Digital Financial Inclusion as a Catalyst for Inclusive Growth and Environmental Sustainability: Evidence from Egypt

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Abstract:

This study investigates the dual role of Digital Financial Inclusion (DFI) in promoting inclusive economic growth and advancing environmental sustainability in Egypt. Drawing on data from a structured survey of 193 respondents across various demographics, the research explores usage patterns, barriers, and user confidence in digital financial services. Findings reveal that while mobile wallets dominate digital financial tool usage—especially among youth and urban populations—significant disparities remain in rural uptake and among older or low-literacy groups. Although 61% of participants expressed digital confidence, concerns about data privacy (35%), digital illiteracy (26%), and infrastructural limitations (20%) persist. Notably, 49% of respondents showed a strong interest in green financial products, signaling an emerging space for environmentally aligned fintech solutions. However, the study's descriptive design and skewed sample highlight the need for broader, more balanced research. The paper contributes policy insights toward Egypt's Vision 2030 and recommends expanding digital literacy, strengthening infrastructure, and integrating green finance to ensure inclusive and sustainable financial transformation.

Keywords: Digital financial inclusion, economic growth, environmental sustainability, green finance, Egypt, financial literacy**.**

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الشمول المالي الرقمي كحافز للنمو الشامل والاستدامة البيئية: دليل من مصر

الملخص :

تهدف هذه الدراسة إلى استكشاف الدور المزدوج الذي يلعبه الشمول المالي الرقميفي تعزيز النمو الاقتصادي ودعم الاستدامة البيئية في مصر. حيث تم اعتماد منهج وصفي كمي، وجُمعت البيانات من خلال استبيان منظم استهدف 193 مشاركًا من خلفيات ديموغرافية متنوعة. أظهرت النتائج أن المحافظ الإلكترونية تُعد أكثر أدوات التمويل الرقمي استخدامًا (بنسبة 55%)، خاصةً بين فئة الشباب وسكان المدن، مما يعكس تحولًا ديموغرافيًا نحو الحلول الرقمية. وعلى الرغم من وجود مستويات واعدة من الثقة الرقمية (61%)، لا تزال هناك تحديات كبيرة تشمل مخاوف تتعلق بخصوصية البيانات (35%)، وضعف الثقافة الرقمية (26%)، والقيود المتعلقة بالبنية التحتية (20%). وتجلت الآثار الاجتماعية والاقتصادية للشمول المالي الرقمي في تحسن سلوكيات الادخار (39%)، وتحسن إدارة ميزانيات الأسر (14%)، وزيادة النشاط الريادي (14%). كما أبدى 74% من المشاركين اهتمامًا بتبني منتجات مالية صديقة للبيئة.

لذا تشير هذه النتائج إلى أن دمج الشمول المالي الرقمي مع مبادرات التمويل الأخضر يمكن أن يعزز استراتيجيات التنمية الشاملة والمستدامة في مصر. وتقدم الدراسة رؤىً سياسية تدعم رؤية مصر 2030، وتساهم في إثراء الأدبيات العالمية حول العلاقة بين التمويل الرقمي والتنمية المستدامة..

الكلمات المفتاحية: الشمول المالي الرقمي، النمو الاقتصادي، الاستدامة البيئية، التمويل الأخضر، مصر، الثقافة المالية

1. Introduction

Financial inclusion has come to be recognized as a key engine of economic growth, giving firms and individuals access to fundamental financial services such as savings, credit, insurance, and payments. Financial inclusion plays a vital role in creating economic resilience, reducing disparities in income, and empowering poor and vulnerable populations. In the past decade, digital financial inclusion (DFI), the use of digital platforms and technologies to deliver financial services, has transformed financial access promotion, especially in developing countries (Mishra et al., 2024).

In Egypt, DFI is becoming a national priority with the backing of the Central Bank of Egypt's Financial Inclusion Strategy (2022–2025) and efforts to expand mobile banking services. These interventions aim to bring into the formal sector underserved segments—women, youth, and rural communities. The rapid expansion of fintech companies such as Fawry, valU, and Khazna, along with government-supported platforms, has significantly raised access to services such as digital savings, microloans, and mobile wallets. The innovations have facilitated entrepreneurship, employment opportunities, as well as transitioning informal-to-formal economic activities (CBE, 2024).

Besides economic growth, digital financial inclusion also intersects with green sustainability. Egypt's Vision 2030 national development strategy illustrates this intersection in its incorporation of digital finance into other sustainability programs. Paperless banking, efficient digital payments, and promoting green investment through financial platforms are becoming elements of the environmental pillar of sustainable development (MPED, 2023).

However, despite its revolutionary promise, Egypt's DFI is still faced with gigantic challenges. Low financial literacy, infrastructure deficits, and regulatory gaps still stand to undermine its mass usage and inclusive reach. They appear more harshly in the rural and under-banked areas, where digital and financial exclusion still dominantly prevail.

This study addresses these critical issues by examining the different roles of digital financial inclusion in Egypt. It explores the mechanisms by which DFI induces economic growth and environmental sustainability, and emphasizes the main drivers and constraints defining its impact. Besides, the study evaluates the role played by Egypt's fintech ecosystem in supporting inclusive and sustainable financial access.

This research aims to look at the role of digital financial inclusion in Egypt's economic growth, discuss environmental sustainability in Egypt Vision 2030 supported by DFI, identify the drivers and inhibitors of financial inclusion in Egypt, especially in rural and underbanked regions, and analyze the role of Egypt's fintech ecosystem in contributing to promoting financial inclusion.

This study is important because it looks at how digital financial inclusion (DFI) drives economic growth and environmental sustainability in Egypt. On the economic front, it highlights DFI's role in employment creation, entrepreneurship, and incorporating marginalized groupse.g., women, youth, and rural areas—into the formal economy. On the environmental front, it shows how digital finance can be used to enable green activities such as paperless transactions and green investments.

The research also has real-world application as it identifies issues such as inadequate infrastructure, poor financial literacy, and regulatory hurdles, making policy suggestions in line with Egypt's Vision 2030. It is also of academic significance as there is little existing research correlating financial inclusion and environmental sustainability in developing countries, which makes it pertinent to policymakers, researchers, and financial sector players in general.

To address the gaps in current literature and offer empirical insights into the socio-economic and environmental outcomes of digital financial inclusion (DFI) in Egypt, this study tests the following hypotheses:

- H1: There is a positive relationship between digital confidence and the use of digital financial services.
- H2: Place of residence (rural/urban) has a statistically significant effect on mobile wallet usage.
- H3: Financial literacy positively influences interest in green financial products.
- H4: Use of digital financial services contributes to improved saving behavior.

By examining these relationships through a behavioral and sustainability lens, this research contributes both theoretical insights and practical recommendations for strengthening inclusive, digital financial systems aligned with environmental priorities in Egypt.

2. Literature Review

A substantial body of literature has examined the dimensions, determinants, and implications of financial inclusion and

FinTech in Egypt, particularly in relation to sustainable development and economic growth. Rashdan and Eissa (2019) utilize logistic regression analysis on data from the World Bank's Global Findex 2017 to identify the primary determinants of financial inclusion in Egypt. Their analysis, based on a sample of 1,000 respondents, focuses on three key indicators: account ownership, saving behavior, and credit usage. The findings reveal that financial illiteracy and insufficient income are the most significant barriers to inclusion, whereas gender does not have a statistically significant effect. The study emphasizes that education, income, and age positively correlate with inclusion, and thus recommends financial literacy initiatives and targeted awareness campaigns.

Complementing this microeconomic perspective, Nada (2020) constructs a composite index of sustainable development—encompassing economic, social, and environmental components—and examines its relationship with four financial inclusion indicators: household deposits, loans per capita, and the availability of ATMs and bank branches. Using multiple regression analysis on data spanning 2004 to 2017, the study reports a very strong positive correlation ($R^2 = 0.99$) between financial inclusion and sustainable development, underscoring the importance of financial access in promoting national progress.

Hassouba (2023) adopts a policy-oriented approach by integrating secondary data from the Global Findex and Financial Access Survey (FAS), along with qualitative inputs from interviews with key stakeholders. The study identifies behavioral and socioeconomic barriers that limit inclusion among low-income groups and argues for a revised national

vision that embeds financial inclusion within Egypt's broader economic growth strategy.

From a banking sector standpoint, Almaleeh (2020) investigates the relationship between financial inclusion and banks' profitability and liquidity using Central Bank of Egypt data (2012–2018) and regression analysis through SPSS. The findings indicate that financial inclusion positively influences profitability, explaining 53% of its variation. However, a negative association with liquidity suggests a trade-off that demands prudent regulatory measures to maintain financial stability.

Methodologically, Ismael (2021) introduces a robust three-step principal component analysis (PCA) framework to develop a comprehensive financial inclusion index. The index includes subcomponents measuring access, usage, and barriers, integrating both traditional and digital channels. The study confirms that digital and traditional financial services are complementary in enhancing overall inclusion, with digitalization efforts playing a growing role despite existing limitations in access.

In terms of environmental sustainability, Saman and Ismael (2023) employ an Autoregressive Distributed Lag (ARDL) model within the STIRPAT framework to examine the long-term environmental effects of digital financial inclusion (DFI) in Egypt. Drawing on data from the World Bank and national institutions such as MCIT and ITU, the study finds that DFI contributes to long-term reductions in CO_2 emissions, although short-term effects remain modest. It also concludes that investment in clean energy has a more direct and substantial environmental impact than financial services alone.

Nouran et al. (2021) explore the role of foreign direct investment (FDI) in Egypt's sustainable development using descriptive and inductive analysis based on official national data. Although FDI shows a positive impact on GDP growth and human capital formation, its effect on trade is limited and statistically insignificant. The study also notes that FDI is unevenly distributed across sectors, leading to inflationary effects and highlighting the need for strategic sectoral targeting in FDI policy.

In a broader regional and institutional context, Attridge et al. (2019) examine the role of development finance institutions (DFIs) in achieving the Sustainable Development Goals (SDGs). Their qualitative study emphasizes that DFIs can play a pivotal role in stimulating private sector investment and job creation, which are central to inclusive development.

Turning to climate finance, Elsherif (2023) assesses the relationship between green finance and greenhouse gas (GHG) emissions in Egypt. Applying Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) tests, and a Quantile ARDL model, the study identifies a long-term inverse relationship—where a 1% increase in green financing results in a 0.2% decrease in GHG emissions. It also finds that R&D spending enhances environmental sustainability, whereas population growth poses a significant challenge.

Similarly, Ibrahiem et al. (2021) investigate the interplay between financial development, clean energy investment, FDI, and natural resources using both ARDL and the Toda-Yamamoto causality test. The results suggest that clean energy and FDI positively influence financial development, while

natural resources exert a negative effect—supporting the "resource curse" hypothesis. These dynamic relationships imply that financial development can catalyze clean energy investment when decoupled from extractive industry reliance.

Hassan et al. (2024) provide a comparative analysis of green finance and economic growth in Egypt, Turkey, and China. While green finance positively correlates with economic growth in all countries studied, Egypt lags behind in integrating green finance into its national development strategies. The study underscores the importance of context-specific institutional and technological frameworks to maximize green finance's potential.

Focusing on the FinTech sector, Adam (2021) analyzes its role in supporting entrepreneurship and economic development in emerging markets. Using theoretical and documentary analysis, the study observes that Egypt's FinTech sector, though rapidly evolving, is still in its early stages compared to countries like India. Key challenges include underdeveloped infrastructure and limited institutional support, suggesting that Egypt can benefit from international best practices to enhance digital inclusion.

Rezk et al. (2022) expand this view by evaluating FinTech developments in the Arab region, particularly in Egypt and Saudi Arabia. Their descriptive analysis finds that while FinTech can enhance productivity and employment, persistent challenges such as regulatory uncertainty, digital illiteracy, and unequal access to technology must be addressed.

Similarly, Anwar et al. (2020) highlight asymmetries in FinTech ecosystem maturity across the MENA region. Egypt is

seen as a high-potential country, yet one constrained by inconsistent regulations and inadequate investment in digital infrastructure. Strategic coordination and deeper digitalization are recommended to unlock the sector's full benefits.

Tawakol (2023) explores the regulatory landscape and the Central Bank of Egypt's role in promoting financial inclusion through FinTech. The study finds that supportive regulatory reforms have been instrumental in formalizing the informal economy and promoting monetary policy efficiency, although gaps remain in aligning financial technology with national economic reforms.

Finally, Rabe et al. (2022) assess the impact of FinTech on the efficiency of Egyptian banks using Data Envelopment Analysis (DEA) and financial data from 2014 to 2020. The results show that while FinTech has improved performance in deposit-taking and lending activities, its overall impact on banking efficiency is limited. Inefficiencies are primarily due to managerial and operational issues rather than technological limitations.

3. Theoretical Framework

Analyzing the interaction among digital financial inclusion, economic growth, and environmental sustainability requires a sound theoretical foundation that recognizes both the behavioral forces of technology uptake and the macro-cumulative effects of financial innovation. Toward this objective, the present study is driven back to two leading theoretical models: the Technology Acceptance Model (TAM) and Sustainable Development Theory.

3.1 Technology Acceptance Model (TAM)

Davis' (1989) Technology Acceptance Model (TAM) is a central theoretical model for new technology adoption and use behavior(Davis, 1989). TAM proposes that two central factors determine the acceptance of a technological system by an individual:

-Perceived Usefulness (PU) – the degree to which a person perceives that the use of a specified system will enhance his/her performance or well-being.

- Perceived Ease of Use (PEOU) – how much an individual believes the use of a system will be effort-less.

These factors shape the user's attitude towards the technology, which further drives their behavioral intention to use the technology, and eventually leads to actual usage.

In the context of digital financial inclusion, TAM finds specific application in examining individual adoption behaviors towards digital financial services. On a micro level, it is especially appropriate to examine users' confidence level, encountered problems, and overall satisfaction with digital financial instruments. Thus, it is relevant to confidence in being capable of conducting these digital finances representative of perceived ease of use. Perceived benefits emerging in areas of life as a function of digital finance connote perceived usefulness.

Through TAM's application in this research, the model is able to capture why individuals adopt or reject financial services through technology based on the extent that they think it serves and is simple to serve them, and how these beliefs are influenced by constructs such as age, occupation, and digital literacy level. This puts TAM as a sound tool to use in

quantifying the psychological and behavioral factors for digital financial inclusion program adoption in Egypt.

3.2 Sustainable Development Theory

Sustainable Development Theory is a multidisciplinary theory that demands the balancing of economic development, social justice, and environmental protection to ensure the prosperity of current and future generations (Chaturvedi, 2024). It developed from the seminal Brundtland Report (1987) that defined sustainable development (UN, 1987) as:

"development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

The theory rests on three pillars:

- Economic Sustainability – promoting inclusive and sustainable economic growth, jobs, and innovation.

- Social Sustainability – ensuring equity, social justice, and access to basic services such as education, health, and finance.

- Environmental Sustainability – preserving natural resources, reducing pollution, and fighting climate change with sustainable consumption and green investments.

Sustainable Development Theory is highly relevant to this research, it explains the impact of digital finance on the users' lives and their need for green financial products. The theory helps place in perspective the dual role of Digital Financial Inclusion (DFI) as both:

• An enabler of economic development through expanding access to financial services, stimulating entrepreneurship, and facilitating financial inclusion among marginalised communities; and
•A tool for environmental sustainability, particularly if paired with green finance products such as eco-loans, carbon-reducing incentives, and green investment streams.

In Egypt, aligning DFI with Egypt Vision 2030 and the UN Sustainable Development Goals (SDGs) requires a focus on ensuring that digital finance not only enhances economic inclusion but also supports environmental governance and social inclusivity.

With the integration of Sustainable Development Theory, the research is better able to examine how digital financial inclusion fits into long-term development goals, looking beyond financial access to comprehend its role in shaping an equitable, stable, and environmentally sustainable economy.

3.3 Conceptual model

This study proposes a conceptual model to examine the influence of digital financial inclusion on economic growth and environmental sustainability in the Egyptian context. The model has been modified to closely align with the questionnaire to ensure a coherent link between theoretical constructs and empirical data collection. It uses a systematic set of variables, in terms of independent, mediating, and dependent, to enable an in-depth examination of how digital financial adoption occurs across different segments of the population.

- The independent variables highlight key demographic factors that offer contextual data on the respondent demographic and partly account for digital financial service (DFS) level variation. These include age group, place of residence (urban or rural), and occupation (employment type or industry) (Ocharive&Iworiso, 2024). The model also considers digital financial service access and usage with the aim to capture the availability and motivational grounds for DFS usage. These include the types of digital services usedsuch as mobile banking, e-wallets, or fintech applications, and the reasons for their use or non-use, including trust in the technology, convenience, cost, and accessibility (DFS-WG, 2024).
- The mediating factors reflect processes shaping individual experiences with digital finance. The first mediator is the user's confidence in digital finance, which is assessed through responses to the user's comfort in holding digital accounts, perceived financial literacy, and trust in digital platforms (Yuneline&Rosanti, 2023). The second mediator is usage barriers or challenges, which are actual or perceived obstacles like limited digital literacy or training, technological or infrastructural limitations, and security or privacy issues. These mediators are expected to play a significant role in shaping the way digital financial services transform individuals' lives (Parvin et al., 2022).
- The dependent variables are the outcomes of digital financial inclusion, aiming at both economic and environmental dimensions. The first is the perceived socio-economic effect, which measures perceived improvement in terms of individual income, savings capacity, and the ease and accessibility of financial

services (Mishra et al., 2024). The second is interest in green finance products, which reflects the respondent's preference for taking up environmentally friendly financial products, such as green loans or environmentally friendly savings schemes (Fdhila, 2024).

This construct also includes specific product interests obtained from open-ended questionnaire responses.

The model in figure 1. hypothesizes several key pathways and interactions. Both access to DFS and demographic factors can be expected to shape user confidence and difficulties experienced, with these in turn impacting perceived socio-economic effect and interest in green finance. Barriers can also mediate the effect of user confidence on outcomes, identifying areas where policy and infrastructure development can be utilized to enhance digital financial inclusion and supplement broader sustainability goals.

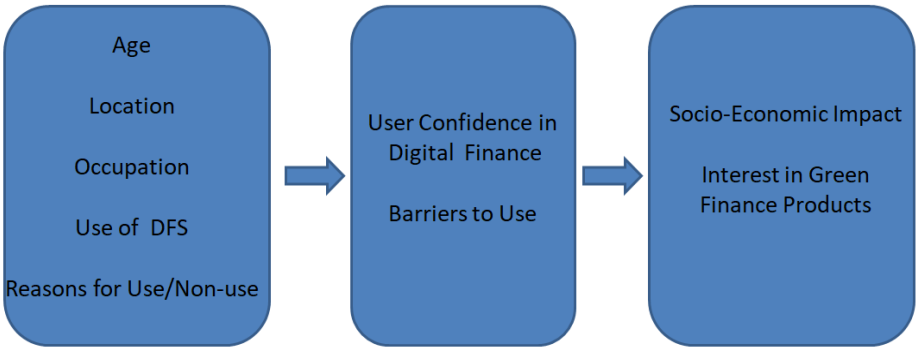

Figure 1. Conceptual model of the study

4. Methodology

4.1 Research Design

This study adopts a quantitative descriptive research design to assess the contribution of digital financial inclusion (DFI) to economic growth and environmental sustainability in Egypt. Primary data were collected through a structured survey aimed at exploring public access to and experiences with digital financial services, perceived socio-economic effects, and interest in green financial products. This design facilitates both descriptive understanding and the basis for future causal inference in this underexplored context.

4.2 Population and Sample

The study targeted Egyptian individuals aged below 20 to above 60 across different governorates, encompassing both rural and urban communities. A non-probability convenience sampling method was employed, given accessibility constraints and the exploratory nature of the study. This approach enabled the inclusion of diverse respondents by gender, age, and occupation. A total of 193 completed responses were collected, ensuring sufficient data for descriptive and correlational analysis.

4.3 Data Collection Tool

Data were gathered through a bilingual (Arabic-English) self-administered questionnaire, distributed both in printed form and online via platforms such as Google Forms. The instrument included closed-ended questions and Likert-scale items and was structured into four main sections:

• Section 1: Demographics – Captured information on age, gender, occupation, and residence to explore socio-demographic determinants of digital financial inclusion.
• Section 2: Access to Digital Financial Services – Assessed

usage patterns of digital financial tools (e.g., mobile wallets, online banking) and motivations for adoption or avoidance.
• Section 3: User Experience and Confidence – Measured perceptions of ease of use, encountered challenges, and confidence in digital platforms using a 5-point Likert scale.
• Section 4: Impact and Sustainability – Investigated perceived socio-economic benefits and interest in green finance solutions such as eco-loans or green savings accounts.

Collected data were coded and processed using descriptive statistics, including means, percentages, and frequency distributions, to summarize participant profiles and financial behavior. Inferential techniques, specifically correlation analysis, were used to assess relationships among socio-demographic factors, confidence in digital tools, and interest in sustainable financial products.

Responses to open-ended questions on green financial preferences were analyzed through qualitative content analysis, facilitating the identification of recurring themes and consumer expectations. Although the current study remains exploratory and descriptive, it lays the groundwork for future studies employing regression and causal inference techniques to examine relationships such as between financial literacy and DFI or between digital confidence and green finance uptake.

4.4 Ethical Considerations

Participation was voluntary, and informed consent was obtained from all respondents. Responses were anonymous to ensure confidentiality. Ethical procedures followed institutional guidelines, although formal ethical clearance was not sought due to the non-sensitive and non-clinical nature of the survey.

5. Analysis of the Results

The data indicate that the "Under 20" age group is the largest among the sample with 88 individuals or approximately 43.3% of the entire sample. The "20–30" age group forms the second largest group among the sample with 55 individuals or approximately 27.0% of the participants. The "40–50" age group follows with 23 individuals or approximately 11.3% of the entire sample. The "30–40" category contains 17 respondents, or 8.4%, while the "50–60" category contains 6 respondents, or approximately 3.0%. Last, but not least, the "above 60" constitute the smallest percentage of the sample, with only 2 respondents, or 1.0% of the interviewees. Results show also approximately 87.7% of the entire sample. On the other hand, only 14 participants live in rural areas, representing about 7.5% of the entire sample. A small percentage, 9 participants, mentioned their locality as semi-urban, representing 4.8% of the entire sample.
The results indicate that the majority of the respondents, 134 individuals, are students and constitute approximately 71.7% of the sample size. This dominance indicates a high academic or youth population in the sample. Among the rest of the respondents, 40 individuals described themselves as working, approximately 21.4% of the sample, while 9 individuals (or 4.8%) reported being self-employed. The less common groups are unemployed and retired, at 3 each representing around 1.6% each. Last but not least, 2 members picked "Other" representing 1.1% of the population.
The prevalence of digital financial services analysis reveals that the most utilized digital financial products (55%) among respondents are mobile wallets such as Vodafone Cash and Etisalat Cash. This notable predominance indicates the standing of mobile wallets as the primary means of digital financial payments in Egypt, likely because of their ease of use,

ubiquitous acceptability, and coverage of widespread population segments. Conversely, online banking apps showed usage by roughly 31% of the participants. This is a growing but comparatively narrower adoption of traditional digital banking interfaces over mobile wallets, reflecting potential barriers such as technical savvy or lower levels of trust among certain user groups. Other digital financial products such as digital savings apps and credit or microloan apps were less frequently reported. Moreover, around 14% of the participants have answered that they do not utilize digital financial services at all. This segment is an essential target for following financial inclusion initiatives to enhance access to digital financial infrastructures. Analysis of the motivators participants use or do not use digital financial services reveals significant majority of participants 78% identified convenience, speed, and accessibility as their prime motivators for adoption.

This strong preference mirrors users' value placed on the convenience of being able to manage financial transactions efficiently and without the encumbrance of bank operating hours or branch locations. Around 8%, highlighted explicit functional utility as reasons for use such as making money transfer, facilitating online shopping, facilitating bill payments, and supporting individual finances (i.e., saving and budgeting). Others cited the role of digital financial services towards a cashless society and extending to remote or under-served areas. This is evidence of increased appreciation of the broader socio-economic benefits of digital financial inclusion. Conversely, about 14% of those who responded indicated they do not utilize digital financial services due to insufficient need or preference for cash payments and concern with trust and security. Sentences such as "I don't feel like I need them," "I don't know how to use it," and "I think it's risky" exemplify such barriers. Furthermore, 10% of the respondents also reported being

underage or not eligible for using such services. Such findings realize the double burden of sustaining and growing digital financial service adoption in Egypt.

The examination of obstacles to using digital financial services showed reported barriers for respondents largely focused around concerns about data privacy or fraud as the most commonly reported barrier, with 35% of respondents reporting this as a barrier. This indicates a high level of concern on the security of personal and financial data in digital financial systems. The second barrier was difficulty understanding how to use the app, which appeared in about 26% of responses. This included respondents who indicated this barrier only, and respondents who indicated this barrier in conjunction with privacy concerns, lack of trust, and high service fees. These findings indicate that the digital literacy gap is likely still a major barrier to larger scale adoption. Third, lack of internet or access to a smartphone appeared as a major barrier with about 20% of the respondents indicating it in various combinations. This structural barrier illustrates the digital divide, specifically in rural or under resourced areas where access to reliable connectivity and technology may be limited. Distrust of digital financial systems also emerged as a barrier in about 13% of responses. In many cases, respondents indicated this barrier in combination with other barriers, including privacy barriers, or trusting technology barriers. These results imply that distrust of technology may exacerbate the perceived risks, which diminishes greater usage and familiarity with these digital financial systems. Finally, high service fees, were identified in about 6% of the responses. The analysis appears to show a multidimensional barrier landscape in which technical, infrastructural, and psychologically-based elements all combine together. Therefore, effective responses to these barriers require connected approaches that consider user education,

infrastructure, data protection policy and reasonable costs to enhance digital financial inclusion.
The analysis of respondents' confidence in managing their finances through digital tools, showed that 34% of the respondents felt neutral towards their ability to navigate digital financial services. This indicates that many users do not strongly self-identify as confident nor completely lacking ample confidence ultimately implying a possible hesitancy or ambivalence with fully embracing a digital finance. However, in turn, about 61% of respondents felt confident navigating financial tools in a digital context. This is a positive development in terms of increased user comfort and proficiency, where nearly one-third reported very high levels of comfort and digital financial literacy with self-efficacy. A smaller percentage of respondents about 5% reported a lack of confidence to manage their finances in a digital context. While this group is relatively small, this finding informs the presence of barriers including gaps in digital literacy or a distrust of digital systems which may need further targeting.
On the question of perceived benefits, 39% of respondents indicated that access to digital finance had contributed to better saving behaviours. This indicates that digital financial services have a strong role in developing financial self-discipline and supporting savings behaviours. Changes to household budgets were also moderately common with 14% indicating that digital finance was likely enabling them to better track and plan for spending levels, which would assist in stabilising household finances. In terms of entrepreneurial activity, 14% indicated that digital finance has helped them either start or grow a business. This demonstrates the potential opportunity within digital financial services to enable the small business development process possibly through more enhanced access to funds, payment systems or online platforms that can support

commerce. Access to loans or credit was reported as an area of improvement by about 9% of respondents. This suggests that while digital finance has begun to open new credit pathways, it has still a relatively small reach and may face further barriers to achieving wider financial inclusion. However, about 24% of respondents indicated that they did not report any meaningful changes in their lives as a result of digital finance. This represents a key sub-group that requires further research and/or policy intervention to explore their varying barriers to realising any benefits.

The study of respondents interest in digital financial products which support environmental parameters shows that 49% of respondents indicated a definite interest in these types of products. Therefore, it's fair to conclude that approximately half of those surveyed are already amenable to some ranges of eco- or climate-friendly financial offerings — like a green savings account or eco-offering for a loan. This signals an opportunity for sustainable finance in Egypt in the not-too-distant future. On the contrary, approximately 26% of respondents indicated a lack of interest in digital financial products that supported environmental sustainability. However, there was roughly 25% of respondents who selected "maybe", or perhaps they are uncertain or ambivalent. This group may have a number of concerns that are present which could include a lack of information about these products, the perceived complexity of the product, or whether the product actually makes a difference.

The responses regarding the forms of green financial products that respondents are interested in indicate that (41%) showed interest in green savings accounts and eco-investment products. This indicates a strong preference for financial products that create personal financial benefits while also supporting clean energy and environmental sustainability programs. A further 22%, indicated interest in green loans and bonds. These

represent a demand for credit instruments to support individuals and businesses that want to fund environmentally responsible projects such as renewable energy installations or energy-efficient updates to their homes. The participants that indicated interest in more specific green finance products, such as "carbon credits," "debt instruments for green projects," and "ESG (Environmental, Social, and Governance) funds," represented a much smaller section of the survey (7%). This indicates a subsequently smaller group of survey participants who had a greater awareness of specialized financial products that relate to sustainability and climate action. By contrast, 23% of respondents either did not know or were unsure about green financial products indicating a significant knowledge gap here.This group is a key area for educational interventions that build understanding of how green finance can support environmental objectives. Around 7% claimed no interest in green financial products. It may be helpful to explore this minority more deeply to understand whether disinterest is driven by skepticism, ignorance, lack of relevance or other barriers.

Conceptual framework of this study investigates the effect of individual and environmental variables (independent variables) on socio-economic and environmental consequences of digital financial services (DFS), mediating for the mediating variables affecting user usage. Such a framework is directly captured in the empirical results obtained through the survey and charted across three interconnected levels: independent variables, mediating variables, and dependence outcome consequences. At the first level, the independent variables of age, residence, and occupation are highly heterogeneous among respondents and play a significant role in DFS uptake. The statistics reveal that 70.3% of the respondents are aged below 30 years, which means there is a young population with greater flexibility to

work with digital tools. Also, 87.7% reside in urban areas, which is a sign of better accessibility to digital infrastructure and connectivity. Besides, 71.7% of the sample consists of students, a group typically more inclined to adopt mobile and internet banking services given their experience with technology and pressures of lifestyle. These characteristics are strongly linked with mobile financial consumption patterns: 55% of the population used mobile wallets, drivers of which were mainly convenience (78%), speed (65%), and accessibility (50%). These statistics empirically validate conceptual model's assertion that demographic and socioeconomic contexts have significant effects on DFS adoption and usage patterns. The second phase of the model is focused on mediating variables specifically, user confidence and perceived barriers—on affecting the strength and nature of relationship between original characteristics and DFS outcome. There is a high degree of trust in using digital financial services, with 61% showing ease and comfort of use, 34% indifferent, and 5% not trusting. This trend indicates that digital confidence functions as a partial mediator, influencing consistency and depth of DFS use. Concurrently, use barriers are reflected visibly in the data: 35% of the non-users cited fear of fraud, 26% cited usability issues, and 20% cited infrastructure issues. These use barriers disproportionately affect older, rural-residing, or less educated users, therefore affecting the impact of key independent variables—age, location, and occupation—on DFS adoption and usage. These results support the notion that the user-characteristics-outcome relationship is multifaceted and heavily contingent on infrastructural environment and psychological preparedness.

The third dimension is regarding dependent variables: the socio-economic effect of DFS use and the intensity of interest in green financial services. The model predicts that effective

DFS engagement should result in improved financial performance and enhanced ecological awareness. Surveys confirm this hypothesis as 39% of the users reported improved saving behavior, 14% improved budgeting ability, and 14% entrepreneurial activity due to digital finance. These findings forecast the positive socio-economic effects of DFS use when confidence levels are high and barriers are low. When it comes to a green environmental impact, 49% said they were interested in green financial products, yet 41% would use green alternatives such as environmentally friendly investments or 'green saving accounts.' Nonetheless, 23% indicated that they did not know about the existence of such products, so environmental priorities are a nascent dimension of digital finance use. In combination, these findings support the conceptual model's hypothesis that DFS adoption, moderated by user attributes and mediated by confidence and perceived barriers, has key contributions toward financial empowerment and fostering nascent adoption of sustainability-oriented financial instruments.

6. Discussion

This study set out to explore how digital financial inclusion (DFI) affects economic participation and environmental awareness in Egypt. The findings broadly support existing literature on the role of financial technology in expanding access to financial services. However, the study also reveals nuanced barriers and behavioral insights that deserve closer examination.

6.1 Demographic Access and the Digital Divide

The strong presence of youth, students, and urban residents among DFS users confirms previous findings by Rashdan &

Eissa (2019), who emphasized that education and age—not gender—are primary predictors of financial inclusion in Egypt. However, the sharp underrepresentation of rural, older, and economically marginalized populations reveals the persistence of a **digital divide**, echoing concerns raised by Hassouba (2023) and Anwar et al. (2020).

Although mobile wallets were widely adopted, the low uptake in rural areas reinforces the impact of infrastructure limitations and trust deficits—both common themes in financial exclusion. These disparities suggest that access alone is not enough: **inclusive DFI must address behavioral and structural barriers simultaneously.**

6.2 Digital Confidence and Behavioral Adoption

The confirmation of **H1**—that digital confidence drives DFS usage—validates the **Technology Acceptance Model (TAM)**, which positions perceived ease of use and perceived usefulness as key determinants of technology adoption (Davis, 1989). The 61% expressing confidence indicates progress, but the 34% who were neutral or uncertain highlights a **hesitation zone** where further behavioral interventions (e.g., user training, interface simplification) could enhance uptake.

This insight aligns with Rabe et al. (2022), who suggest that inefficiencies in Egypt's financial system stem not only from technical gaps but also from user-level readiness and literacy. Our results indicate that users who lack confidence tend to avoid even basic digital tools, regardless of physical access—confirming the need for **dual focus on infrastructure and user capability.**

6.3 Economic Outcomes and Inclusion Gaps

The reported improvements in saving (39%), budgeting (14%), and entrepreneurship (14%) affirm previous research (Nada, 2020; Ismael, 2021) linking DFI to positive financial behavior. However, the low percentage of users reporting increased access to credit (9%) shows that **FinTech lending remains limited in reach**, likely due to risk-aversion, eligibility barriers, or lack of credit history among the financially excluded.

This supports Nouran et al. (2021), who noted that while digital finance can enhance macro-level indicators like GDP or investment flows, its **transmission to grassroots credit access is still shallow**. To overcome this, policymakers and FinTech platforms must develop more **inclusive, low-risk credit models**, especially tailored for informal sector users and micro-entrepreneurs.

6.4 Green Finance: Interest vs Awareness

The finding that 49% of users expressed interest in green financial products is consistent with the global trend of linking finance and sustainability. Studies like Saman & Ismael (2023) and Elsherif (2023) confirm that green finance can support emissions reduction when effectively implemented. However, the **23% who were unaware** of green finance options in this study reveals a critical gap in financial and environmental literacy.

While higher education and digital confidence were associated with greater interest in eco-products (supporting **H3**), the lack of actual adoption or access underscores that green finance in Egypt remains **more aspirational than practical**. As Hassan et al. (2024) warned, Egypt lags behind peers like China and Turkey in embedding environmental finance into mainstream policy and practice.

6.5 Conceptual Model Reflection

The study's conceptual framework, which positioned digital confidence and usage barriers as mediators, was supported by the data. Users with high confidence and low barriers experienced stronger financial benefits and were more open to green finance—validating the theoretical linkages proposed in the model.

This reinforces the dual relevance of **TAM** and **Sustainable Development Theory** in analyzing DFI. The former helps explain **individual behavior**, while the latter frames **systemic integration** of finance, equity, and environmental impact. However, future research should explore these models with **more advanced statistical tools**, such as structural equation modeling (SEM), to better capture interaction effects.

6.6 Policy and Practice Implications

These findings have practical implications for:

- **Policy design**: Targeted subsidies or public-private partnerships to expand mobile internet in rural zones.
- **FinTech platforms**: Simplified interfaces, local language support, and gamified digital literacy training.
- **Green finance providers**: Awareness campaigns linking personal finance to environmental outcomes.

Overall, DFI in Egypt is advancing—but unevenly. Its sustainability potential is high, but largely untapped. Closing gaps in trust, literacy, infrastructure, and awareness will be key to leveraging digital tools not only for financial inclusion but for long-term development.

7. Conclusion

This study provides empirical insight into the role of Digital Financial Inclusion (DFI) as both an economic enabler and a potential tool for environmental sustainability in Egypt. Drawing on survey data from 193 respondents, the research affirms that while digital finance tools—particularly mobile wallets—are gaining traction among urban youth, major gaps remain in usage, trust, and impact among rural, older, and less digitally literate populations.

The study's findings validate key behavioral and structural assumptions: digital confidence significantly drives usage; place of residence shapes access; and financial literacy influences both usage patterns and openness to green finance products. These results confirm the relevance of both the Technology Acceptance Model and Sustainable Development Theory as guiding frameworks.

Although DFI contributes to improved saving behavior and financial planning for many, the relatively low rate of credit access and the widespread unawareness of green financial products suggest that Egypt's digital transformation remains incomplete. There is a pressing need to design DFI strategies that are not only digitally accessible but also behaviorally inclusive and environmentally oriented.

Policy and practice should prioritize:

- Expanding digital infrastructure in underserved areas.
- Investing in digital and environmental financial literacy.
- Creating and promoting inclusive green financial products.

- Addressing trust and security concerns through regulation and awareness.

Limitations of the study include its sampling bias toward students and urban youth, the descriptive nature of the statistical analysis, and reliance on self-reported data. These constraints limit generalizability but offer a valuable entry point for more rigorous future research.

Future studies should consider using representative sampling, regression or path analysis, and longitudinal tracking to measure behavioral change over time. More importantly, future research should explore how DFI adoption translates into measurable economic empowerment and environmental outcomes at household and community levels.

In conclusion, DFI holds significant promise for Egypt—not just as a vehicle for financial access, but as a platform for inclusive growth and green innovation. However, realizing this potential will require a deliberate shift from digital expansion to **digital equity**.

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