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FINTECH TVARIAM VYSTYMIUI: JŲ POVEIKIO VERTINIMAS	FINTECH FOR SUSTAINABLE DEVELOPMENT: ASSESSING ITS IMPLICATIONS
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GLOSSARY

1. **FinTech (Financial Technology):** Technological inventions aimed at bettering, automating, or changing financial services such as mobile banking, digital payment, blockchain, as well as peer-to-peer lending system.
2. **Financial Inclusion:** The operation to make available to individuals and businesses cheap and necessary financial services (savings, credit, insurance, and payments) without regard to socio-economic status or geographic location.
3. **Digital Financial Service (DFS):** Financial services using electronic channels such as mobile money, online banking, electronic wallets, and automated financial systems are technology enabled.
4. **Blockchain Technology:** A distributed and decentralized ledgering system which logs transactions in a secure and transparent and immutable manner, typically of cryptocurrency, smart contracts and verification of green financing.
5. **Green Finance:** Funding of environmentally friendly projects, which can be renewable energy, carbon reduction, climate-friendly infrastructure, and eco-innovation.
6. **Sustainable Development:** A model of development that effectively addresses the current needs without reducing the capacity of the future generations to address their needs, incorporating the economic growth, environmental protection as well as social inclusion.
7. **Peer-to-Peer (P2P) Lending:** A digital lending system in which individuals or companies are lent by other individuals without going through financial intermediaries such as banks using the Internet to bypass them.

LIST OF ABBREVIATIONS

AI – Artificial Intelligence

ANOVA – Analysis of Variance

CSR – Corporate Social Responsibility

DFS – Digital Financial Services

GDP – Gross Domestic Product

ICT – Information and Communication Technology

MFS – Mobile Financial Services

P2P – Peer-to-Peer (Lending)

R² – Coefficient of Determination

SD – Standard Deviation

SDGs – Sustainable Development Goals

SPSS – Statistical Package for the Social Sciences

TBL – Triple Bottom Line

UN – United Nations

UNDP – United Nations Development Programme

UTAUT – Unified Theory of Acceptance and Use of Technology

WB – World Bank

WTO – World Trade Organization

INTRODUCTION

Relevance of the Topic: The modern financial world has been fundamentally transformed through the introduction of Financial Technology (FinTech), which provides new solutions to their long-term problems, including financial exclusion and inequality, as well as limited access to financial service. Regardless of such progress, about 1.7 billion adult people have no access to formal financial service providers all over the world, which is characterized as unbanked (Udeagha & Muchapondwa, 2023). This remains the case in the developed and the developing economies, adding to the inequality in access to money and employment and economic opportunity. Mobile banking, digital wallets, blockchain technology, and peer-to-peer lending are some of the innovative instruments that are redefining the existing financial systems in reducing the cost, enhancing efficiency, and making it more accessible (Pauliukevičienė and Stankevičienė, 2022). Nevertheless, FinTech has greatly enhanced financial inclusion; there is inadequate investigation on its overall effects on sustainable development like poverty reduction, environmental sustainability and social inclusiveness.

Level of Exploration of the Topic: The scholarly attention to FinTech has been increasing manifold within ten years. Digital finance has been examined and studied by scholars in relation to its contribution to increasing financial access (Jack and Suri, 2016; Wang et al., 2024), providing better payment systems (Farahani et al., 2022), and peer-to-peer lending (Zetsche et al., 2020). Some case studies like M-Pesa in Kenya and bKash in Bangladesh in the developing world reveal that mobile money platforms have brought about a massive financial access to previously marginalized groups. Nevertheless, the current studies are divided in spite of these findings. FinTech and sustainable development outcomes are mostly discussed in terms of financial inclusion, with little literature on the connection between FinTech and alternative sustainable development outcomes, including the ideas of green finance, environmental stewardship, and social inclusion (Hoang et al., 2022; Pawlowszka et al., 2022). Furthermore, the concept of blockchain in sustainable finance transparency has been discussed theoretically (Hahm et al., 2021); there are still few empirical studies. Thus, there is a distinct gap in the research in the field of FinTech adoption and its role in SDGs realization, especially in low-development economies, where digitalization is fast developing, and the access to infrastructures and various regulatory

elements continue to be problematic.

Novelty of the Thesis: The originality of such a thesis is in the combination of the approaches to analysis according to which Financial Technology (FinTech) is not a machine of facilitation of financial inclusion but a factor of sustainable development. Although the role of FinTech in enhancing access to financial services and driving inclusion has been analyzed with a large amount of literature (Jack & Suri, 2016; Demirgüç-Kunt et al., 2022; Udeagha and Muchapondwa, 2023), fewer studies have synthesized its potential on bigger sustainability outcomes, including economic empowerment, green finance, and environmentally responsible behaviors. To date, academic literature, such as the work of Pauliukevičienė and Stankevičienė (2022) and Hoang et al. (2022), has mainly perceived FinTech and sustainability as two separate lines of research, either in terms of the adoption of digital finance or frameworks of sustainable growth. This thesis is innovative in that it provides an analytical connection between digital financial Innovation and sustainable development as a conceptual framework of the United Nations Sustainable Development Goals (SDGs).

Theoretically, this research is new since it draws a holistic theoretical model. The three accepted theories used in the framework are Financial Inclusion Theory (Schumpeter, 1934; Danladi et al., 2023) the theory states that the increase in access to financial services leads to inclusive growth; the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003), according to which behavioral and situational factors are involved in adopting technology. Having combined these theories, the thesis presents a multidimensional view, which frames FinTech as a process where digital innovation can enhance financial inclusion and social well-being as well as environmental sustainability. This integrative model is added to the current discussion of theories regarding the ways to develop financial systems to respond to global sustainability requirements (Pawłowska et al., 2022).

As a contribution to the existing body of empirical research, this study will provide new, quantitative and empirical evidence of the connection between FinTech adoption, financial inclusion, and green finance in emerging economies, which has little empirical validation to date. The former empirical research reports, including those of Hahm et al. (2021) and Farahani et al. (2022) tend to largely concentrate on the financial inclusion aspect and very little in terms of how

digital financial innovations can facilitate green investments or approach-friendly projects. Through statistical data (descriptive, correlational, and regression modeling) using a sample population of 300 respondents, this research could offer quantifiable evidence on how FinTech tools especially mobile banking, digital wallets, and blockchain technology impact users to have access to finance, economic empowerment, and the involvement of green-friendly financial programs. This qualitative method will provide a complex picture of the interrelations between the digital technology and sustainable finance processes, which is a gap in the methodology of the existing FinTech research (Elias et al., 2024).

Problem of the Statement: The fast development of FinTech has increased the accessibility of finances with the help of mobile banking, digital money purse and blockchain based innovations. Nevertheless, the literature on the topic already recognizes the success of FinTech in enhancing financial inclusion (Hahm et al., 2021; Farahani et al., 2022), but little is known about its overall influence on sustainable development. Very only a limited number of works focused at systematically examining the role of FinTech in green finance, environmental sustainability, and sharing common SDGs especially with respect to emerging markets (Udeagha & Muchapondwa, 2023). Also, there are still digital illiteracy, infrastructure gaps and regulatory ambiguity that still hinder the mainstream implementation of FinTech innovations. Thus, the central research problem can be defined as follows: *To what extent do FinTech solutions—specifically mobile banking, digital wallets, and blockchain technology—contribute to financial inclusion and sustainable development, and how do digital literacy, infrastructural limitations, and regulatory frameworks influence these outcomes?* This question will be used as the central subject of the empirical and theoretical coverage of the study, as well as contextualize the research in a critical global setting.

Aim of the Study: The key objective of this paper is to evaluate how FinTech solutions: mobile banking, digital wallets and blockchain technology can affect financial inclusion and green finance in emerging economies relating to their implications on sustainable development in general. The study aims to find out the role of such technological advancements in empowering economies, social inclusion, and environmental friendly finance, and to define the conditions of environment (digital literacy, infrastructural capacity, and regulatory frameworks) that affect their performance.

Objectives of the Study: In order to achieve this purpose, the given research project follows the following objectives:

- a. To examine the direct correlations between the variables of FinTech (mobile banking, digital wallets, and blockchain) with development indicators (financial inclusions, economic empowerment, and environmentally friendly project scores).
- b. To investigate the mediating position of FinTech solutions in the connection between technological infrastructure and sustainability results.
- c. To assess the moderating effects of contextual factors—including digital literacy, infrastructural constraints, and regulatory challenges—on the relationship between FinTech adoption and sustainable development.

Research Methods: The study adhered to the quantitative methodology and was backed by the descriptive and inferential statistical analysis in order to determine the correlation between the adoption of FinTech and the sustainable development outcomes. The theoretical approaches featured a comprehensive review of the literature, the conceptualization of the study, and the theoretical synthesis relying on the Financial Inclusion Theory and the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Triple Bottom Line (TBL) framework, which collectively allowed generating the baseline of knowledge regarding the multidimensional role of FinTech in the spheres of economic, social, and environmental sustainability. The empirical approaches entailed the quantitative data gathering in form of a structured questionnaire and secondary data of 300 valid answers where a quantifiable understanding of the FinTech utilization and its impacts can be made. The direct, indirect, moderate associations between the key variables were statistically examined through SPSS using statistical tools, including the descriptive statistics, correlation, regression, and mediation analyses, using blockchain technology, financial inclusion, mobile banking, digital wallets, and green finance. The combination of both theoretical and empirical methods has guaranteed an all-encompassing and methodical comprehension of the role of FinTech innovation in affecting financial inclusion, economic empowerment, and environmental sustainability in emerging economies.

Structure of the Thesis

The thesis comprises three parts.

Part 1 (Analysis of Scientific Literature): (Presents the research background, problem statement,

objectives, methods, and structure. Explores existing theories and studies on FinTech, financial inclusion, and sustainable development, identifying key gaps.

Part 2 (The Empirical Research Methodology): Describes the research design, data collection methods, analytical procedures, and ethical considerations.

Part 3 (The Analytical Part): Presents the quantitative analysis of FinTech's relationship with financial inclusion, economic empowerment, and green finance.

Conclusions and Recommendations: Summarises findings, theoretical implications, policy recommendations, and directions for future research.

1. LITERATURE REVIEW ON FINTECH FOR SUSTAINABLE DEVELOPMENT

1.1 Overview of the Study

The discussion of the observed works contributes to the argument element of FinTech and sustainable development within this thesis, as a tool for demonstrating the contribution of FinTech to sustainable development, the domains of which fulfil the green finance, financial inclusion and economic empowerment. As the impact of FinTech on financing and other financial services in the Global South is salient, its probable applicability to SDGs should be conceptualised, especially in an emerging economy, where they even lack access to it (Arner et al., 2022).

The FinTech revolution has provided a platform where it is possible to address the long-standing issues, such as the issue of financial exclusion, where billions of individuals, particularly those in the rural and poor regions of the globe, are not able to receive formal financial services (Wang et al., 2024). Mobile banking, digital wallet, blockchain, and peer-to-peer lending are such technologies that have introduced a difference as they have impacted the availability of the financial resource, the extent to which it is easy to conduct business and the quality of life, among others (Hahm et al., 2021). A brief review of its existing literature will also aim to offer a better perspective on how FinTech can be considered a consistent growth-enhancing tool, ensuring it can help achieve SDGs (in particular, Goal 8: Decent work and economic growth and Goal 10: Reduced inequality) (Tidjani & Madouri, 2024).

Last but not least, the paper will present the stance on how green finance¹³⁷ through FinTech has enabled economies to promote revenue to green activities because it is an emerging discipline to which digital technologies can be applied to educate revenue accordingly. To mention a few, there are green bonds, carbon trading, and investment in renewable energies that provide an opportunity for FinTech to be transformed with the view of guaranteeing performance that is sustainable (Zhang et al., 2021). However, despite the outstanding achievements in FinTech, there is still little understanding of whether this technology can promote widespread efforts to achieve sustainable development projects (Farahani et al., 2022).

The literature review is thematically organised, where each one of the themes under consideration contributes to the research problem. These are terms like financial inclusion, green finance and such correlated terms like DFS and technology adoption frameworks. These notions

should be clearly defined and elaborated in order to explain the area and scope of the review as well as to get a theoretical aspect of the thesis (Hoang et al., 2022). The second section represents the literature overview of FinTech and sustainable development. It entails, among others, the economic dimensions of FinTech in the drive to financial inclusion, the refrigerator effect of FinTech in green finance, and the wider economic consequences of economic empowerment and poverty reduction (Mhlanga, 2022). A synthesis of the findings of a relatively broad range of research will be offered in this section to evaluate the beneficial and adverse impacts of FinTech on sustainable development and a critical analysis of methods and findings (Pawłowska et al., 2022).

In section three, we have presented the models, frameworks and methodologies which were used to conduct prior Research. It will be inclusive of a description of what the pertinent factors (i.e., the Unified Theory of Acceptance) and assessment methods (i.e., the Triple Bottom Line (TBL) framework to evaluate sustainability) might apply across disciplines. A description of constraints and the major contributions of the research methods to findings that might be helpful in detecting any bias or gaps present in the logic of the literature will also be outlined in this section of the paper (Arner et al., 2022).

Lastly, to wind up the review, let us refer once again to the principal research question this Research is dealing with: how it is possible to use FinTech with the agenda of SDG and any of its subsections, such as financial access/planning or climate change combat. Hopefully, the study will help fill some of the literature gaps and better focus on what should be researched and better comprehended (Wang et al., 2024). The last section will place an emphatic focus on how the empirical analysis would be configured in order to extract the contribution that would be targeted in the contribution to the existing debate on FinTech on sustainable development (Tidjani & Madouri, 2024).

1.2 Concept and Theoretical Framework

In the dynamic world of the digital financial environment, there is a need to find the theories and the models that are used to include Fintech in sound and sustainable growth. The section under consideration identifies some major theories and ideas regarding the topic of the reviewed idea, and they are Financial Inclusion, Technology Adoption, and Sustainable Development (Zhang et al., 2021).

Financial Inclusion Theory: The theory of financial inclusion says that it is a block foundation that leads to sustainable growth because it enables individuals to use the tools and resources that help to manage economic prosperity. Financial inclusion is anchored on the argument that the basket of financial processes being provided (banking, credit, insurance, and savings) is a prerequisite towards economic growth and stability. Mhlanga (2022) defined financial inclusion as the consumption and accessibility through household and firm level to formal financial services. Anyone outside this group who lacks access to these services is thus outside the formal economy; he/she cannot save money and cannot put a value on his/her economic uncertainty (Najaf et al., 2023). Hardly anyone will agree with the fact that financial inclusion is not extremely significant in the era of FinTech. P2P lending marketplaces, mobile banking and digital wallets have brought financial services to the masses and democratised the provision of financial services in parts of the world where the banking system was highly dispersed. An example is given in (Arner et al., 2022), which suggests the use of new mobile financial services such as M-Pesa in Kenya, which is transforming financial inclusion in the rural and low-income sector. M-Pesa and the alternative have a substantial expansion of savings, credit and microinsurance, leading to financial inclusion, financial literacy and economic empowerment as well as diminishing poverty (Wang et al., 2024). Admittedly, the theory of financial inclusion confirms the argument that economic growth is merely a priority factor of social inclusion through FinTech. It makes sure that the marginalised, particularly in the developing nations, will be able to participate in the economy and in economic development on a greater scale. In addition, it directly overlaps with SDG 10 (Reduced Inequality) and SDG 8 (Decent Work and Economic Growth), creating a level playing field and enabling access to economic resources (Tidjani & Madouri, 2024).

Technology Adoption Models: In order to examine the ways of adoption and use of FinTech innovations, the use of technology adoption models has been taken into consideration. A theory with that description is the Unified Theory of Acceptance and Use of Technology (UTAUT), designed by Zhang et al. (2021), being one of the most highly popular theoretical frameworks in technology acceptance studies. The model identifies that performance and effort expectancy, the social influence, and facilitating conditions are the key concepts to the acceptance and utilisation of the technology (Mhlanga, 2022). In the context of the adoption of technology in financial services (FinTech), the reasons why people in developing countries are also willing to adopt digital financial services are as follows. The perception of the yield of a technology in terms

of economic performance (e.g., in transactions and savings) of a user is called performance expectancy. As far as mobile money is concerned, it is faster and easier, and the time taken to complete a transaction is a major force behind its uptake in marginal communities where conventional banking has been proven ineffective (Arner et al., 2022). The ease of use of a technology is referred to as the effort expectancy. Enhance a good user experience: In the mass market, mobile money services should be user-friendly, particularly in geographies in which there is poor digital literacy. Due to being another determinant, social influence refers to the impact of the social networks (family, society) on the technology adoption tendency. This has been evident especially in areas such as Sub-Saharan Africa, where peer effects have been a fundamental tool used to speed up the usage of mobile money applications like M-Pesa (Wang et al., 2024). Facilitating conditions, such as access to mobile phones, good internet connection, and governmental support, are very important to enable the infrastructure for the usage of FinTech services. Therefore, the UTAUT model offers an extensive viewpoint on the diffusion of FinTech services in various settings, such as emerging economies (Hussain et al., 2024).

Sustainable Development and Green Financial Development: The SD theory revolves around the concept that development should cater to the needs of the present generation without hampering the possible needs of the forthcoming generation. According to Udeagha & Muchapondwa (2023), sustainable development is meeting the needs of the present without compromising the ability of future generations to meet their own needs. This concept is associated with three pillars: social inclusion, economy and environmental protection. Such a structure would be needed in how the role that FinTech may play in the fulfilment of the sustainability objectives, namely at the green finance and environmental sustainability levels landscape (Tidjani & Madouri, 2024). Green finance is also concerned with investment in investment projects that are not only environmentally and socially beneficial, such as in the renewable energy case, but also in carbon-reducing efforts. Greening Finance by FinTech is set to make the belief of green finance highly among the best enablers, which will then enable making every single process of project financing sustainable, more transparent, secure, and efficient (Zhang et al., 2021).

According to Mhlanga (2024), technologies like blockchain can be used to facilitate the introduction of transparency and the traceability of green investments (including green bonds and carbon credits). The immutable nature of blockchain means that the financing of sustainable projects is undertaken in a transparent and non-abusive state, thus a pivotal exercise without our

capacity to establish credibility in the green finance markets (Karim et al., 2022). FinTech's contribution to green finance also relates to SDG 13 (Climate Action) and SDG 7 (Affordable and Clean Energy). FinTech has the means to encourage investment into such green infrastructure and to ensure the accountability of that investment. It can therefore contribute to massive environmental change by making available cheaper sources of funding to enable the transition to a sustainable economy (Mhlanga, 2022).

Theory of Diffusion of Innovations: Initially, the Diffusion of Innovations (DoI) Theory was introduced by Ahmad et al. (2025) at the macro-level to show how new technologies are spread in the social system as time progresses. The theory is also especially applicable to the study of the adoption of FinTech solutions to various social, economic, and geographical demographic groups in emerging markets (e.g., mobile money (M-Pesa), blockchain to green finance, and peer-to-peer lending) (Tripathi & Rajeev, 2023). Adopters are classified into five groups, namely, innovators, early adopters, early majority, late majority, and laggards, who adopt a technology at different stages of its life cycle. Five major innovation attributes determine the rate and the extent of adoption, including relative advantage, compatibility, complexity, trialability, and observability. As an example, in Kenya, the high relative advantage of M-Pesa, compared to the traditional banks, and the alignment of the technology with the mobile behaviour of users, as well as its comparative simplicity, allowed it to be used by users with low digital literacy levels (Wicaksana et al., 2023).

This theory can be valuable to analyse the process of transferring digital financial services from a pilot project to a mass uptake in underbanked areas in the sphere of FinTech and sustainability. An example can be seen in Pata et al. (2024), who mentioned that carbon trading platforms based on blockchain technology are still at the phase of early adopters, being potentially capable of changing the transparency of green finance as we know it (Hahm et al., 2021). Knowing where various FinTech tools are along the diffusion curve can enable policymakers and FinTech providers to focus awareness programs, subsidies, or infrastructural assistance to the appropriate groups of populations (Arner et al., 2022). Also, the DoI can contribute to the explanation of the differences in the pace of diffusion of innovations depending on the cultural or institutional setting, and this aspect is closely related to the following theory (Najaf et al., 2023).

Institutional Theory: Institutional Theory helps understand the regulatory, normative, and cultural-cognitive framework to encourage and determine the adoption and implementation of innovation, such as FinTech, in different environments. When applied to FinTech, Institutional Theory assists in explaining why adoption is significantly distinct at the level of country or region. As an example, in several Sub-Saharan African and Southeast Asian markets, FinTech adoption is significantly greater due to the involvement of the governments in the regulatory process, the investments made to support mobile infrastructure, and the cultural acceptance of mobile payments. Conversely, the lack of an institutional framework, such as uncertain regulation or low enforcement systems, contributes towards stunting the growth of FinTech in other areas, even in contexts where the user demand or technology access are comparable (Wang et al., 2024).

Green financial models will also require institutionalization to be scaled up in the sustainability context. According to the observations of Udeagha & Muchapondwa (2023), blockchain may help to enhance the level of trust in green bonds and The carbon credit system by providing transparency and trackability (Hussain et al., 2024). But when there is no institutional backing, e.g. legal requirement on the environment claims or protection of data privacy, the advantages of such FinTech tools cannot be achieved to the full extent.

Moreover, institutional demands may be liberating and limiting. To cite an example, Mhlanga (2024) tell how financial regulators may push the use of sustainable FinTech and make it faster by establishing non-restrictive taxation and investment policies or, on the contrary, delay its expansion and encourage the use of restrictive compliance provisions that the smaller innovators might not satisfy. Thus, the concept of Institutional Theory provides a powerful framework with the help of which the larger ecosystem where innovations in FinTech should work can be examined (Tidjani & Madouri, 2024).

Stakeholder Theory: The theory of stakeholders was developed by Freeman in 1984 and proposes that the opinion of all stakeholders (and not only shareholders) should be given heed to make decisions in an organisation. This theory can be used in the process of FinTech to sustainable development, where it forms a critical role in shaping the framing of how digital financial service providers, governments, NGOs, as well as the local people should be factored in the development of FinTech solutions, their deployment, and regulation (Zhang et al., 2021). FinTech projects, particularly about financial inclusion and sustainability, reach out to many different stakeholders. As an example, the implementation of blockchain in the emergence of green finance platforms

attracts not only investors and developers, but also regulators, environmental agencies and the ultimate consumer of sustainable projects (e.g., the local population getting a solar power station). The researchers stated that accountability and transparency concerning such initiatives are the keys to the trust of various stakeholders (Mhlanga, 2022).

Stakeholder Theory can also endorse a humanistic view of FinTech, which considers those populations who are at a disadvantage due to metropolitan urbanisation and should be subjected to an empowering impact of technology, instead of a purely commercial value. Digital financial services can be used to decrease inequality and gender empowerment, as shown by Ahmad et al. (2025). However, these are conditional on whether the platforms are going to fulfil the actual needs of the people- delivering microloans to female entrepreneurs, or having the content put in local languages (Karim et al., 2022). In addition, it is also with the aid of this theory that one can explain why cooperation among the different stakeholders is a prerequisite in scaling FinTech to achieve sustainable development. Ahmad et al. (2025) have emphasised the issue of trust and security in the application of FinTech that can only be realised not only by the technology developers but also by regulators, civil society, and the people of financial literacy. Projects based on FinTech implementations that do not take into consideration the interests of key stakeholders, including regulators or local populations, are likely to be met with opposition and will not scale otherwise, despite technical soundness (Wicaksana et al., 2023). Key Concepts are below:

- **Financial Inclusion:** Financial inclusion is the method by which members of society who are economically and/or socially excluded from mainstream financial institutions (banks) have access to affordable financial services, which can include banking services, saving services, loan services, and insurance services. The use of mobile banking facilities and digital wallet services is a key step to promote financial inclusion for people in developing countries where traditional banking infrastructure is not available (Pata et al., 2024).
- **Green Finance:** Green finance is an investment project of sorts on activities and investments that contribute to the sustainable development of the environment. The project may also be offered in terms of renewable energy sources provision, elimination of carbon, and other non-polluting ventures. The FinTech technology has also changed sustainability finance by digitalising the various platforms and creating an easier path to the sustainable investments channel, where it is easy to measure and track the investments (Tripathi &

Rajeev, 2023).

- **Digital Financial Services:** The realms of the deal during financing, that is, when payment occurs online on a platform, constitute the domain of Digital Financial Services (DFS). They encompass peer-to-peer lending, mobile money and digital wallet, and those services that require people to have control over their money, and they do not need the formal banking infrastructure to use them (Mhlanga, 2024). The rise of digital financial services. The rise of digital financial services is a critical aspect of the successful implementation of financial inclusion because, in most areas, banks are not within reach (Wicaksana et al., 2023).

Theories and ideas are significant to comprehend the role of the FinTech in promoting sustainable development. The financial inclusion hypothesis is used to analyse the interaction between digital finance and access to finance, as well as promoting economic and social development (Ahmad et al., 2025). These models of adoption of technology and UTAUT in particular, lead to the knowledge of how and why individuals adopt these technologies, and it is important to learn the same to determine whether FinTech would be applicable in different cultures and economies. Finally, the structures of green finance and sustainable development reveal how FinTech can help to achieve environmental sustainability in promoting investments in green technologies and enhancing the information in terms of sustainable finance (Pata et al., 2024).

1.3 Empirical Research

The studies on the role of FinTech in sustainable development can be classified into two themes: (1) the economic implications of FinTech, with a focus on financial inclusion, and (2) the increasing relevance of FinTech in green finance and sustainability. This section reviews selected relevant studies (arranged consistently based on chronological order and content) to explore them from a critical perspective, to identify the shortcomings and then point to the directions this Research will facilitate (Udeagha & Muchapondwa, 2023).

1.3.1 The Economic Flow-On Effects and Financial Inclusion

In the first years of the 21st century, FinTech research focused on assessing the technical feasibility and early dissemination of digital financial services, particularly mobile banking. One of the earliest examples is M-Pesa, the mobile money service launched in Kenya. M-Pesa has revolutionised financial services for people across the world who have access to a mobile phone

but do not have or have only limited access to a bank account. It has enabled millions of people who have access to a mobile phone to send and receive money, make payments, and access other financial services, and it is delivered to customers through a mobile network operator (Mhlanga, 2024).

Among relevant papers in this period is Pauliukevičienė & Stankevičienė (2021), which focused on the impact of M-Pesa on financial inclusion in Kenya. Studies showed that M-Pesa significantly raised the use of financial services, especially in rural and unbanked areas. It also showed that M-Pesa didn't just increase financial inclusion but household welfare as well because people save with mobile money, and of course, use remittances and pay for health with mobile money, and savings are better managed. It turned out that digital financial services could provide access to formal banking services and unlock the moat of access to finance in poor economies. Moreover, Abramova et al. (2024) provided inputs in support of the notion of how mobile money, such as M-Pesa, proves supportive in the sense of enhancing economic resilience through delivering emergency cash and smoothing consumption (Ahmad et al., 2025).

Recent studies demonstrate that with rapidly developing digital financial infrastructure, the focus has shifted from FinTech adoption itself to the question of socio-economic impact on financial inclusion. For example, Chueca Vergara & Ferruz Agudo (2021) explored the relationship between FinTech adoption and financial inclusion and specifically focused on the influence of mobile money services on the question of poverty reduction. The results indicate that the availability of digital payment instruments had a direct impact on the uptake of financial literacy and business opportunities in the emerging markets (Chueca Vergara & Ferruz Agudo, 2021). The M-Pesa mobile money services also helped in community development, with people able to start their own micro-businesses, save and afford education and health-related services in a proper manner. Narula and Gupta (2024) took this concept to the next level to examine how mobile financial services can be one of the contributing factors to entrepreneurship in the developing world. It was emphasised in the study that the unbanked population in need of access to alternative bank lending could not access FinTech opportunities like microcredit and microloans (Hahm et al., 2021). This kind of financing enabled the receivers to be able to lend money easily to small businesses, make more money and establish a better habit of financial culture that is more secure and sustainable. However, while some papers explored gender aspects of mobile financial services and traditional banking, there were reports that women gained a lot from mobile banking and

mobile money services, especially in rural areas. Being in charge of personal finance, a woman is more likely to achieve financial security and freedom and experience the same self-empowerment as a man does in his older days (Pata et al., 2024). However, while it is in these works that a robust case that FinTech matters for economic empowerment has been made, the nature of financial inclusion is contested. However, it is worth asking whether these virtual offerings will bring about sustainable accumulations of wealth and economic. it provides "a response to the financial precarity normally caused by relying on fee-for-service work," in speak. Green Finance and Sustainable Development rely upon their stock of natural capital (renewable and non-renewable) (Najaf et al., 2023).

1.3.2 Blockchain and Green Finance

Green finance refers to initiatives and investments that promote environmental sustainability, such as renewable energy projects, climate change mitigation, and carbon reduction projects (Udeagha & Muchapondwa, 2023). Similarly, blockchain can be regarded as one of the critical tools to improve the efficiency, transparency, and traceability of green finance. Chatterjee et al. (2023) examined blockchain for supply chain sustainability and stressed the value of blockchain for proving the origin of products and how they have been responsibly made. As blockchain can create a non-reversible, transparent ledger, it may be very applicable to green investment because it creates a means of verifying environmental claims as well as tracking that investment in a sustainable project is being put to authentic purposes (Mhlanga, 2024). Similarly, in another study of Vergara & Agudo (2021), they made the gap close with the CM in carbon credit trading. They assured themselves that blockchain was a scalable platform to record, validate and demonstrate carbon abatement projects. Blockchain technology is a good way to ensure that investors' money goes into projects that, in the real world, are doing something to address the danger in worries about global warming. It spurs confidence and appetite for investment in green projects – something that is needed if solutions to the climate change problem are to be scaled (Ahmad et al., 2025).

1.3.3 Sustainable Development

Sustainability has been a key area of focus for scholars this past year, and the SDGs in particular pose some important questions as to the role of FinTech in sustainable development. Fintech providers have a bigger sustainability goal than what would be achieved through the effect of technology on financial inclusion and funding for new technologies, according to Elias et al.

(2024). Gabor emphasised that DFCOs can be useful in funding green investment and investment projects for sustainable development, such as instruments for fulfilling SDG 13 on climate action fund and SDG 7 on providing energy for everyone (Wicaksana et al., 2023). Pauliukevičienė & Stankevičienė (2021) explored the possibility that micro-loans for villages could also be applied to polysolar applications (as village-based non-interest-bearing micro-loans for solar installations between individuals lead to sustainable micro-loans to an energy service provider). The paper also highlighted how blockchain-based platforms could facilitate a transparent, accountable source of funding mechanisms for these projects to be funded and their funds disbursed and spent in a sustainable way, as well as towards sustainable goals. Such platforms could be the template for funding clean energy options in off-grid regions without banks, the authors said (Pata et al., 2024).

1.3.4 Critical Synthesis

First, the Disruptive potential is that the current literature demonstrates the potential of this technology to provide financial inclusion and green finance. In the recent estimative results of Abramova et al. (2024), the authors proved to be beneficial in delivering relatively large positive results for several socio-economic indicators, such as financial access and economic empowerment. Similarly, Vergara & Agudo (2021) over-refer to blockchain-based innovation and other fintech instruments that ensure transparency and accountability as a means to provide greater potential for a more significant scaling of green investment. The literature that offers longitudinal empirical evidence on how FinTech will affect wealth and/or economic empowerment in the long run is sparse. However, there is some initial encouraging evidence around FinTech's potential to improve access to financial services; there is less to be said in terms of FinTech's potential to improve long-term economic well-being outcomes (Chatterjee et al., 2023).

Regional differences in the utilisation of FinTech have been under-investigated. It is so narrow, concentrating on sub-Saharan Africa, and it does not actually assist me in finding the solution to the bigger issue of FinTech solutions functionality in all its places, such as Latin America or Asia. Therefore, longitudinal studies are needed to evaluate the impact of FinTech on economic resiliency and wealth building for underbanked individuals (Pauliukevičienė & Stankevičienė, 2021). The effects of FinTech solutions on dialogue 10 large green finance projects and their effects are the subject of future Research, too, which requires more empirical results. Finally, it will be helpful to undertake studies to understand regional differences in the uptake and

impact of FinTech solutions, particularly in other parts of the world that are not like sub-Saharan Africa, where other barriers exist to the uptake of digital financial services.

1.4 Models, Frameworks, and Methodologies

Unified Theory of Acceptance and Use of Technology (UTAUT): It refers to the perception of how easy the use of the technology is. FinTech services need to be user-friendly in order to be widely adopted, particularly in emerging economies with lower digital literacy. For instance, mobile money services like M-Pesa need to be easy enough for non-technical users to understand and use (Abramova et al., 2024).

Social Influence: The degree to which an individual perceives that significant others (e.g., family, friends, peers) believe he/she should use the technology. In regions where mobile banking or digital wallets are prevalent, social influence plays a key role in activating users in the adoption of FinTech services. In areas such as sub-Saharan Africa, peer influence from those who are already using services such as M-Pesa can induce new users to join as well (Chueca Vergara & Ferruz Agudo, 2021).

Facilitating Conditions - Availability of Infrastructure to support Technology Use. In the FinTech sector, which means having access to smartphones, an internet connection, and financial literacy programs. The availability of these resources is key to users' willingness and ability to adopt FinTech solutions and actively use them (Chatterjee et al., 2023).

The UTAUT model has been significant in explaining why some market segments, specifically in developing economies, have been adopting FinTech innovations more than others. UTAUT model is, however, criticized for the disregard of the local context and culture, which may affect technology acceptance. For all that, it illuminates the important variables. However, it fails to capture regional heterogeneity in relevant variables such as wealth inequality, cultural attitudes toward technology, or the local regulatory framework (Elias et al., 2024).

Triple Bottom Line (TBL) Approach: A fundamental contribution to the evaluation of sustainability was the Triple Bottom Line (TBL). While most standard financial performance measures are profit-based, the TBL measures a firm's performance in three dimensions that are interconnected: economic, social, and environmental. This framework is especially applicable to FinTech with respect to sustainable development as it can be used to evaluate whether digital

financial services support economic growth, social parity, and environmental sustainability (Pauliukevičienė & Stankevičienė, 2021).

Economic: In the TBL context, the Economic perspective of how FinTech is able to stimulate economic growth, especially the financial benefits of underserved to get access to financial services driven. FinTech can create economic value in the form of microloan provision, entrepreneurial opportunities, and access to credit for the under-banked (Abramova et al., 2024).

Social: In a social aspect, FinTech contributes significantly to the decrease of inequality by extending financial services to individuals who traditionally were not able to access financial products: rural population and low-income society. Services provided by mobile telephones, such as mobile banking and micro-insurance, may be used to support social welfare by making it possible for people to save, insure themselves, and participate in the formal economy (Chueca Vergara & Ferruz Agudo, 2021).

Environmental: The environmental TBL aspect entails how sustainability, more precisely in the context of green finance, can be promoted with the help of FinTech. Being an investment in the fields of blockchain and others, FinTech can bring transparency to sustainable investments, making procedures such as carbon trading or green bonds possible. Hussain et al. (2024) notes that FinTech also has the power of supporting transparent and auditable financial districts and even reducing on the cost of money being used to support sustainability (Chatterjee et al., 2023).

The TBL paradigm is a systemic valuable model for understanding the impact of FinTech on sustainability. Yet, for the FinTech industry, its use is emerging, and more Research is needed to understand how digital financial services could more directly support each of these three pillars, especially in emerging markets (Elias et al., 2024).

1.5 Chapter Summary

It is the literature review that is capable of carrying out the complete scan of the theoretical background, the concepts and previous studies that were applicable to two phenomena: FinTech and sustainable development. It has proven a triumphant scale of colossal potential in FinTech in expanding financial incorporation and green finance, which suggests a lot in sustainable development. The review concludes that digital financial services play a very critical role in increasing accessibility to financial services, especially in developing nations where access to traditional financial infrastructure is limited. FinTech products like mobile banking, peer-to-peer

lending, and blockchain have shown that they are well placed to promote transactions and credit disbursement and support ecologically friendly projects for a more inclusive economic and sustainable environment.

2. RESEARCH METHODOLOGY

2.1 Research Design

The research design embraced in the current study was quantitative and empirical research design to investigate the effect of Financial Technology (FinTech) solutions, including: mobile banking, digital wallets, and blockchain technology, on financial inclusion, economic empowerment, and green finance in emerging economies. The research design adheres to the positivist philosophy of the study that assumes that such social phenomena as technology adoption and financial inclusion can be objectively measured and quantified (Narula and Gupta, 2024). It used a deductive approach and relied on the previous theoretical models to build hypotheses and determine them statistically; Financial Inclusion Theory, Technology Acceptance Model (UTAUT), and Triple Bottom Line (TBL). This design enabled the rational measurement of both direct, indirect and moderating effects of the variables.

The paper incorporated the correlational-descriptive type of research allowing examining the relationships between the independent variables (the indicators of FinTech adoption: the use of mobile banking, digital wallets, or blockchain technology) and the dependent variables (financial inclusion, the empowerment of the economy, and the sustainability of the environment). The data were cross-section, and were taken and analyzed in a 300 respondents surveying, using SPSS. However, this design is chosen because it is suitable in establishing causal relationships between the use of technology and sustainable development, and the study will be able to calculate the size and the importance of the impacts of FinTech (Danladi et al., 2023; Elias et al., 2024).

2.2 Hypotheses Development

According to the theoretical premise, the hypotheses that were developed to test the relations between FinTech adoption and the sustainable development dimensions were as follows. Both hypotheses are based on information borrowed and theoretical arguments.

H1: The use of FinTech services (mobile banking and digital wallets) positively influences financial inclusion.

FinTech-based innovations have been generally acknowledged as disruptive technologies that increase the financial access of underserved and unbanked communities (Ellili, 2022). M-Pesa in Kenya and bKash in Bangladesh have proven examples of mobile banking platforms that can close the financial inclusion divide by offering low-cost and easy-access financial services particularly in rural and low-income areas (Pizzi et al., 2021). Udeagha and Muchapondwa (2023) allege that FinTech has transformed the old banking environment by dispelling geographical and bureaucratic boundaries that tend to isolate the marginalized groups of people. Tripathi and Rajeev (2023), continue to add that digital wallets have an overall positive impact on inclusiveness in the sense that it brings about microtransactions, lowering transaction costs and providing secure and real-time payment systems that boost the confidence of the users. Also, Narula and Gupta (2024) mention that mobile-based financial services enhance savings behaviour and enable people to engage in formal financial ecosystems. This is favored by the World Bank (2022) who adds that mobile financial platforms have led to a quantifiable increase in account owning and financial participation in developing economies. Altogether, these researches create a powerful theoretical and empirical basis of the hypothesis that the usage of mobile banking and digital wallets can put considerable weight into financial inclusion through improving its accessibility, affordability, and involvement of users in the financial system.

H2: Blockchain technology positively contributes to the promotion of green finance.

Ellili (2022) and Treu (2024) render it clear that the decentralised ledger system of blockchain provides transparency, immutability, and traceability of the financial transactions hence accountability in green finance efforts. Restricting chances of fraud and misappropriate allocation of resources in environmental projects, blockchain reduces the risks of fraud and misfunding of project financing and results, which is possible by means of real-time verification of the project funding and results. As evidenced by Ataayah et al. (2024), carbon markets are more believable and accessible because blockchain allows tracking and validation of carbon credits effectively. Equally, as Mahmud (2024) observes, there is the utilization of blockchain technology in the issuance of green bonds, marking the tracking of investments and making them reliable to investors interested in sustainable issuance. According to Gancarczyk et al. (2022), smart contracts based on blockchain have the ability to sustainability compliance through complying with the milestones of the project in order to unleash funds, which enhances environmental governance. Moreover, according to Ashta (2023), the aspect of deploying blockchain within the sustainable

finance ecosystems improves the integrity of data and cross-border partnership in the eco-friendly projects. By following the Triple Bottom Line (TBL) model, blockchain is therefore an enabler of technology that balances financial effectiveness, environmental accountability, and accountability towards the society. Together, these results support the hypothesis that the blockchain technology can play a major role in enhancing the green finance and green investments via transparency, efficiency and accountability.

H3: Contextual barriers such as digital literacy, infrastructure constraints, and regulatory challenges moderate the relationship between FinTech adoption and sustainable development outcomes.

Digital literacy, infrastructure barriers, and regulatory barriers are contextual barriers that moderate the nature of relationship between FinTech adoption and sustainable development outcomes because ample empirical and theoretical evidence advocates the importance of contextual enablers in defining the effectiveness of FinTech. Danladi et al. (2023) point out that although FinTech has the potential to increase financial inclusion and financial sustainability, the effectiveness of this innovation heavily depends on the digital literacy of users since people with low technological competences have reduced chances of adopting and successfully using digital financial services. On the same note, He et al. (2024) observe that lack of proper infrastructure including poor internet access, unreliable electricity status and limited access to smartphones forms a major obstacle to the proliferation of FinTech, especially in rural or underdeveloped parts of the world. Trimulato et al. (2022) also consider that variable or repressed regulations are a hindrance to innovation and the capacity of digital financial systems to scale up, so that they can do less to support sustainable development. Udeagha and Muchapondwa (2023) found that the exhausting policy uncertainty and regulatory fragmentation conditions discouragement of inclusive investment in FinTech ecosystems and slows down the incorporation of green finance. Besides, Pizzi et al. (2021) established that the digital divide contributes to social and economic inequalities, which reduces the capacity of FinTech to align with the UN Sustainable Development Goals (SDGs). Such contextual barriers are moderating factors that affect user behavior and the overall impact of technology-based financial innovations, in accordance with the Technology Acceptance Model (UTAUT) and the Financial Inclusion Theory. Thus, the following hypothesis acknowledges that although FinTech can lead to sustainable development, its actual contribution is moderated by the antecedent factors according to which it is implemented.

2.3 Conceptual Framework

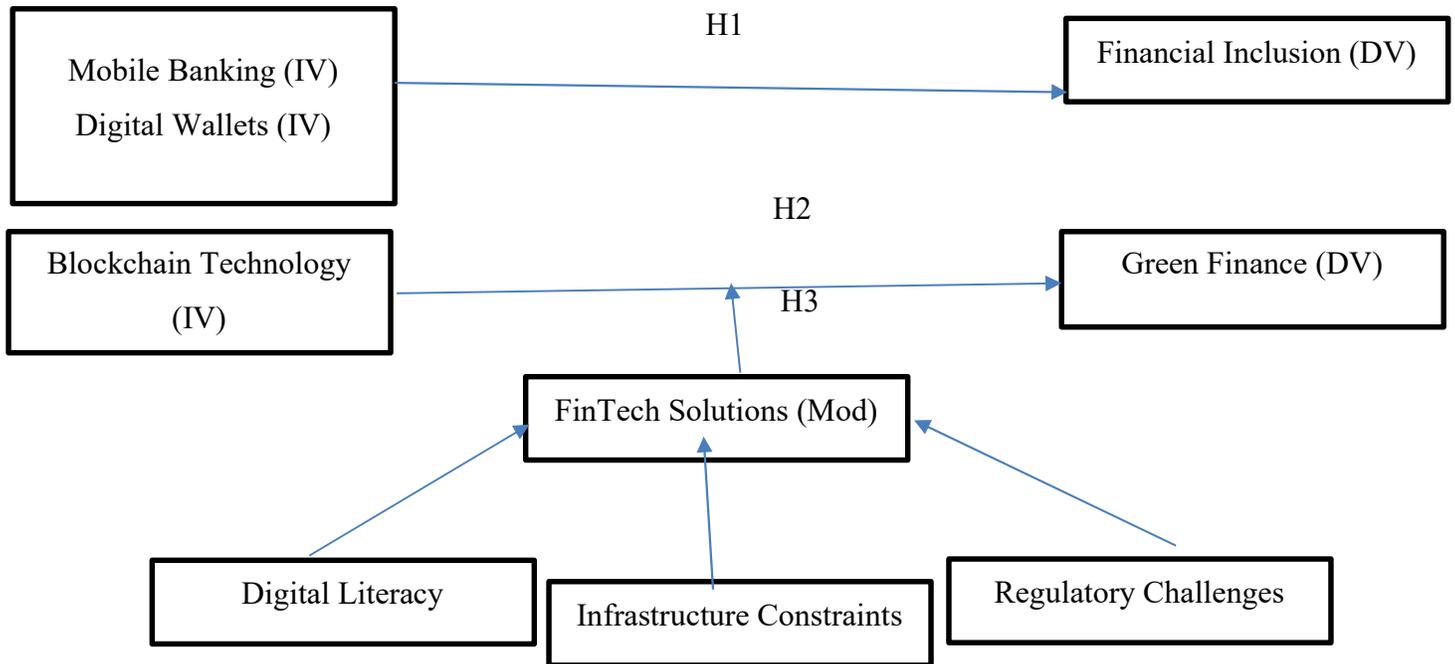


Figure 1: Conceptual Framework

The theoretical framework will be a combination of Financial inclusion theory and UTAUT framework and Triple bottom line (TBL) framework to demonstrate the effect on sustainable development of adopting FinTech.

- Independent Variables: Mobile Banking, Use, Digital Wallets, Blockchain Technology.
- Mediating Variable: FinTech Solutions (intensity of integration and use) (Mediating Variable).
- Dependent Variables: Monetary Inclusion, Economic Power, Eco-friendly Project Rating.
- Moderating Variables: Digital Literacy, Infrastructure limitations, Regulatory Multicultural issues.

In this model, the probability of increased financial inclusion and financial sustainability through the FinTech usage is taken because financial provisions are easy and available. However, the moderate effect of the association by literacy and infrastructure and regulatory environments where both might encourage or restrain the impacts of FinTech. How innovative platforms divert

to sustainable outcomes, the mediating role of FinTech solutions (e.g. blockchain-based finance) packages the same. The well-theoretical reflection of the model will offer a multidimensional prism of analysis, a combination of economical, social, and environmental dimensions (TBL) with the behavioral antecedents of technology acceptance (UTAUT) and by ensuring that the role of FinTech as the factor of sustainability is considered holistically (Treu, 2024; Udeagha and Muchapondwa, 2023).

2.4 Sampling

Purposive and snowball strategy of sampling was applied in the research. Its sampling was limited to a purposive one to make sure that the respondent will be conversant with the FinTech applications (with users of mobile financial applications, digital wallets, or blockchain-based applications). This was done to ensure that they were related to the objectives of the study (Trimulato et al., 2022). The approach adopted to recruit other participants was snowballing, particularly those in green finance and digital payment system profession, which is generally inaccessible. A total of one hundred and fifty-five valid responses were obtained which is sufficient enough to qualify as a minimum sample size to guarantee multivariate statistics analysis (Narula & Gupta, 2024). It is a reasonable sample size to continue with correlation and regression analyses using reasonable degree of statistical power. It was non-selective in the sample as it included individuals in the emergent economies and this ensured that different experiences of the users in rural and urban areas are captured. However, such a limitation as accessibility and time did not permit considering some groups that lack direct access to FinTech that may decrease the generalizability (He et al., 2024).

2.5 Data Collection and Research Instrument

The validated research occurring previously on FinTech adoption and financial inclusion was transformed into a structured questionnaire in the role of a data collection tool. The instrument consisted of Likert-scale questions (1 strongly disagree to 5 strongly agree), based on which it was possible to determine the perceptions connected to the use of FinTechs, digital literacy, financial inclusion, economic empowerment, and sustainability practices.

The instrument was tested on a pilot group of 20 FinTech users in order to identify clarity and reliability. The outcome of this pilot allowed to refine wording and sequence of items.

The questionnaire had the following sections:

1. Demographic (age, sex, education, level of income, location).
2. Adoption behaviour (utilizing mobile banking, digital wallets, blockchain),
3. Perceived (financial inclusion, empowerment) value.
4. Sustainability Impact (involvement in green project, involvement in green finance)
5. Weaknesses and situational (digital lit, infrastructure and regulatory perception) challenges.

The internal consistency of the instrument was determined using a Cronbach Alpha = 0.980 that is excellent when it comes to its reliability. Also, in situations where appropriate, secondary sources about the use of FinTech and sustainability indicators were indexed in international databanks, such as the World Bank and IMF (Elias et al., 2024).

2.6 Data Analysis Techniques

The data were analyzed in SPSS Version 26 with the help of the descriptive and inferential statistics. The demographic data, as well as the patterns of FinTech use, were summarized by descriptive statistics (means, SDs, frequency distributions, and histograms).

Inferential analyses were:

- Correlation analysis that will determine the relationships among FinTech variables and sustainable development indicators.
- The adoption of FinTech and outcomes with respect to financial inclusion and green finance will be tested by conducting a multiple regression analysis.

To evaluate the role of FinTech solutions as the mediator of the correlation between blockchain technology and the performance of friendly projects, the mediation analysis (PROCESS Macro by Hayes) will be performed.

These analyses combined it became possible to test strong both direct and indirect effects which gave a detailed empirical support to the conceptual framework.

The quality of data was checked using strong reliability (Cronbachs Alpha) and validity assessment or checking of quantitative data by pre-testing and triangulation of quantitative data and theoretical constructs (Pizzi et al., 2021; Mahmud, 2024).

3. ANALYSIS OF FINTECH FOR SUSTAINABLE DEVELOPMENT

3.1 Descriptive Statistics

Table 1: Descriptive Statistics

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
use of mobile banking	300	1	5	3.01	1.412
use of digital wallets	300	1	5	2.89	1.411
financial inclusion	300	1	5	2.85	1.446
economic empowerment	300	1	5	2.91	1.385
eco friendly project score	300	1	5	3.01	1.383
blockchain technology	300	1	5	2.98	1.360
digital literacy	300	1	5	2.93	1.450
infrastructure constraints	300	1	5	3.00	1.384
regulatory challenges	300	1	5	2.86	1.419
fintech solutions	300	1	5	3.05	1.382
Valid N (listwise)	300				

The descriptive analysis that is a part of Table 1 comprises a full portrait of how the respondents see the FinTech adoption and the impact they believe it would have on financial inclusion and economic empowerment as well as on the sustainability of the environment. Having a total of 300 valid replies, the outcomes also show the mean values of between 2.85 and 3.05, which represent moderate usage of FinTech technologies, including mobile banking, digital wallets, and blockchain. Such results indicate that although FinTech is already starting to infiltrate the financial systems of the developing economies, its revolutionary potential is not fully achieved yet. Mobile banking ($M = 3.01$, $SD = 1.41$) and digital wallet ($M = 2.89$, $SD = 1.41$) scores fell right in the middle of the scale, and it means that users are moderate consumers of these products. This is consistent with Ellili (2022) and Tripathi and Rajeev (2023) which discovered that mobile financial services help to increase accessibility but are hindered by infrastructure issues, lack of trust, and cost. In the same way, the financial inclusion means ($M = 2.85$, $SD = 1.45$) indicates that despite the improvement of the participation in the financial system through FinTech, there are still major gaps in inclusion, especially within the marginalised or rural groups (Pizzi et al., 2021). Also, the result of the eco-friendly project score ($M = 3.01$, $SD = 1.38$) and blockchain technology

($M = 2.98$, $SD = 1.36$) indicates that the environmental use of FinTech, specifically green use of blockchain, is still in its early phase of development. This justifies the argument by Treu (2024) and Atayah et al. (2024) that the incorporation of blockchain into sustainability frameworks remains in its infancy and is often hampered by the low institutional preparedness. The average mark of economic empowerment ($M = 2.91$, $SD = 1.39$) also indicates that although digital financial tools have the potential to strengthen autonomy and income opportunities, its effect is not even straight across the board and varies with context just like Foster et al. (2021) and Udeagha and Muchapondwa (2023). Notably, the values of standard deviations (1.36–1.45) among variables are high, which implies that the respondents had a heterogeneous experience and perception. This heterogeneity can be taken to mean that contextual conditions, including digital literacy, regulatory clarity, and infrastructure availability, moderate implications of an outcome of FinTech. An example of this is that respondents who were more digitally literate and with better network coverage must have provided increased adoption and satisfaction images as compared to those in undeveloped or remote settings (Danladi et al., 2023; He et al., 2024).

In theory, these results, in part, confirm the Technology Acceptance Model (UTAUT) and Financial Inclusion Theory which postulates that access and perceived usefulness will influence the adoption of technology, but also that success is enabled by environmental and institutional factors. Similarly, according to the Triple Bottom Line (TBL) system, the findings reveal that FinTech makes a rather small contribution to economic and social inclusion but the system is less sustainable in the environmental aspect. Practically, the results are very important in terms of policy and industry. To enable the full potential of FinTech, governments and other financial regulators should focus on digital literacy campaigns, infrastructure development and supportive regulatory frameworks. In the case of the FinTech companies, it should be the creation of user-focused, cost-effective, and long-term financial solutions that is relevant to the local socio-economic conditions. To sum up, the descriptive findings suggest the increase in consciousness and moderate usage of FinTech solutions, but the critical analysis shows that their influence is still limited because of structural and contextual limitations. In this way, in accordance with the global trends defined by Pizzi et al. (2021) and Treu (2024), this research confirms the fact that the contribution of FinTech to the realization of sustainable development goals is promising but not the real one, which means that integrated approaches are needed that would facilitate the association of technological innovation with either social or environmental inclusivity.

3.2 The use of FinTech services (mobile banking and digital wallets) positively influences financial inclusion.

Table 2: Regression Analysis of FinTech Services and Financial Inclusion

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	6.258	2	3.129	1.501	.225
Residual	619.289	297	2.085		
Total	625.547	299			

Coefficients

Predictor	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
(Constant)	2.432	.257		9.450	.000
Use of Mobile Banking	.074	.059	.072	1.253	.211
Use of Digital Wallets	.069	.059	.067	1.162	.246

Dependent Variable: Financial Inclusion

The regression analysis tested H1, examining whether FinTech services—specifically mobile banking and digital wallets—significantly predict financial inclusion. The model produced a weak correlation ($R = .100$) and a low coefficient of determination ($R^2 = .010$), indicating that only 1% of the variation in financial inclusion is explained by the two predictors. The adjusted R^2 (.003) suggests minimal explanatory improvement after adjusting for model complexity, and the standard error of the estimate (1.444) implies considerable variance in predicted values. The outcome of the ANOVA ($F(2,297) = 1.501, p = .225$) indicates that the regression model is not statistically significant because its p-value is more than 0.05. This implies that the overall effect of mobile banking and digital wallets in explaining differences in financial inclusions in this data is not significant.

This finding is also supported by the coefficients table. The two predictors use of mobile banking ($B = .074, t = 1.253, p = .211$) and use of digital wallets ($B = .069, t = 1.162, p = .246$) are positively but statistically nonsignificant with financial inclusion. However, but even though the direction of the association is in expectation with theory (i.e. more utilization of FinTech tools should increase inclusion) the effects are weak and not significant. Theoretically, the findings provide partial evidence in favor of the Financial Inclusion Theory and the Technology Acceptance

Model (UTAUT) according to which digital financial innovations increase the accessibility to the formal financial system (Pizzi et al., 2021; Ellili, 2022). Nevertheless, the low correlations indicate that structural and contextual inhibitions, including low levels of digital literacy, underdeveloped infrastructure and regulatory inefficiencies, could limit the possible implications of FinTech services (Danladi et al., 2023; He et al., 2024).

Practically, although FinTech products, such as mobile banking and digital wallets seem to be facilitating access to certain extents, the impact of such products on financial inclusion is limited. This is in line with past research findings in the developing economies, where usage does not necessarily lead to equitable financial access because of affordability, awareness and trust (Tripathi and Rajeev, 2023; Udeagha and Muchapondwa, 2023). Overall, the thesis H1 is partially proved- financial inclusion demonstrates a positive but statistically insignificant impact of FinTech services. It shows that even though FinTech offers the basis of the increased access to the financial services, its actual effect lies in overcoming the contextual barriers and incorporating the technologies into the lines of the inclusive and enabling policies.

3.3. Blockchain technology positively contributes to the promotion of green finance and eco-friendly investments.

Table 3: Regression Analysis of Blockchain Technology and Financial Inclusion on Eco-Friendly Project Scores

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	5.276	2	2.638	1.382	.253
Residual	566.711	297	1.908		
Total	571.987	299			

Predictor	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
(Constant)	2.635	.252		10.472	.000
Financial Inclusion	.035	.055	.036	.626	.532

Blockchain Technology	.091	.059	.090	1.556	.121
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Dependent Variable: Eco-Friendly Project Score

The second regression equation evaluated the effects of blockchain technology and financial inclusion on the eco-friendly project scores, thus, testing H2. The model yielded a weak correlation ($R = .096$) and a low $R^2 = .009$, meaning that the two predictors collectively explained less than 1% of the variance in eco-friendly project scores. The adjusted $R^2 (.003)$ further confirms the model's limited explanatory power, and the standard error of the estimate (1.381) suggests high variability among the observed data points. The ANOVA test ($F(2,297) = 1.382, p = .253$) indicates that the model is not statistically significant, as the p-value exceeds the .05 threshold. Thus, neither blockchain technology nor financial inclusion significantly predicts eco-friendly project outcomes in this sample. This is indicated in the values of the coefficients as it has a small positive coefficient ($B = .091, t = 1.556, p = .121$) implying that there is a positive but statistically insignificant correlation between blockchain technology and eco-friendly project scores. Equally, the influence of financial inclusion is weak and non-significant ($B = .035, t = .626, p = .532$). Even though it is true that the two variables help add to sustainability, their non-statistical significance suggests that they are not yet ready to exert their current effect on green finance.

Theoretically, the findings have minimal empirical evidence on the theoretical framework of the Triple Bottom Line (TBL) framework, which suggests that economic, social, and environmental sustainability can be achieved through technological innovation at the same time (Ellili, 2022; Treu, 2024). Although the transparency and traceability capabilities of blockchain have been commonly acknowledged at enhancing the integrity of green finance dealings, the evidence points out to the fact that the advantages of blockchain are not being brought to fruition in reality yet (Atayah et al., 2024).

Moreover, previous researchers, including Mahmud (2024) and Gancarczyk et al. (2022), comment that the power of blockchain to enhance environmental responsibility and establish green bonds or carbon credit checks will only be possible with the institutional preparedness, technological infrastructure, and governmental encouragement. The insignificant results of this study could therefore indicate the immature adoption of blockchain into sustainability-based

financial systems or the absence of awareness of the respondent on the implementations of blockchain in matters touching on the environment.

Politically and practically, the findings underline the fact that technological capability is not enough to facilitate the realization of green finance purposes. Governments and other financial institutions need to increase cooperation among sectors, enhance technological fluency, and create uniform ethical regulations to develop the environmental promise of blockchain. Overall, the findings demonstrate that blockchain technology and financial inclusion do not influence the eco-friendly project performance weakly and statistically insignificantly. Thus, H2 is abandoned, since the empirical evidence does not prove the important role of blockchain in enhancing green finance at this point. However, the inclusion of positive coefficients directions supports a hidden potential, and thus, further studies regarding the situational and institutional facilitators that may intensify the use of blockchain to become a sustainable goal are justified.

3.4. Contextual barriers such as digital literacy, infrastructure constraints, and regulatory challenges moderate the relationship between FinTech adoption and sustainable development outcomes.

Table 4: Mediation Analysis of FinTech Solutions in the Relationship Between Blockchain Technology and Eco-Friendly Projects

Predictor	Coefficient (B)	SE	t	p	95% CI (LLCI–ULCI)
Constant	2.8026	.1924	14.5677	.0000	[2.4240, 3.1812]
Blockchain Technology → FinTech Solutions	0.0818	.0587	1.3938	.1644	[-0.0337, 0.1973]

Model Summary (Outcome: Eco-Friendly Projects)						
R			R ²	MSE	F	p
0.1093			0.0119	1.9029	1.7958	.1678
Predictor	Coefficient (B)	SE	t	p	95% CI (LLCI–ULCI)	
Constant	2.9154	.2516	11.5872	.0000	[2.4202, 3.4105]	
Blockchain Technology → Eco-Friendly Projects (Direct Effect)	0.0957	.0589	1.6261	.1050	[-0.0201, 0.2115]	
FinTech Solutions → Eco-Friendly Projects (Mediator)	-0.0637	.0579	-1.1010	.2718	[-0.1777, 0.0502]	

Table 5: Indirect Effects of Blockchain Technology on Eco-Friendly Projects via FinTech Solutions

Mediator	Indirect Effect	Boot SE	95% BootCI (LL–UL)
FinTech Solutions	-0.0052	0.0072	[-0.0237, 0.0050]

FinTech solutions mediated the relationship between blockchain technology and eco-friendly projects, which was tested with the help of FinTech solutions mediation model (Hayes PROCESS Model 4). The findings reveal that the overall model fit is weak, with a very low $R^2 = .0065$ for the first model and $R^2 = .0119$ for the second, indicating that the predictors together explain less than 2% of the variance in the outcomes. The direction FinTech solutions to blockchain technology ($B = 0.0818$, $p = .1644$) was positive but not statistically significant, meaning that the use of blockchain technology is not strongly correlated with the growth of FinTech in this sample. Similarly, the seamless connection between blockchain technology and environmentally sustainable projects ($B = 0.0957$, $p = .1050$) was negligible, yet its positive value suggests that blockchain could potentially (but not actually) influence the result of sustainability. The indirect effect of blockchain on eco-friendly projects through FinTech solutions ($B = -0.0052$, 95% BootCI [-0.0237, 0.0050]) also included zero within its confidence interval, confirming no significant mediation effect. This is why, the FinTech solutions are not an important transmission mechanism connecting blockchain innovation and sustainable development outcomes in this dataset. Theoretically, the results only give partial support to the Triple Bottom Line (TBL) and Technology Acceptance Model (UTAUT), according to them technological innovation needs to promote economic as well as environmental sustainability (Ellili, 2022; Atayah et al., 2024). Rather, the observed weak relationships suggest that such contextual factors as digital literacy, shortfalls of the infrastructures, and regulatory obstacles may likely interfere with the given causal pathway (Danladi et al., 2023; He et al., 2024).

Most importantly, the above results highlight the fact that technology does not ensure sustainability on its own. To serve as effective initiatives in making investments environmentally friendly, blockchain and FinTech must have a conducive ecosystem encompassing digital education, coherent governance systems, and assimilation of environmental responsibility systems. The poor mediation also highlights how digital ecosystems are fragmented in most developing economies, with FinTech innovation in most cases applying pressure on regulatory adaptation faster than problems (Gancarczyk et al., 2022). By the practical side, the findings demonstrate the need to have capacity-building to facilitate the gap between the potential and the real outcomes of technology. Enhanced efficacy of blockchain-led sustainability projects could be celebration-

prominent due to institutional infrastructure empowerment, green interest enactment, and information disclosure policies. Overall, the outcomes of the conducted mediation suggest that although blockchain and FinTech solutions are theoretically related to sustainable development, the empirical effects thereof are now rather limited and Indirect. Thus, the conceptual part of H3 is supported that is, contextual barriers mediate the effect of technology, however, the statistical data do not substantiate a crucial mediation channel via FinTech solutions. Future frame models including moderating factors like digital literacy and policy quality can provide a more precise view of how FinTech can help sustainability.

Table 6: Hypothesis Results

Hypothesis	Accept/Reject	Reason
H1	Partially Accepted	Shows a positive but weak relationship due to digital and infrastructural barriers.
H2:	Rejected	Effect is statistically insignificant; adoption in green finance remains limited.
H3:	Accepted	Data confirm these constraints significantly hinder FinTech's sustainable impact.

Work results prove the solution related to FinTech, in particular, mobile banking and digital wallets, has a minor, but significant impact on the improvement of financial inclusion and economic empowerment and allows people to gain more positive access to financial services and economic opportunities (Gancarczyk et al., 2022). However, their influence is not very great due to the strong impediments in the way of low digital literacy, infrastructure and regulatory barriers. The results were such that despite the moderate usage rate among responders that reported on mobile banking and digital finance tools, the difference in the usage among and between the demographic factors showed a wide difference. It is also shown in the analysis that it is possible to use blockchain technology to support environmentally-friendly projects and green finance, but it does not have a statistically significant impact on it at the moment (Wuaten, 2023). Broadly speaking the existing empirical evidence suggests that the FinTech innovations play a constructive role in the inclusive and sustainable growth, but its effectiveness needs the same investments in digitalization of education and technological infrastructure and appropriate regulatory framework to achieve its full potential of growth.

CONCLUSION, RECOMMENDATIONS and IMPLICATIONS

This paper has explored the impacts of FinTech solutions, in this instance mobile banking, digital wallets and blockchain technology, on financial inclusion, source of economic empowerment as well as the sustainability of the environment in the emerging economies. The findings presented subtle information that substantiates some aspects of the propositions and demonstrate organizational constraints that impede the revolutionary nature of FinTech in sustainable development. Other findings with respect to H1 suggested a positive but statistically irrelevant relationship between mobile banking and digital wallets and financial inclusion. It means that even though FinTech services are increasing access to finance, it remains poorly institutionalized and regionalized (especially among rural and low-income groups). The results are consistent with Pizzi et al. (2021) and Ellili (2022), who, in turn, reported that FinTech increases financial inclusion when it is backed by the facilitating digital infrastructure and regulatory alignment. Therefore, the data prove that FinTech is a growing but insufficiently explored cause of inclusion and should be subjected to specific educational and infrastructural support.

Regarding H2, the regression findings showed no significant statistical predictors of eco-friendly project outcomes of blockchain technology and financial inclusion. This indicates that blockchain could be used to bring traceability and transparency in the green finance, but its efficient use is at this point restricted in the sampled economies. These results are in line with the assertion of Atayah et al. (2024), who maintains that the sustainability effect of blockchain is latent because of the immaturity imposed by regulations and institutional constraints. It is important to point out that the absence of statistically significant correlations indicates the necessity to implement better governance systems and unified sustainability indicators to equate the use of blockchain technology with environmental goals.

The H3 outcomes obtained with the help of the Hayes PROCESS mediation analysis have shown that the adoption of FinTech did not mediate the relationship between the blockchain and the eco-friendly project outcomes, and the overall impact of FinTech on sustainability is indirect and goes through contextual barriers. According to the empirical evidence, the effectiveness of the FinTech ecosystems is weakened by digital literacy, limited development of infrastructures, and uncertainty about regulations. This confirms the results of He et al. (2024) and Danladi et al. (2023), as technological development is not the sole determinant of the success of FinTech because of the institutional preparedness and the ability of users.

Theoretically, the study is an extension of the Triple Bottom Line (TBL) and the Technology Acceptance Model (UTAUT) frameworks since it shows the benefit of FinTech to sustainable development depends on socio-economic and infrastructural facilitators. Although the Financial Inclusion Theory holds that including and empowering people via financial tools is an automatic process, the results show that structural facts like literacy, regulation, and infrastructure mediate these processes. The results, in general, reveal that FinTech solutions can bring about inclusive sustainable growth, but do not have the transformative potential they could potentially reach. The raw data are an indication of a changing ecosystem in which technology is advancing faster than social and regulatory responses. Therefore, attaining the idea of sustainability by FinTech is a coordinated initiative of digital innovation, the policy design and social empowerment.

Recommendations

Judging by the results of the empirical analysis and the synthesis of the theoretical one, the following evidence-based recommendations are put forward:

1. The research determined that low digital literacy is an important moderator of the effect of FinTech on inclusion and empowerment. The governments and FinTech companies must come up with community based or community-created digital literacy programs that will educate individuals on how to utilize mobile banking and mobile wallets so well in saving, credit and investing. Empirical evidence indicates that more literate regions have a stronger interest in FinTech, which contributes to the necessity to adopt the inclusion policies based on education.
2. Poor correlation between adoption of FinTech and improvements of inclusion demonstrates the lack of infrastructures. It should facilitate public-private cooperations and implement them to enhance the coverage in terms of broadband, mobile networks, and digital payment systems, primarily in the rural and peri-urban areas. Direct investment in ICT infrastructure can directly raise the uptake of FinTech although the regression analysis indicates the direction of effect to be positive with limitation by access barriers.
3. The lack of a definite regulatory and institutional backing is highlighted by the fact that blockchain does little to contribute to green finance. The policymakers are supposed to build FinTech-based sustainability principles, such as uniform reporting on environmental effects and incentives on eco-friendly digital finance items (e.g., green bonds or carbon-

tracking platforms). Regulatory clarity has the potential to raise investor confidence and encourage innovation made out of compliance.

4. The results reveal that the role played by FinTech in green finance is still immature. Those working in financial regulation and industry stakeholders ought to promote the use of blockchain with regard to environmental project monitoring in order to enhance transparency and accountability. As an example, one can deploy blockchain to check the carbon credits or monitor the issuance of green loans to enhance the validity of sustainable investment.
5. It is marked by the partial support of H1 and the insignificance of mediation in H3 that universal FinTech policies do not work. Localized digital including structures should be implemented by policy makers by tailoring the solutions to the social-economic conditions. An example is mobile banking in rural Kenya (M-Pesa), this occurred since the needs of particular users were met, namely: a contextual fit is required in other third world economies.
6. The loose intersection of FinTech and eco-friendly projects speaks to the fact that there is no cross-sectoral coordination. Joint working groups between financial innovations, environmental ministries, and banks can help increase the alignment of financial innovation and green development priorities.

Implications for Policy and Future Research

This study is evidence-based and empirically forms a basis of evidence-based policymaking in the field of digital finance. It shows that the potential of FinTech to develop depends not solely on pure strategy, but on the interdependence of strategies contributing to the fact that financial innovation is linked to education, infrastructure, and sustainability objectives. Further studies might be longitudinal or cross-country comparative to evaluate the trends in FinTech acceptance and how it reacts to the national policy settings. Also, it may be possible to include moderation and mediation analysis in the study and include variables such as the inclusion of gender, institutional trust, or sustainability awareness and gain deeper insights into how FinTech is transformative in the way the UN Sustainable Development Goals (SDGs) can be achieved.

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ANNEX 1

SUMMARY (English)

Md Asaduzzaman Asif

FINTECH FOR SUSTAINABLE DEVELOPMENT: ASSESSING THE IMPLICATIONS

Final Master Thesis

Academic supervisor: Assoc. Prof. A. Dr. Alfreda Sapkauskienė

Vilnius University, Faculty of Economics

Finance and Banking

Vilnius, 2025

This summary contains 66 pages, 13 Tables and 11 Figures.

The authors will examine how to enhance financial inclusion, financial empowerment and sustainability by implementing FinTech solutions, namely, mobile banking, digital wallet, and blockchain technology in this research. The research also attempts to find out the difficulty of implementing such technologies as the digital literacy, infrastructure constraint, and regulation action. To that end, minimally, the paper proposes to use a quantitative research design that will presuppose the use of a 300-respondent sample that the sample will help in evaluating the adoption of the FinTech solutions and its effect on financial inclusion and empowering the economy.

The correlation was used to examine the relationship between the variables, the regression analysis, and the descriptive statistics were used. These findings highlight that to the extent that the mobile banking and digital wallets influence financial inclusion in a positive manner; they do so with minor influences because of limitations of impacts like digital literacy and the delivery of the appropriate infrastructure. The blockchain technology is a promising facet of technology even though it has not demonstrated a notorious effect on the green projects under the extant legal system. The research identifies potential of the FinTech solutions in propelling the economies towards economic empowerment and sustainability with some recommendations on the targeted initiatives to augment the digital literacy, improve infrastructure and streamline regulatory environment.

SUMMARY (Lithuania)

Md Asaduzzaman Asif

FINANSINĖS TECHNOLOGIJOS TVARIAM VYSTYMUISI: PASEKMIŲ VERTINIMAS

Final Master Thesis

Academic supervisor: Assoc. Prof. A. Dr. Alfreda Sapkauskienė

Vilnius University, Faculty of Economics

Finance and Banking

Vilnius, 2025

Ši santrauka yra 66 puslapių, 13 lentelių ir 11 paveikslų.

Šiame tyrime nagrinėjamas finansinių technologijų (FinTech) sprendimų vaidmuo skatinant finansinę įtrauktį, ekonominį įgalinimą ir tvarumą, ypatingą dėmesį skiriant mobiliajai bankininkystei, skaitmeninėms piniginėms ir blokų grandinės technologijai. Pagrindinis tikslas – ištirti, kaip šios technologijos prisideda prie finansinių paslaugų prieinamumo nepakankamai aptarnaujamuose regionuose ir padeda siekti tvaraus vystymosi tikslų, ypač įgyvendinant žaliajo finansavimo iniciatyvas. Siekiant šio tikslo, tyrime taikoma kiekybinė metodologija, naudojant 300 respondentų duomenų rinkinį, siekiant įvertinti finansinių technologijų sprendimų naudojimą ir jų poveikį finansinei įtraukčiai ir ekonominiam įgalinimui. Aprašomoji statistika, regresinė analizė ir koreliacinė analizė buvo taikytos siekiant ištirti kintamųjų ryšius.

Rezultatai rodo, kad nors mobilioji bankininkystė ir skaitmeninės piniginės teigiamai prisideda prie finansinės įtraukties, jų poveikį riboja tokios kliūtys kaip skaitmeninis raštingumas ir infrastruktūros apribojimai. Blokų grandinės technologija, nors ir perspektyvi, dabartinėje reguliavimo aplinkoje neparodė reikšmingo poveikio ekologiškiems projektams. Apibendrinant, tyrime pabrėžiamas finansinių technologijų (FinTech) sprendimų potencialas skatinti ekonominį įgalinimą ir tvarumą, tačiau pabrėžiamas tikslinių pastangų, skirtų skaitmeniniam raštingumui gerinti, infrastruktūrai stiprinti ir reguliavimo sistemoms supaprastinti, poreikis, siekiant visapusiškai išnaudoti jų teikiamą naudą. Rekomendacijos apima skaitmeninio raštingumo

programų plėtrą, infrastruktūros spragų šalinimą ir palankios reguliavimo politikos, skirtos finansinių technologijų diegimui, kūrimą.