications (dApps) and oracles, which together constitute its technological and infrastructural backbone. These components are deployed on leading blockchain platforms such as Ethereum, Binance Smart Chain (BNB Chain) and Solana, each contributing distinct capabilities to the broader decentralised financial ecosystem.

DeFi Infrastructure

Smart contracts form the foundational layer of the DeFi infrastructure. They are autonomous, self-executing programmes embedded within blockchain networks that automatically implement contractual terms once predefined conditions are satisfied. Since 2024, advancements in formal verification, automated auditing and AI-assisted anomaly detection have significantly enhanced the security and reliability of these contracts (Liquidity, 2025). These improvements aim to address historical vulnerabilities that have resulted in security breaches, rug-pull incidents and systemic protocol exploits. Through these innovations, smart contracts now underpin increasingly sophisticated financial instruments, including algorithmic stablecoins, decentralised lending markets and on-chain derivatives.

Decentralised applications (dApps) function as the interactive layer connecting users to smart contracts and blockchain-based services. Unlike conventional centralised applications, dApps operate across distributed networks, thereby minimising single points of failure and censorship. In 2025, leading dApps exhibit multi-chain interoperability and AI-enabled trading optimisation, allowing users to execute cross-chain transactions, manage multi-asset portfolios and implement complex yield strategies in real time (LamprosTech, 2025). These features have substantially improved accessibility, efficiency and user experience for both retail participants and institutional investors.

Oracles, which act as conduits between blockchain systems and external data environments, have undergone notable transformation. Traditional oracles, such as Chainlink, are increasingly complemented by governance-driven, cost-efficient models that provide developers with low-cost, community-validated data feeds (Ecosystem, 2025). By integrating real-time information on asset prices, interest rates and macroeconomic indicators, oracles enable smart contracts to respond adaptively to off-chain dynamics. Consequently, they play a pivotal role in ensuring that decentralised systems remain responsive to external market conditions.

While these infrastructural innovations have enhanced the scalability and reliability of DeFi, they have simultaneously introduced new complexities and risks. Issues such as oracle manipulation, cross-chain bridge vulnerabilities and smart contract exploits continue to pose significant challenges, thereby positioning security assurance and regulatory oversight as central themes in current DeFi research (Mishra & Phansalkar, 2025).

Platforms and Ecosystem Developments

The DeFi ecosystem in 2025 is characterised by continued platform diversification and a pronounced shift toward multi-chain architectures. Blockchain networks now compete across dimensions of scalability, interoperability and cost efficiency. Although Ethereum maintains its position as the dominant network, its overall market share has declined due to the proliferation of faster, lower-cost alternatives. As of early 2025, Ethereum's share of the total DeFi Total Value Locked (TVL) fell from approximately 63.5 percent to 56.6 percent, reflecting an ongoing process of technological decentralisation and inter-chain differentiation (CoinGecko, 2025).

Ethereum remains a cornerstone of the DeFi landscape through established protocols such as MakerDAO, Aave and Curve Finance, which collectively represent the largest on-chain liquidity and lending infrastructures globally. In parallel, BNB Chain (formerly Binance Smart Chain) has expanded rapidly, benefitting from Ethereum Virtual Machine (EVM) compatibility that facilitates seamless migration of smart contracts and multichain deployment (LamprosTech, 2025). Flagship platforms such as PancakeSwap and Venus have integrated AI-based trading systems, gamified staking mechanisms and cross-chain liquidity aggregation, contributing to greater market dynamism and capital efficiency (LamprosTech, 2025).

Solana has emerged as a high-performance alternative distinguished by exceptional throughput capabilities processing thousands of transactions per second. Its ecosystem hosts prominent decentralised exchanges such as Serum and Raydium, which enable high-frequency, low-latency trading and liquidity provision. Solana's network has reported monthly decentralised exchange (DEX) trading volumes exceeding US \$100 billion in 2025, underscoring its growing relevance to institutional DeFi activity (Cryptobriefing, 2025).

Emerging platforms, including Avalanche, Polygon and Fantom, have prioritised interoperability and cross-chain integration, supporting a multi-chain environment where assets and liquidity can move fluidly between networks (Universal Business Council, 2025). Meanwhile, Berachain, launched in early 2025, rapidly achieved a total value locked (TVL) of over US \$5.2 billion, reflecting sustained investor appetite for novel blockchain architectures (CoinGecko, 2025).

Collectively, these developments indicate that the DeFi ecosystem is transitioning from a monolithic, Ethereum-centric model toward a heterogeneous, interconnected network of platforms optimised for diverse financial applications.

Methodology

The study adopted a scoping review design to map and synthesise existing evidence on decentralised finance (DeFi), with specific attention to how DeFi is conceptualised, the opportunities it enables, and the challenges that may undermine trust, stability, and mainstream adoption. A scoping review approach was appropriate because DeFi is a rapidly evolving field with a fragmented and heterogeneous evidence base that spans conceptual scholarship, technical studies, regulatory analyses, and a limited set of reputable industry outputs.

The scope of the review was limited to literature published between 2020 and 2025, reflecting the period in which DeFi expanded significantly as a scholarly topic and matured into major strands of inquiry, including protocol-level risks, regulatory and compliance debates, infrastructure security, governance dynamics, and adoption constraints. The review considered English-language publications only. While this timeframe captures the most active phase of DeFi research growth, it is acknowledged that developments occurring after 2025 may not yet be reflected in peer-reviewed outputs at the time of writing.

A comprehensive search was conducted using Google Scholar, supplemented by targeted screening of relevant industry reports from credible sources used to contextualise ecosystem developments such as platform diversification, market indicators, and infrastructure trends. Search activities were conducted on the specified search dates and adapted to the functionality of each platform. Search terms were developed to capture both the core construct of DeFi and its related technical and governance dimensions. These terms included variations of “decentralised finance”, “decentralised finance”, and “DeFi”, combined with terms such as blockchain finance, smart contracts, decentralised applications, oracles, tokenisation, interoperability, scalability, regulation, governance, cybersecurity, consumer protection, AML/CFT, adoption, market volatility, and systemic risk.

Eligibility criteria were applied to determine which studies were included. Sources were included if they were published between 2020 and 2025, written in English, and explicitly examined DeFi in relation to its functions, applications, technological foundations, opportunities, risks, governance dynamics, regulatory implications, or adoption barriers. Peer-reviewed journal articles, conference papers, book chapters, and academically oriented working papers were eligible for inclusion. Studies were excluded if they addressed blockchain or cryptocurrency markets without substantive engagement with DeFi protocols and decentralised financial mechanisms, fell outside the specified timeframe, were not available in English, or lacked sufficient relevance after full-text assessment.

The study selection process proceeded through sequential screening stages. Records retrieved from database and platform searches were exported to EndNote and Excel, and duplicates were removed prior to screening. Titles were screened first to remove clearly irrelevant sources, followed by abstract screening to assess alignment with the eligibility criteria. Full-text screening was then conducted to confirm that each study addressed DeFi directly and contained extractable information relevant to the review’s objectives.

Data extraction, also referred to as charting, was conducted using a structured extraction framework to ensure consistency across included studies. For each included source, key bibliographic details and study characteristics were captured, including author and year, study type, and the specific DeFi focus area where applicable. Extracted content was recorded in a way that supported cross-study comparison and thematic consolidation, ensuring that recurring concepts and patterns could be identified reliably.

The synthesis was conducted using thematic analysis to organise findings into coherent and analytically meaningful themes. Extracted data were coded iteratively and codes were then clustered into higher-order themes representing DeFi opportunities and challenges. Opportunity themes included transparency and auditability, financial inclusion and accessibility, efficiency and automation, disintermediation and user empowerment, innovation through tokenisation and programmable finance, and borderless or cross-border functionality. Challenge themes included regulatory and legal ambiguity alongside compliance pressures such as AML/CFT, cybersecurity and smart-contract vulnerabilities including oracle and cross-chain risks, market volatility and systemic contagion, scalability and interoperability barriers, governance and accountability deficits, consumer protection concerns, and user adoption constraints driven by complexity, trust deficits, and limited literacy. Themes were compared across studies to identify areas of convergence and to clarify the conditions under which opportunities may realistically translate into durable institutional and societal value.

This review synthesised publicly available literature and did not involve human participants, personal data collection, or access to confidential datasets. As a result, formal ethical clearance was not required. The study's limitations include restriction to English-language sources and the 2020–2025 publication window, which may exclude relevant evidence published in other languages or outside the timeframe. In addition, because DeFi evolves rapidly, some recent technical and regulatory developments may not yet be captured in peer-reviewed publications, and database coverage and ranking dynamics, particularly on Google Scholar, may affect the visibility of some sources despite supplementary searching approaches.

Results

Transparency, Trust and Fraud Reduction

A recurring theme in contemporary DeFi scholarship is the role of decentralisation in fostering transparency, trust and fraud mitigation across financial systems. Blockchain technology, which underpins DeFi, provides an immutable and publicly verifiable ledger that enhances transactional transparency and minimises opportunities for manipulation or data falsification (Aayush & Mayank, 2024; Yan & Cristiano, 2019). By recording all activities on a distributed ledger, stakeholders including regulators, institutions and consumers gain unprecedented visibility into transactional processes, thereby promoting accountability and confidence in the system (Isabelle, 2022).

Furthermore, smart contracts automate key financial processes such as invoice factoring, lending and trade finance, significantly reducing human error and the risk of fraudulent activity (Olukunle et al., 2024). Through automation and cryptographic security, DeFi systems remove intermediaries who traditionally act as custodians of trust, thereby reducing operational inefficiencies and costs while improving transactional integrity (Gayatri Kisan & Jyoti Rajput, 2024).

This disintermediation contributes not only to enhanced efficiency but also to the democratisation of financial access, as individuals and institutions can engage in transparent, peer-to-peer transactions without centralised oversight (Alexandr et al., 2023). Moreover, DeFi's reliance on public blockchain records enables efficient liquidity management and agile interest rate adjustments, ensuring that capital

allocation and financial decision-making are both transparent and responsive to market dynamics (Isabelle, 2022).

From a systemic perspective, the adoption of DeFi technologies has the potential to enhance institutional legitimacy and attract mainstream and institutional investors by improving auditability and consumer protection frameworks (Ngozi Samuel et al., 2024). This growing regulatory clarity around decentralised systems further strengthens market credibility, aligning DeFi mechanisms with broader goals of financial inclusion, trust and resilience in Africa. Collectively, these advancements suggest that DeFi represents a foundational shift toward more open, transparent and fraud-resistant financial architectures which can be instrumental in shaping the financial economy in Africa.

Financial Inclusion and Accessibility

A central proposition within the literature on decentralised finance (DeFi) is its potential to enhance financial inclusion and accessibility, particularly for populations historically excluded from the formal financial system. Scholars highlight that DeFi, through its blockchain-based architecture, allows individuals to access financial services without reliance on centralised intermediaries such as banks or credit institutions (Amrutha & Muralidhar, 2024). By eliminating these intermediaries and enabling peer-to-peer transactions, DeFi lowers entry barriers and operational costs, providing affordable financial instruments to the unbanked and underbanked segments of society (Campbell et al., 2021).

Globally, an estimated 1.7 billion individuals remain outside the traditional banking system and DeFi platforms present scalable alternatives to bridge this gap by offering decentralised savings, lending and payment systems accessible through digital wallets (Keshab, 2023). These systems operate on open-source protocols, which foster innovation and competition, empowering users from diverse socioeconomic backgrounds to participate in the financial ecosystem (Soni, 2023). This decentralisation not only democratises access to capital but also redefines inclusivity, as users no longer require formal identification, high credit scores, or physical proximity to financial institutions (Saravanakrishnan et al., 2024).

The automation of financial functions through smart contracts further contributes to inclusivity by ensuring transparent, efficient and low-cost service delivery (Olawale et al., 2024). DeFi protocols can autonomously execute lending, trading and yield-generation activities, minimising administrative overhead and allowing small-scale participants to engage in markets previously dominated by large financial intermediaries (Abesalom, 2024). This transformation has enabled micro-lending and over collateralised loan models, which offer individuals with limited credit histories access to capital under transparent and algorithmically governed terms (Irina et al., 2022).

Moreover, DeFi's cross-border interoperability allows small businesses and retailers to bypass high-cost payment networks, facilitating cheaper international transactions and enabling participation in the global digital economy (Campbell et al., 2021). This borderless structure strengthens financial resilience, particularly in emerging markets where conventional financial infrastructure remains weak or inaccessible (Andry et al., 2024). Collectively, these developments underscore DeFi's capacity to foster inclusive growth, reduce structural inefficiencies and democratise access to financial opportunities on a global scale (Siyuan, 2025).

Efficiency, Cost Reduction and Automation

A defining feature of decentralised finance (DeFi) is its capacity to enhance efficiency, reduce operational costs and automate financial processes through blockchain-enabled infrastructures. Unlike legacy financial systems, which rely on multiple intermediaries and manual verification, DeFi protocols

enable direct, peer-to-peer transactions facilitated by smart contracts self-executing codes that enforce agreement terms automatically once predefined conditions are met (Campbell & Daniel, 2024; Fabian, 2021). This technological automation eliminates the need for third-party validation, reducing administrative overhead and substantially accelerating settlement times compared to traditional banking and payment systems (Manoj Kumar, 2022).

The cost-efficiency of DeFi arises primarily from the disintermediation of financial services. Traditional financial institutions often impose substantial fees related to credit assessment, compliance and transaction processing. DeFi systems, operating on decentralised ledgers, remove many of these layers by leveraging blockchain consensus mechanisms and automated verification, resulting in lower transaction costs and improved resource allocation (Manoj Kumar, 2022). This structural reduction in costs has made DeFi particularly attractive for small-scale investors, businesses and participants in developing economies, who face high transaction fees and restricted access in traditional finance (Andry et al., 2024).

Another driver of efficiency in DeFi is its ability to streamline financial workflows through automation and interoperability. Smart contracts can execute complex financial operations including lending, borrowing and asset exchange without manual intervention, significantly reducing processing time and the risk of human error (Tim et al., 2023). As decentralised applications (dApps) evolve to operate across multiple blockchain networks, the interoperability of DeFi ecosystems has improved, allowing liquidity and data to flow seamlessly between protocols. This has led to enhanced scalability and an improved user experience, as participants can engage with different financial products without needing to switch ecosystems or intermediaries (Nic & Linda, 2021).

Beyond transaction processing, DeFi is also driving capital efficiency and diversification through the tokenisation of real-world assets (RWAs). By representing physical or traditional financial assets (e.g., real estate, bonds, or commodities) as blockchain tokens, DeFi protocols can unlock liquidity, increase accessibility and promote trustless capital allocation mechanisms (Sanket et al., 2024). This innovation enhances not only market efficiency but also risk management, as investors can engage with fractionalised, transparent and automated financial instruments in real time.

The convergence of automation, transparency and cost reduction positions DeFi as a transformative force capable of redefining global financial efficiency standards. However, these benefits depend on continuous improvements in blockchain scalability, smart contract security and regulatory clarity to ensure that the gains from automation do not come at the expense of systemic stability or consumer protection.

Disintermediation and User Empowerment

Decentralised finance (DeFi) fundamentally transforms traditional financial systems by removing intermediaries and enabling direct peer-to-peer transactions. By leveraging blockchain technology and programmable smart contracts, DeFi protocols provide transparent, permissionless access to financial services, reducing reliance on centralised financial institutions (Gayatri Kisan & Jyoti Rajput, 2024; Roberto & Andrea, 2023).

This disintermediation empowers users to maintain full control of their assets through non-custodial models, where transactions and ownership are managed programmatically without third-party oversight (Iwa, 2021). The result is a democratisation of financial access, allowing individuals, merchants and businesses to participate in financial markets that were previously limited by geography, credit history, or high costs (Komal, 2024). In addition to increasing accessibility, DeFi fosters financial innovation

by enabling new products such as decentralised stablecoins and automated lending platforms, which further decentralise control and enhance market efficiency (Tetiana & Valeriya, 2022).

Innovation, Modernisation and Tokenisation

Decentralised finance (DeFi) serves as a catalyst for innovation and modernisation in financial systems, offering transformative opportunities across multiple domains. By integrating blockchain-based protocols and smart contracts, DeFi enables trustless financial operations, reduces dependency on traditional intermediaries and supports algorithmic management of assets (Johannes Rude et al., 2021; Sanket et al., 2024).

One key area of innovation is asset tokenisation, which allows real-world assets to be represented as digital tokens on blockchain networks. This process enhances capital diversification, increases liquidity and facilitates efficient, borderless trading while maintaining transparency and security (Sanket et al., 2024). Tokenisation also supports novel financial products and platforms, including decentralised stablecoins, lending protocols and algorithmic trading systems, which contribute to a multi-tiered, interoperable DeFi ecosystem ((Enric Junqué de & Yifei, 2023).

DeFi also drives modernisation in financial markets by redistributing market power and enabling more equitable pricing mechanisms, fostering broader participation and efficiency (Abesalom, 2024). In sectors such as supply chain finance, DeFi applications transform operational relationships, enhance transparency and streamline financial workflows (Olukunle et al., 2024). Furthermore, the adoption of DeFi protocols promotes regulatory innovation, including concepts such as embedded compliance frameworks that integrate oversight directly into smart contracts (Dirk Andreas et al., 2020).

The implementation of DeFi facilitates enhanced efficiency, transparency, inclusivity and accessibility while fostering financial innovation and enabling modernised transaction structures, positioning DeFi as a disruptive force in contemporary finance (Marianna Tolevna & Rizvanova, 2025; Rajmund, 2024).

Security, Legitimacy and Risk Management

Decentralised finance (DeFi) introduces significant enhancements in security, legitimacy and risk management within traditional financial systems. By leveraging blockchain technology and smart contracts, DeFi ensures that transactions are transparent, immutable and cryptographically secured, reducing the potential for fraud and unauthorised interference (Campbell & Daniel, 2024). This transparency not only safeguards assets but also fosters trust and legitimacy among users and institutional participants (Egon, 2023). It also strengthens the overall resilience and reliability of financial systems, offering a credible alternative to traditional centralised models while maintaining efficiency and reducing costs (Campbell & Daniel; Egon, 2023).

Globalisation, Interoperability and Borderless Finance

Decentralised finance (DeFi) enables globalised, interoperable and borderless financial ecosystems, offering a transformative approach to international finance. By utilising distributed ledger technology, DeFi provides transparent, efficient and low-cost transactions that are accessible across borders, eliminating the constraints of traditional financial intermediaries (Nurgün Komşuoğlu, 2024).

The interoperability of DeFi platforms allows seamless interaction between different blockchain networks, enhancing cross-border financial connectivity and facilitating global access to financial services for individuals and businesses alike. Additionally, DeFi fosters permissionless innovation, allowing users worldwide to participate in decentralised markets without the barriers imposed by legacy systems (Manoj Kumar, 2022).

Consequently, DeFi promotes financial inclusivity on a global scale, offering scalable solutions that reduce transaction costs, expand market reach and increase transparency, ultimately supporting a more equitable and connected international financial system (Manoj Kumar, 2022; Nurgün Komşuoğlu, 2024).

Challenges of Decentralised Finance (DeFi)

Although decentralised finance (DeFi) presents substantial potential for financial innovation, financial inclusion and efficient market infrastructure, the literature consistently emphasises that these benefits are accompanied by significant challenges. The reliance on code-driven smart contracts and decentralised protocols necessitates robust risk management frameworks to address vulnerabilities, operational failures and evolving cyber threats (Kavita & Rajeev, 2024). These challenges span regulatory, technological, governance-related and user-centric concerns, many of which undermine DeFi's stability, credibility and large-scale adoption. The following subsections synthesise key challenges across the scholarly domain.

Regulatory, Legal, Compliance and Policy Challenges

A dominant theme in the literature concerns the absence of clear regulatory frameworks, which creates deep uncertainty for innovators, users and policymakers. Scholars argue that DeFi's permissionless and pseudonymous architecture complicates AML/CFT enforcement, taxation and consumer protection (Igor & Antoinette, 2022; Iwa, 2021). This regulatory opacity has led to fragmented global approaches, inconsistent oversight and unclear liability frameworks for smart-contract-based services (Dirk Andreas et al., 2020; Ngozi Samuel et al., 2024).

Additionally, regulatory uncertainty interacts with increasing interlinkages between DeFi and traditional finance, amplifying systemic risk and threatening financial stability (Irina et al., 2022). The decentralised architecture also complicates supervisory intervention, as there is often no identifiable accountable entity (Campbell et al., 2021; Egon, 2023).

Further, extensive scholarship emphasises compliance pressures, particularly regarding Know Your Customer (KYC) and Anti-Money Laundering (AML) obligations in a permissionless system (Kavita & Rajeev, 2024). Studies also note legal ambiguities surrounding smart contracts, including enforceability, jurisdiction and dispute resolution (Abdulgaffar et al., 2024; Kavita & Rajeev, 2024). This is consistent with concerns about legal risks emerging from the absence of central oversight structures (Shire Ahmed, 2022).

DeFi's regulatory challenge is compounded by technology-specific issues, such as scalability constraints, protocol automation and reliance on external infrastructure (Ghodke & Pawar, 2024; Borg, 2022; Nartey, 2024). Addressing these issues requires governments to develop coherent regulatory frameworks, invest in research and talent and build public-private partnerships to mitigate systemic risk (Abdullah, 2024; Olukunle et al., 2024).

Security, Smart-Contract, Cyber and Operational Risks

Security-related vulnerabilities form one of the most critical challenges in DeFi. Scholars consistently describe smart-contract flaws, code exploits, oracle manipulation and protocol interdependencies as recurrent sources of loss and instability (Fabian, 2021; Johannes Rude et al., 2021; Saravanakrishnan et al., 2024). The technical immaturity of DeFi infrastructures exposes users to hacking attacks, re-entrancy vulnerabilities and unaudited protocol risks (Nalini et al., 2024).

The literature highlights that the complexity of DeFi protocols increases operational risk, as minor errors can cascade across smart-contract ecosystems (Komal, 2024; Prudhvi, 2024). Furthermore, reliance on volatile cryptoassets magnifies economic exposure, creating risks of sudden liquidity loss and protocol failures (Petrov, 2025; Yousuf et al., 2024). Security risks are closely intertwined with regulatory and governance gaps, where the absence of oversight and insurance mechanisms leaves users vulnerable to fraud, exploitation and permanent asset loss (Aayush & Mayank, 2024; Shire Ahmed, 2022). These vulnerabilities collectively undermine the trust required for mainstream adoption.

Market Volatility, Stability and Systemic Risk

DeFi markets are deeply intertwined with speculative cryptoasset activity, making them highly sensitive to liquidity shocks, leverage cycles and manipulative trading practices (Tetiana & Valeriya, 2022). For instance, studies argue that extreme price volatility and stablecoin fragility are core threats to DeFi's stability (Siyuan, 2025; Younes, 2024).

Moreover, the absence of central authorities exacerbates systemic contagion, where failures in one protocol can transmit rapidly across interconnected platforms (Nic & Linda, 2021). Scholars further note that insufficient governance, combined with high-risk incentives, increases the likelihood of systemic disruptions (Rajmund, 2024). These dynamics render DeFi structurally more fragile compared to traditional finance.

Scalability, Performance and Interoperability Challenges

Scalability constraints are widely recognised as a major barrier to DeFi's expansion. High transaction fees, network congestion and limited throughput reduce protocol efficiency and accessibility (Dr. Ramakrishnan et al., 2023; Gayatri Kisan & Jyoti Rajput, 2024). Scholars also note challenges in integrating DeFi with traditional infrastructure and achieving cross-chain interoperability (Asheetu Bhatia, 2024; Keshab, 2023; Nic, 2022).

These issues are exacerbated by technological immaturity, dependence on external data feeds and continued reliance on fiat-based settlement mechanisms (Isabelle, 2022; Jiahua & Nikhil, 2021) (Borg, 2022; Xu & Vadgama, 2021). Without improvements in interoperability standards and network performance, DeFi's ability to scale sustainably remains limited.

Governance, Accountability and Consumer Protection

Governance weaknesses present another significant challenge. Many authors raise concerns about reconcentration of power in protocol developers or validators, contradicting DeFi's decentralised ethos (Dirk Andreas et al., 2020; Hassanein et al., 2022). The absence of meaningful oversight mechanisms exposes users to governance manipulation, insider control and inadequate decision-making processes (Gupta & Singh, 2022).

Consumer protection risks are also well-documented, especially regarding pseudonymous transactions, fraud and lack of recourse in cases of protocol failure (Amrutha & Muralidhar, 2024; Tetiana & Valeriya, 2022). These governance deficits hinder investor confidence and limit DeFi's viability as a mainstream alternative to traditional finance.

User Adoption, Education and Trust

The literature consistently demonstrates that limited user understanding, technological complexity and security fears hinder widespread adoption (Alexandr et al., 2023; Hendrik et al., 2021). Regulatory ambiguity and negative public perceptions exacerbate scepticism, particularly among risk-averse

populations (Febin et al., 2023; Roberto & Andrea, 2023). Several authors highlight the necessity of robust education initiatives, usability improvements and institutional adaptation, arguing that without them, DeFi's learning curve will remain a barrier to inclusive participation (Maimunah & Bashar, 2024; Olawale et al., 2024). Trust deficits closely interact with security risks, perpetuating a cycle of low adoption.

Data Privacy, Identity, AML/CFT and Taxation Challenges

Privacy-related and identity management challenges arise due to DeFi's pseudonymous design, which creates conflicts between privacy features and compliance obligations (Igor & Antoinette, 2022) (Makarov & Schoar, 2022; Salami, 2021). Beyond compliance concerns, users face data security and privacy risks from transparent blockchains, immutable records and potential metadata leakage (Josephine, 2024). These tensions highlight the need for new regulatory and technological approaches that balance security, privacy and accountability.

Dependence on Traditional Finance and Cross-Border Integration

Although DeFi operates independently of central intermediaries, scholars emphasise its substantial dependence on traditional financial infrastructure, especially regarding fiat on-ramps, stablecoin collateralisation and cross-border liquidity (Jiahua & Nikhil, 2021). This interdependence increases systemic exposure and constrains DeFi's capacity to function autonomously.

Cross-jurisdictional participation further creates complex regulatory overlaps, heightening the compliance burden and complicating international governance (Rajmund, 2024; Shire Ahmed, 2022).

Discussion

This article mapped how decentralised finance (DeFi) is conceptualised in the 2020–2025 literature and examined what this implies for the transformation of traditional financial institutions. The findings indicate that DeFi is not treated merely as an incremental technological upgrade; rather, it is positioned as an alternative institutional arrangement that reconfigures how core financial functions payments, trading, lending, borrowing and asset issuance can be delivered through code-mediated protocols executed via smart contracts (Doerr et al., 2021; Johannes Rude et al., 2021). In this framing, DeFi challenges the foundations of traditional finance, where trust and stability are produced through regulated intermediaries, centralised governance and legally enforceable accountability structures. However, the findings also demonstrate that DeFi's transformative potential is inseparable from persistent constraints related to security, governance, regulatory enforceability and systemic stability. Accordingly, the evidence supports a dual interpretation: DeFi may modernise financial service delivery by expanding automation and accessibility, yet it can also reproduce and in some cases amplify classical financial risks through new socio-technical pathways (Nic & Linda, 2021; Mishra & Phansalkar, 2025). A key contribution of the findings is the integration of opportunity themes (transparency, inclusion, efficiency, disintermediation, innovation and borderless finance) with the structural challenges that condition whether these opportunities translate into durable institutional change. Transparency and auditability are repeatedly emphasised because transactions are recorded on publicly verifiable ledgers, potentially reducing certain forms of fraud and information asymmetry and enabling enhanced traceability (Aayush & Mayank, 2024; Isabelle, 2022). Yet the findings also clarify that transparency does not automatically deliver accountability. In traditional finance, transparency is paired with clear responsibilities, supervisory oversight, consumer redress mechanisms and enforceable liability. In DeFi, transparency frequently coexists with ambiguous responsibility because accountability is difficult to allocate when protocols are permissionless, governance is dispersed among pseudonymous actors and

control can reconcentrate in developers, validators, or large governance token holders (Dirk Andreas et al., 2020; Igor & Antoinette, 2022). This gap helps explain why DeFi's "open" and "trust-minimising" design can paradoxically weaken confidence when failures occur and losses are irreversible, particularly where recourse is limited (Nic & Linda, 2021; Iwa, 2021).

Financial inclusion emerges as one of the most prominent value propositions. The findings indicate that DeFi is commonly framed as lowering entry barriers by reducing intermediation costs and enabling access to financial products through digital wallets and decentralised applications, including for populations underserved by formal banking systems (Campbell et al., 2021; Amrutha & Muralidhar, 2024). However, the findings also suggest that inclusion claims warrant careful qualification. Much of the literature operationalises inclusion as "access", while effective inclusion also depends on usability, consumer protection, financial capability and the ability to manage risk. DeFi may reduce some barriers (fees and gatekeeping), but it may introduce others (private key management, interface complexity, limited risk comprehension and exposure to volatility) that can disproportionately affect inexperienced users (Hendrik et al., 2021; Maimunah & Bashar, 2024). As a result, the evidence supports a conditional view: DeFi can advance inclusion, but outcomes depend on user literacy, infrastructure readiness and safeguards that provide protection comparable to those embedded in regulated financial systems.

In terms of transforming traditional financial institutions, the findings imply that disruption is likely to occur through functional reconfiguration rather than wholesale displacement. DeFi protocols perform discrete functions automated market-making, collateralised lending, decentralised exchange at speed and scale, placing competitive pressure on transaction fees, settlement timeframes and product innovation in traditional intermediaries. At the same time, the findings highlight continued reliance on Traditional finance interfaces, such as fiat on-ramps, custody services, stablecoin collateral structures and compliance gateways, suggesting that the emerging landscape is more hybrid than fully disintermediated (Jiahua & Nikhil, 2021; Irina et al., 2022). In this hybrid configuration, traditional institutions may evolve towards roles such as regulated access points to decentralised markets, custodians and risk managers for digital assets, providers of identity and compliance services and infrastructure partners for tokenisation and settlement modernisation. This reinforces the broader implication that institutional transformation will be shaped by the capacity of Traditional finance actors to integrate programmable finance while maintaining regulatory obligations and consumer protection mandates.

Security and operational resilience emerge as decisive constraints on mainstream adoption and institutional integration. The findings consistently identify smart-contract vulnerabilities, oracle manipulation, protocol composability risks and cross-chain bridge weaknesses as recurring failure points with the capacity to trigger cascading losses (Fabian, 2021; Mishra & Phansalkar, 2025). These are not merely technical problems but institutional barriers because repeated exploits undermine legitimacy, deter risk-averse users and constrain regulated entities' willingness to engage with DeFi at scale. In traditional systems, operational resilience is supported through layered controls, audits, capital buffers and legal accountability. In DeFi, the findings suggest resilience is uneven often dependent on voluntary audits, variable security standards and governance processes that may prioritise rapid growth and yield incentives over prudential stability (Tim et al., 2023; Nic & Linda, 2021). Therefore, the evidence indicates that DeFi's sustained integration into the broader financial system will depend on whether security assurance becomes systematic and governance structures develop credible accountability mechanisms.

The findings emphasise that unclear or fragmented regulatory approaches shape both innovation incentives and the scale of harm when failures occur, particularly given DeFi's cross-border,

pseudonymous and permissionless characteristics (Igor & Antoinette, 2022; Ngozi Samuel et al., 2024). Persistent tensions are highlighted between DeFi design and conventional compliance requirements (AML/CFT, KYC, taxation, consumer protection), alongside unresolved issues of smart contract enforceability, jurisdiction and dispute resolution (Iwa, 2021; Shire Ahmed, 2022). These constraints matter for institutional transformation because regulated intermediaries operate within defined supervisory expectations and liability regimes, whereas DeFi protocols frequently operate in environments where “code execution” does not map cleanly onto legal rights and responsibilities. The findings, therefore, support the inference that regulatory coherence will strongly shape the pathway of convergence: risk-aligned regulation may enable responsible integration, while fragmented regulation may promote arbitrage, increase vulnerability and delay institutional adoption.

The findings also underscore macro-structural concerns regarding volatility and systemic risk. DeFi markets are described as highly sensitive to liquidity shocks, leverage cycles and contagion across composable and interconnected protocols (Nic & Linda, 2021; Siyuan, 2025). This is especially significant as linkages between DeFi and Traditional finance deepen through stablecoins, tokenised assets and institutional participation; integration without credible risk governance can transmit shocks in both directions and magnify instability (Irina et al., 2022). Consequently, the evidence does not imply that integration should be avoided, but rather that integration requires prudential oversight, operational resilience and robust disclosure to prevent innovation from translating into systemic fragility.

For emerging markets, including African contexts referenced in parts of the synthesised literature, the implications are particularly high-stakes. The inclusion promise is salient where access barriers persist, yet infrastructure constraints, uneven digital literacy and limited regulatory capacity may intensify exposure to fraud, instability and consumer harm. The findings therefore support a governance-led interpretation: DeFi may contribute to inclusion and efficiency, but only if accompanied by user-centred design, credible risk disclosures, dispute-resolution pathways and context-sensitive regulatory capacity-building (Amrutha & Muralidhar, 2024; Olawale et al., 2024). Without these safeguards, DeFi risks producing “access without protection”, where participation expands while vulnerability deepens.

Finally, the findings reveal empirical gaps that matter for scholarship and practice. A substantial portion of the literature remains conceptual or descriptive, with limited longitudinal evidence on inclusion outcomes, governance performance and the mechanisms through which protocol risk translates into user harm, particularly outside major global markets. There is also a need for more systematic evaluation of how decentralisation functions in practice, including governance concentration, accountability and the real distribution of control within protocols (Doerr et al., 2021; Dirk Andreas et al., 2020). Addressing these gaps would strengthen future contributions by moving beyond disruption narratives to measurable evidence on institutional transformation pathways, risk trade-offs and the conditions under which DeFi can responsibly complement or reshape traditional finance.

Conclusion

DeFi is widely framed as a disruptive shift that can enhance transparency, improve efficiency through automation, expand access to financial services and enable innovation through programmable finance and tokenisation. However, it is accompanied by substantial regulatory, technical, governance and user-related challenges that may limit its legitimacy and large-scale adoption. Key constraints include legal and compliance uncertainty, smart contract and cyber risks, market volatility and systemic contagion, scalability and interoperability limitations, governance and accountability deficits and consumer protection gaps. The literature therefore supports a balanced conclusion: DeFi has meaningful potential to modernise financial services, but its sustainability depends on governance capacity, security

assurance, regulatory clarity and improved usability and literacy to ensure that innovation translates into safe and inclusive outcomes.

Recommendations and Implications

Policy Implications

Policymakers should develop clearer and more coherent regulatory approaches for decentralised finance by addressing accountability, consumer protection and the legal enforceability of smart contract–based services, while recognising DeFi’s decentralised and cross-border character. In addition, governments and regulators should strengthen alignment on AML/CFT and taxation expectations in ways that are practical within pseudonymous, permissionless environments, balancing compliance requirements with the privacy tensions highlighted in the literature. Finally, policy support should extend to standards and enabling conditions for interoperability and infrastructure resilience, given the persistent constraints noted across studies relating to scalability, cross-chain integration and dependence on external data feeds such as oracles.

Practice Implications for Industry and Platforms

DeFi developers, protocol teams and ecosystem stakeholders should prioritise security assurance by strengthening auditing practices, improving smart contract testing and adopting mitigation measures that reduce exposure to exploits, oracle manipulation and cascading failures across interconnected protocols. Industry actors should also improve governance and accountability arrangements to limit the reconcentration of power and reduce governance manipulation risks that undermine decentralisation and legitimacy. In parallel, platforms should strengthen user protection and accessibility by improving interface usability, providing clear risk disclosures and expanding user education and support mechanisms, since the literature consistently indicates that adoption barriers and trust deficits remain major constraints on broad participation.

Recommendations for Future Research

Future research should move beyond conceptual debates by examining how DeFi governance operates in practice and whether decentralised decision-making produces meaningful accountability.

Additional research is required on security and systemic stability, particularly how smart-contract exploits, oracle failures, and cross-chain bridge incidents propagate across interconnected protocols.

Finally, stronger evidence is needed to evaluate DeFi’s inclusion and adoption claims, especially in emerging markets. Future studies should assess the extent to which inclusion is constrained by digital literacy, infrastructure quality, trust, usability, and regulatory capacity, and whether participation produces “access with protection” or introduces new forms of digital exclusion and consumer harm.

Declarations

Competing Interests

The author declares no competing interests.

Author Contributions

GI conceived the study, carried out the scoping review, synthesised the literature, developed the conceptual framework, and prepared, reviewed and revised the manuscript.

Funding Information

No funding was received for conducting this study.

Data Availability Statement

The data underpinning this study's findings can be obtained from the corresponding author on reasonable request.

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