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# Fintech, the Fourth Industrial Revolution Technologies, Digital Financial Services and the Advancement of the SDGs in Developing Countries

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## *Abstract*

Fintech has gained ground in the financial services sector globally, increasing implementation, usage, and acceptance. Digital Financial Services (DFSs) are dominating the financial sector. This has been attributed to the growth of the digital economy, fintech, the Fourth Industrial Revolution(4IR), and the Covid-19 pandemic. Developing countries have not been spared from the growth of fintech and 4IR technology usage in the financial sector. 4IR tools such as Artificial Intelligence, Big data, the Internet of Things, Cloud computing, and Blockchain technologies have been adopted to improve service provision in the financial sector and to expand digital financial inclusion. Recognizing that technology has a two-fold impact, that is transformative (impactful) and disruptive, through a systematic review, this study sought to assess the role of fintech and 4IR tools in advancing digital financial inclusion and the attainment of the 2030 United Nations Sustainable Development Goals (SDGs) in developing countries. SDGs are critical for all countries globally in efforts to achieve sustainable development dimensions (social, economic, political, and environment), yet access to financing and DFI are key to building inclusive finance, promoting digital finance, and ensuring accessibility to affordable funding to drive sustainable development. The findings of the review were convoluted and ambivalent. While positive effects such as financial inclusion, DFI, improved access to affordable funding, enhanced profitability for service providers and the delivery of certain SDGs, the negative effects of using fintech and 4IR tools were equally compelling. The unfavorable consequences include the perpetuation of biases, increased risks and fraud, increased inequalities, and gender divide due to digital financial illiteracy, and lack of digital infrastructure. The negative externalities could impede DFI and the fruition of the SDGs such as SDG1 on poverty reduction, SDG2 on eradicating hunger, SDG5 on ensuring gender equality, SDG8 on economic growth and decent work, and 10 on reducing inequalities among others. The review recommends a balanced assessment of the impact and fact-based solutions that support the positive outcomes and minimize the negative impacts. Key among the recommendations is the enhancement of digital and digital financial literacy, effective regulation, and improved risk assessment and mitigation procedures.

***Keywords:*** *Fintech; 4IR; Digital Financial Inclusion; Digital Financial Services; Innovation; SDGs*

## *1. Introduction*

The Fourth Industrial Revolution (4IR) has increased digital transformation in all sectors of the economy. The sectors include security, transport, health, trade, and finance among others (Mhlanga, 2022a). Examples of 4IR technologies that have been rolled out include artificial intelligence (AI), Big Data, Cloud Computing, and Block Chain (Mhlanga, 2022a). In the financial services sector, the rollout of digital financial services (DFSs) has been described by the term "Fintech". Fintech is articulated as a combination of financial technologies that have been developed and deployed in the financial services sector (Ozili, 2018; Shipalana, 2019). These novel technologies have altered trade activities (both domestic and international), buying, and selling of goods and services, data processing, and banking. Additionally, fintech has led to the emergence and trading of virtual currencies such as cryptocurrencies and bitcoins employing algorithms and specialized software.

The Covid-19 pandemic quickened up digital financial technologies and DFS globally. The pandemic disrupted social and economic settings all over the world. As part of the response measures to minimize the spread and effects of the disease on human lives and the economy, governments-imposed lockdowns, and mandatory wearing of masks as well as social distancing. DFSs were deployed to ensure continuity in banking, insurance, trading in securities markets, transfers, deposits, payments, and access to credit during the pandemic period (World Bank, 2020). Most people had no choice but to embrace digital tools in banking, education, and e-commerce (Mhlanga, 2022b). Therefore, the Covid-19 pandemic fueled digital transformation in the financial services sector and indirectly availed an opportunity to enhance digital financial inclusion.

It is important to emphasize that while the Covid-19 pandemic widened financial inclusion for some economies and some segments of the population, for some the pandemic heightened existing inequalities, increased poverty, and job losses, thus worsening financial exclusion. Some of the previously banked became unbanked due to job losses. While fintech has gained ground globally in developed countries in achieving digital financial inclusion (DFI), its acceptance and effective usage is rather slow in developing economies owing to several constraints. These constraints include the availability of adequate digital infrastructures, poor internet connectivity, affordability, and access challenges. The other challenges encompass digital literacy, financial literacy, and digital financial literacy among others. Developing countries need to surmount these challenges to promote DFI as well as inclusive and sustainable development that delivers on the United Nations 2030 Sustainable Development Goals (SDGs). Using an array of digital technologies, people can be connected to financial, social, and economic systems. Access to affordable, convenient, and reliable financial services through financial or digital financial inclusion, people could be enabled to have access to key services such as health, education, electricity, finance, and information.

DFI is topical in financial inclusion discussions, especially about how to ensure the financially exclude or those with limited access to financial services get access to mainstream financial services (Mhlanga, 2021). Fintech has revolutionized the financial services sector, concerning service provision, consumption patterns saving options, and investment channels. In affirmation, United Nations (2021), articulates that technology is key in minimizing the gap between the high income-earners and the poor concerning access to financial services and resources in both developed and developed countries. The level of financial exclusion is high in developing countries, especially in fragile states, due to weak degrees of financial development, inadequate and ineffective regulation, and digital infrastructure among other problems. In these developing countries, it is pivotal that governments and financial institutions look for alternative means and technologies to expand financial inclusion.

The DFSs sector is a very critical and sensitive sector that affects not only the financial well-being of individuals but that of the country as well. Fintech companies are harnessing 4IR tools to ensure DFI small businesses, the informal sector, women, youth, and low-income earners. These technologies are

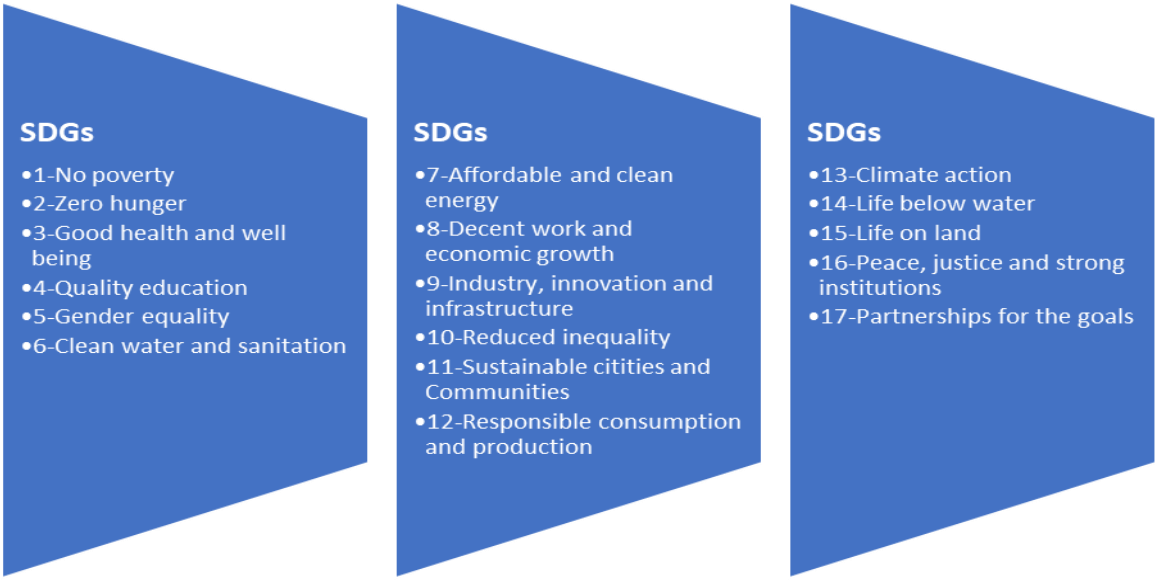
meant to ensure that these previously disadvantaged groups are ushered into the mainstream financial services systems through digital means or access to affordable, convenient, and reliable DFSs. Operators in the financial services sector (both the banking and non-banking firms) firms are exploiting 4IR technologies such as machine learning (ML), AI, distributed ledger, and cognitive computing (Mhlanga, 2021). Digital technologies have both transformative and disruptive consequences on business models and processes, operational activities, client assessments, communications, and relations (Mhlanga, 2020). Various stakeholders such as customers, governments, traders, investors, and arbitrageurs benefit and suffer from the advantages and negative externalities in a variety of ways. Several advantages have been attributed to the use of 4IR technologies and fintech. These include automation which leads to less operational costs, an increase in economies of scale, advancement of peer-to-peer transactions, and ushering in of a new financial ecosystem driven by fintech which is characterized by enhanced transparency and improved customer service (Rauniyar, Rauniyar, & Sah, 2021). Financial technologies also come with an array of challenges for various stakeholders. In addition to the disruptive, nature of technologies, several other risks emerge from the provision and usage of 4IR technologies in the financial services sector. These risks include operational risks (for example, hidden and unpredictable costs), regulatory risks (risks attached to stringent regulations or treatment of certain products based on regulation or contrary to regulation), business risks, transaction risks, and exchange rate risks (Shipalana, 2019). Rauniyar et al. (2021) argue that is important to assess the negative, positive, and dual perspectives that link, fintech, the use of DFSs, and financial innovation with DFI and value creation for governments, customers, financial institutions, and businesses in the digital era of the 4IR or industry 4.0.

The interconnectedness between DFSs and DFI in a business environment is greatly influenced by industry 4.0. 4IR technologies are considered a double-edged sword, with both negative and positive outcomes. While other 4IR tools are equally relevant to the financial sector, this study focuses on the role of AI, the Internet of Things (IoT) big data, and blockchain in advancing the usage of DFSs, DFI, and the Sustainable Development Goals (SDGs). The study explicates how the selected 4IR technologies can affect DFI and sustainable development, because of the technologies' disruptive and enhancement abilities. Ozili (2021) proclaims that AI is key to sustainable development and financial inclusion and is a critical part of the discussions in the UN Agenda on 2030 SDGs how AI contributes to financial inclusion and the achievement of SDGs remains limitedly explored. Ozili (2020) portends that there is a paucity of research that explores DFI in emerging and developing economies. Dal Mas et al (2021) refer to a dearth of studies and usage of AI technologies in Sub-Saharan Africa. According to Sampene et al (2022), research that evaluates AI in Africa and its transformative role is limited. Acknowledging the research gap, Langley and Rodima-Taylor (2022) articulate there is insufficient research on fintech in Africa.

## *2. Literature Review*

The United Nations Assembly in 2015 adopted the 2030 Agenda for Sustainable Development which culminated in the agreement on the 17 Sustainable Development Goals. The SDGs focus on prosperity, the people and planet. The SDGs set out targets and indicators of achieving economic, environmental, and social sustainability. While these SDGs do not directly focus on financial inclusion, improved access to financial services is pivotal to achieving these SDGs. Through a review of related literature on DFSs, Digital financial inclusion (DFI) and the SDGs, this section aims explore whether and how financial services can help in the attainment of the SDGs in developing countries. According to Demir et al. (2022: 87), "Increasingly, fintech is seen as a key enabler of financial inclusion and mobile financial services as the type of fintech with the greatest potential to bring the remaining underbanked into the formal financial system and ultimately to achieve more equitable growth". The UN 2030 Agenda for Sustainable Development considers financial inclusion pivotal to achieving the SDGs and addressing inequalities (SDG 10). Figure 1 provides an overview of the SDGs to inform the discussions on fintech, 4IR and the attainment of the SDGs.

**Figure 1: The 17 Sustainable Development Goals**




Source: https://sustainabledevelopment.un.org/sdgs

Hinson et al. (2021) provides evidence that fintech through DFI can contribute positively to the fruition of SDGs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 16 and states that as for SDGs 11, 12, 13, 14, 15 and 17, the role of financial services was not directly evident and accordingly additional research was required to reveal the connection between these goals and financial services. The researchers further state that in terms of SDG 1 on poverty alleviation, access to financial services can lead to emergence of small businesses and access to education. In India, access to financial services for the rural population was said to have reduced poverty by between 14 to 17%. In Nepal households' education related expenditure is observed to having risen by 20% and in Malawi food security is said to have increased as expenditure on equipment increased by 13% increasing farming output by 21%. In Kenya household expenditure on health increased by 66%. Access to credit can drive innovation and contribute to SDG8. The role of financial inclusion on SDGs 8, 9, 10 and 16 is contested and mixed. For example, there is no strong evidence on financial inclusion reducing inequalities or driving inclusive growth in developing countries. Affirming the controversy surrounding the contribution of fintech to the attainment of the SDGs, Yawe et al. (2022:1) states that "Financial inclusion is not a panacea to the problems of economically challenged families, despite the merit of both mobile money and digital payments for financial inclusion. The economically challenged need a combination of knowledge, skills, attitude, and habits to break out of the poverty trap".

### 2.1 Fintech and 4IR technologies in advancing SDGs

SDGs are crucial for every country, developed or developing. DFI and financial inclusion are inextricably connected to the attainment of the 2030 SDGs because "financial inclusion is a lubricant for the entire economic system" (Tay et al, 2022:1). While the Covid-19 induced digital transformation that did not spare the financial services sector, it was fundamental in increasing access to and usage of DFS in some countries, it resulted in challenges to DFI inclusion in some countries. In developing countries where poverty, inequalities, and unemployment are high coupled with financial and technical resources limitations (World Bank, 2018), the impact of DFSs on DFI and financial inclusion is mixed. Similarly, the effect on SDGs is mixed and debatable. Tay et al (2022) argue that while for Asian countries, digital financial inclusion has been embraced to reduce poverty, in most developing countries, the digital financial inclusion divide continues to exist concerning gender, level of income, and location (such as

rural and urban areas) concerning access and usage of DFSs. Tay et al. (2022) further describe DFI inclusion as a stepping-stone to achieving the SDGs by 2030, articulating that it helps attain 13 SDGs out of a total of 17. The 13 SDGs include SDGs 1 (poverty reduction), 2(addressing hunger), 3(promoting good health and well-being), 4 (developing quality education), 5(addressing gender equality), and 6 (provision of clean water and sanitation). In addition, to the six mentioned, the remaining seven SDGs encompass, SDGs 7 (ensuring access to affordable and clean sources of energy, 8 (ensuring economic growth and decent work, 9 (promoting innovation, industrialization, and building strong institutions), 10, (reducing inequalities, 11 (building sustainable communities and cities), 13 (dealing with climate change and climate change impacts and 16 (promoting justice, peace and building strong institutions. Ojo (2022) and Shipalana (2019) argue that DFI is key to the achievement of nine SDGs, these being SDGs1, 2, 3, 5, 8, 9,10, 12, and 17. Therefore having already explained the other SDGs except SDG 12, this SDG speaks to fostering responsible production and consumption, thus encouraging savings mobilization and responsible usage of resources.

The SDGs are connected and are not divisible. They affect one another. The achievement or non-achievement of the other can positively or negatively affect other SDGs, the multiplier effect. For example, poverty is one of the biggest challenges facing humanity with an estimated 800 million people surviving with below US$1.25 per day (Deloitte, 2018). Poverty in SDG1 affects hunger in SDG 2, energy use in SDG 7, gender equality in SDG 5, access to clean water and sanitation in SDG 6, and inequalities in SDG 10, just to mention a few of the interlinkages. In addition, millions of people are estimated to be facing hunger largely driven by drought, global warming environmental degradation, and loss of biodiversity (SDG 7, 13, 14, and 15, being linked to SDG 2). Green fintech can alleviate the effect of climate change (Puschmann, Hoffmann & Khmarskyi, 2020).

Achieving the SDGs would be difficult without financial inclusion, which entails access to loans, savings accounts, insurance as well as other financial products and services, complemented with adequate security and protection of privacy. In Nepal, after being offered bank accounts women expanded their assets by approximately 16% and in India, access to bank accounts by the previously underserved and unserved groups reduced poverty by 17%. In Kenya when female market vendors were given access to savings accounts, their daily expenditure rose by 37% as compared to their counterparts with no accounts (Deloitte, Klapper, 2016). Financial inclusion and exclusion have a big role to play in the attainment or non-attainment of SDGs. Table 1 gives a summary selected studies on fintech and the attainment of the SDGs in developing countries, considering this an under-researched area.

**Table 1: Studies on Fintech, DFI and the achievement of the SDGs**

| Studies | Focus | Methodology | Findings |
|---|---|---|---|
| Demir et al. (2022) | The relationship between fintech, financial services and income inequality in developed and developing countries | Quantile Regression approach, employing Global Findex survey data for 2011, 2014 and 2017 | Fintech indirectly reduces income inequality through its impacts on financial inclusion in high income countries. Fintech was found to be a less effective tool in minimizing income inequality in low-income countries owing to the lack of proper infrastructure and low literacy levels |
| Ojo 2022 | Digital financial inclusion for women in the 4IR centering on SDG 5 on gender equality in Africa (Namibia, Kenya, Ghana, and Lesotho) | Literature Review | Participation of women in the 4IR still low and the gender gap in DFI persists |
| Pandey, Kiran, and Sharma | Impact of drivers of financial inclusion (technology, digitization, and usage) and financial literacy in | Partial Least Squares Structural Equation Modelling and | The study found that financial inclusion helped in the attainment of the SDGs with highly |

| | | | |
|---|---|---|---|
| (2022) | facilitating sustainable growth in North India | questionnaires for data collection | significant positive results for SDGs 8, 17, 10 and 1, but there was a need for improvement in the contribution of financial inclusion to SDGs 3 and 5 |
| Emara and Mohieldin, (2021) | Assessing the impact of financial inclusion (access and usage) on reducing extreme poverty (SDG 1) in the Middle East and North Africa African countries (MENA) | General method of moments on annual data of 23 emerging economies and 11 MENA countries | Financial access measures have a positive and statistically significant impact on the reduction of extreme poverty |
| Chikalipah (2020) | Effects of mobile money services on the achievement of the SDGs | Field data | Factors constraining the access to credit and ability to save are not simply addressed by the adoption of fintech (mobile money in this case). Therefore, fintech is not a quick fix for financial inclusion and the attainment of SDGs |

Source: Author's Compilation

### 2.1.1Fintech, 4IR, DFI, and the positive influence on SDGs

Mobile technologies, fintech, and 4IR technological tools such as data analytics, AI, ML, and blockchain can enhance financial inclusion in developing countries and contribute to poverty reduction efforts (Markus &Nan, 2020; Van Hove & Dubus, 2019). M-Pesa in Kenya and Eco-cash in Zimbabwe enable consumers and businesses to keep money, transfer and withdraw money through mobile phones. This encourages financial inclusion and financial empowerment while reducing the number of financially excluded members of society, thus reducing poverty (SDG1). In Kenya, the M-Pesa is estimated to alleviate poverty by approximately 2%. Mobile money facilitates peer-to-peer remittances, person-to-business, business-to-business, government-to-person, and person-to-government remittances. It also facilitates international remittances, and these are crucial for African countries such as Zimbabwe with most of the population working outside the country. Sending money back home facilitates economic development and reduces poverty. Mobile money activities also promote lending and crowdfunding in developing countries, thus facilitating financial sector development, growth, and stability as well as job creation and viability of small businesses and availing funding to the poor. These activities foster improvements in the welfare of citizens, poverty reduction, and empowerment of the traditional financially excluded groups such as women, the youth, and informal traders (Ojo, 2022a; Ozili, 2021; Shipalana, 2019). In countries such as Bangladesh and India, mobile money, and digitalization using fintech and 4IR tools, efficiency in financial transactions has improved and corruption reduced (Kumar, Mishra & Mishra, 2019).

Agur, Peria, and Rochon (2020) and Makina (2019) articulate that as transactions such as receiving, sending, withdrawing, depositing, and saving money as well as getting credit are made convenient, citizens are more in control of their finances. Governments can also exploit mobile money platforms to make government-to-person payments such as social grants, pensions, and salaries. The flexibility and convenience in accessing and managing finances by citizens especially the previously financially excluded can positively contribute to SDG1, 2, 3, 4, 5, 10, and 12.

With the use of AI technologies, mobile money, and blockchain, developing countries have also made efforts towards achieving food security, promoting agriculture, and ending hunger, thus addressing SDG 2 (focusing on zero hunger). Through smart contracts, farmers in developing countries can be linked to buyers around the world securely and execute contracts. This protects farmers from exploitation. Additionally, through easy access to funding, farmers can expand their agricultural activities by procuring

the necessary infrastructure. This not only increases the productivity of farmers and their contribution to economic growth but also to SDGs 1 and 2 (Singh & Yadava, 2020).

Employing the IoT promotes the provision of inclusive and quality education as well as lifelong learning opportunities for all advocated in SDG 4. For example, through IoT, with fintech and 4IR technologies incorporated into financial services, as youths and adults strive to get digital knowledge and financial knowledge to improve digital financial literacy, SDG 4 is advanced (Unterhalter, 2019).

In countries like India through the pay-for-use model called Simpa Network, by amalgamating AI technologies, IoT, and mobile money technologies, telecoms firms can supply services such as the purchasing of electricity to financially excluded communities and those in remote areas (Salvia & Brandli, 2020; Yadav &, 2021). Other developing countries could employ these models to improve SDG7 by promoting access to affordable, sustainable, reliable, and modern energy by all segments of the population. In Zimbabwe, through the Eco-cash mobile money platform residents could transfer money from their banks to this mobile money platform then pay their bills and purchase electricity (Simatele, 2021). This was very convenient and helpful during the Covid-19 pandemic lockdown restrictions.

As Fintech and the 4IR technologies help expand access and usage of DFS, digital financial inclusion, and financial inclusion widened. This expansion contributes to the fulfillment of SDG8, which speaks to ensuring economic growth that is sustainable and inclusive through the provision of employment and decent work for all employable members of society. Firstly, using IoT, big data, AI tools, and Fintech to facilitate access to DFS, could empower the previously excluded members of society (women, youth, vendors, and cross-border traders) and businesses (such as SMEs, sole traders, and startups). Access to funding is key to the survival of SMEs where the failure and collapse rate is high, especially in the first five years of inception. This could promote employment creation and the survival of small businesses. Secondly, with programs such as Ant Forest, environmental or green activities concerning consumption choices could be linked, assessed, and integrated into individual carbon accounts, thus motivating users to be conscious of their consumption decisions. Consumers will be indirectly encouraged to make consumption decisions that minimize carbon activities and emissions (Zhang et al,2021). These decisions would not only contribute to SDG8 but SDG 13 which advocates for the preservation of the environment, paying attention to climate and climate change impacts, and SDG7. In some continents through global warming, the resultant droughts and floods contribute to SDG1 and 2 (on poverty and eradication of hunger). This indicates that these SDGs are interlinked, addressing one could positively or negatively influence the achievement of another SDG.

Concerning SDG 9, which proselytizes for building resilient infrastructure, and promoting sustainable and inclusive industrialization, while fostering innovation, through employing big data, blockchain, AI, mobile technology, and fintech to widen peer-to-peer lending, crowdfunding, and other lending platforms, sources of finance have been expanded. The widening of sources of funding and making them accessible to SMEs, sole traders, big businesses, and vendors, do not only foster the attainment of SDG9, but SDGs 1, 2, and 8. (Piliyanti, 2019).

AI technologies such as ML, IoT, big data other fintech such as mobile money have been employed to enhance the security and transparency of financial activities and transactions. This has increased the audit trail and reduced corruption, risk, and money laundering. This contributes to addressing SDG 16, which advocates for ensuring inclusive and peaceful societies, by ensuring justice for all as well as building inclusive and accountable institutions (Zarrouk et al., 2021). This has been affirmed in countries such as South Africa and India (Klapper and Singer, 2017).

The use of fintech and 4IR technologies in championing DFSs also contributes to strengthening and stimulating a global partnership for the achievement of the sustainable development goals espoused in SDG 17 (Adegbite & Machete, 2020). Digital finance can work as a tool for the creation of new partnerships between countries, and partnerships between the private and public sectors (Public Private

Partnerships, PPPs). These could lead to sustainable digital finance and exploit technology to drive sustainability in the business environment, bring stability to the financial sector, and sustainable global cooperation (Babu et al., 2020). These activities would enhance the fruition of SD17 together with other SDGs such as 1, 3, 7, 8, and 9 among others.

### 2.1.2 Fintech, 4IR, DFI, and the negative influence of SDGs

Tay et al. (2022:1) posit that "When offered ethically and sustainably in a well-regulated environment, digital financial inclusion encourages development and accelerates progress towards the Sustainable Development Goals (SDGs)''. This implies that if not properly regulated or delivered ethically and sustainably that promotes inclusivity, transparency, and stability in the financial ecosystem DFS can impair DFI and hinder efforts toward sustainable development and ultimately the attainment of the SDGs. The researchers further emphasize that for DFI to effectively contribute to the fruition of the SDGs, especially to SDG1 on poverty reduction, concerted efforts, and collaboration between countries both developed and developing, considering the level of development and technical capacities characterizing the two groups of countries.

Fintech can negatively affect the fulfillment of the SDGs. It brings several factors to the table that can affect various stakeholders such as governments, financial service providers, individuals, businesses, regulatory authorities, and the economy at large. These factors include continuous technological updates that require service providers to continuously respond by upgrading their digital infrastructure and training staff, evolving digital finance risks such as fraud, phishing, hacking, and identity theft (these would require increased and improved risk prevention and management frameworks) (Shipalana, 2019). Furthermore, for businesses the expenses of acquiring and maintaining digital infrastructure, costs of organizational change resistance, training and risk management, and financial losses due to financial fraud can affect the profitability of financial institutions. The business and industry risks might affect the stability of the financial sector and that of the economy at large, thus affecting the fulfillment of the SDGs negatively (Ozili, 2020, 2021). For consumers risks of high indebtedness, failure to consider hidden costs due to aggressive marketing tendencies of DFSs providers, digital illiteracy, financial illiteracy, and digital financial illiteracy as well as the costs of internet and connectivity challenges can further perpetuate inequalities, the digital financial exclusion for the illiterate, women, the elderly, and those in remote areas. This would negatively impact addressing SDG1, 2, 4, 8, 9, 10, 12, and 16 among others.

Generally, 4IR technologies such as blockchain, AI, and IoT among other technologies are still in their nascent stages of use, and investment in infrastructure is high. Additionally, the fintech environment is characterized by uncertainty, technical skills shortages as well capacities and capabilities gaps. These costs and cybersecurity concerns could affect implementation, usage, and acceptance by consumers (Houang, Nguyen & Le, 2022), thus impeding the attainment of SDGs. For example, machine learning algorithms can improve decision-making on loan assessment and creditworthiness and reduce discrimination and prejudices such as bias or race drive discrimination, the same algorithms can further perpetuate the prevailing biases by their reliance on historical data (Ozili, 2018; Shipalana, 2019). While on the first perspective, the algorithms can reduce inequalities, and promote gender equality, DFI, and poverty reduction, on the counter-argument algorithm scan reinforce inequalities, poverty, and gender divide.

Li et al (2020) raise a concern about the huge power consumption of blockchain technology and its appropriateness in developing countries' contexts, hence raising questions on fintech and sustainable development. The question is whether technologies such as blockchain and cryptocurrency mining promotes or impede sustainable development, sustainable use of energy as well as responsible production and consumption, thus touching on SDGs 7, 12, and 13. Developing countries face financial resources challenges as well as power shortages. Similar concerns were also raised by Náñez Alonso et al. (2021)

and Putranti (2022). The researchers allude to the possible pollution and excessive usage of electricity driven by cryptocurrency mining.

While acknowledging the possibility of improved decision making the financial services sector driven by 4IR and fintech-driven failure prediction models, machine learning and data analytics predictive comparisons and forecasting, repayment prediction models, and fraud prediction (Crowley et al, 2020), Ardichvili (2022) and Lehner et al (2022) raise ethical dilemmas from the use of technology, skills, and expertise challenges as well as possible loss of employment. The loss of employment might not only perpetuate poverty, affecting the welfare of those who lose their jobs to technology but also affect tax revenue mobilization, consumption patterns in the economy, and ultimately economic growth.

Hinson et al. (2021) while focusing on the role of fintech in the transformation of agribusinesses and the achievement of SDGs argue that fintech contributes to the attainment of SDG 12, enhancing synergies between the environmental and social SDGs such as SDGs 15 and 1 respectively. The researchers portend that there is normally a trade-off in the achievement of the SDGs and these tradeoffs are context dependent. For example, in addressing SDGs 1 and 2, if done through increased agricultural production, this might affect biodiversity preservation and, in some cases, increase emissions affecting SDGs 13 and 15, severely affect water systems (SDGs 6, 7 and 14) when water is used for irrigation. Fintech could be employed to increase synergies and reduce trade-oofs through green finance, green technologies, and the application of data science. The outcomes are context dependent.

The researchers further state that "There is also an emerging risk of a new form of inequality with entire geographic areas and population (partially) excluded from new technologies and the new world of data and information. Such inequalities can stem from human capital differences". Success of big data, AI and 4IR technologies depend on the availability of skilled workforce such as data scientists. Shortages of the skilled people in Africa affects fintech. This has been further affected by the general shortage of those with 4IR expertise in the world which has led to the increased brain drain from developing countries to developed countries with better working conditions and remuneration.

## *3. Methodology*

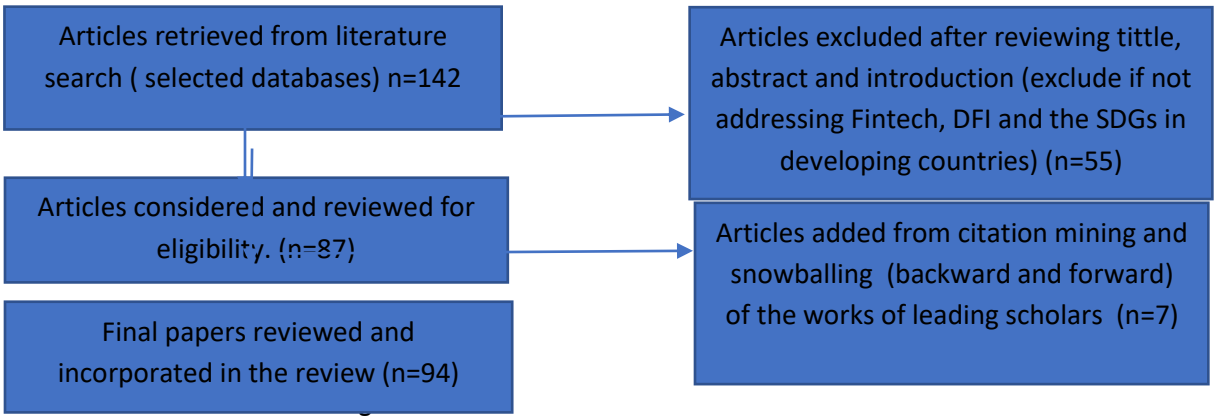
Borrowing from the works of Tay et al. (2022) who used a systematic literature review protocol, employing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), this study also employed a qualitative systematic review approach. According to Mpofu (2021a:560), a systematic review "aims to systematically search and identify studies, extract, analyze and synthesize information guided by some pre-established guidelines (these could be design, year of publication or findings) or research protocol". The researcher further alludes to the fact that systematic reviews are largely structured "outline, analysis, synthesis, and presentation". The findings from the review process can be quantitative or qualitative depending on the nature of the analysis. The findings can inform policy construction and practice (Booth, 2009; Snyder, 2019). A systematic review protocol allows for the standardization and reproducibility of the review process (Paré & Kitsiou, 2017) and Mpofu (2021a) this enhances the trustworthiness, credibility, and confirmation of the findings.

In their study, Tay et al. (2022) used a content-centric analysis to address the research questions guiding their study. The researchers' focus was on two main areas, firstly, on the development and evolution of financial inclusion across countries. Secondly, on how digital financial inclusion fosters the SDGs and economic growth across countries. The current study, firstly, focused on how fintech and the 4IR tools can be used to promote DFI in developing countries. Secondly, the study discusses how in the advancement of DFI in developing countries, fintech and 4IR tools can further espouse sustainable development and the fulfillment of SDGs in developing countries. A literature search was done through the Emerald, Springer, Elsevier, Scopus, Science Direct, and ProQuest databases. The following search

terms were used "Fintech and digital financial inclusion in developing countries", "Fourth Industrial Revolution technologies and digital financial inclusion in developing countries", "Fintech, 4IR and Digital financial inclusion in developing countries", "Fintech, 4IR and the Sustainable Development Goals in developing countries", and 4IR technologies and SDGs in developing countries". The exclusion and inclusion criteria of papers were based on the papers being published in the selected peer-reviewed journal databases identified. The articles should have been published in English. Where reports and working papers were used to buttress arguments, these were from official websites of development organizations and these included the Organisation of Economic Corporation and Development (OECD), the Institute of development studies (IDS), the World Bank, the International Monetary Fund (IMF), the McKinsey Global Institute, UN and International Centre for Tax and Development. In addition, the articles included should have been focusing on fintech and DFI, 4IR technologies and DFI as well as fintech and SDGs or 4IR technologies and SDGs (all this focusing on developing countries).

Lastly, full texts of the articles included should have been accessed for inclusion in the review. For articles that were not open access, the institutional access login was used to access them, where some articles remained inaccessible, and the help of the faculty librarian was enlisted. Where there were still not accessible, they were excluded. In total from the databases search, 142 articles were accessed, and based on the inclusion and exclusion criteria, these were screened by assessing the titles, the abstract, and the introduction (where possible). The selected articles were further assessed based on the accessibility or non-accessibility of full texts. This led to 87 articles being included in the review. These articles were further complimented by an additional 7 papers that were identified through citation list mining from the reference list of the selected papers. The prevalence of the works in different studies indicates that perhaps the authors were leading scholars in the subject area or that their contribution was interesting, topical, or unique, hence this study decided to 'mine' these. The selected works were then searched for, and the exclusion and inclusion criteria were applied for their inclusion in the review. In total 94 articles were included in the review. The dates of the reviewed articles range from 2015 to 2022, this points to the topical nature of the subject and especially with most articles ranging from 2020 to 2022. Perhaps reflecting that digital transformation in the financial sector gained momentum during the Covid-19 pandemic through the post-Covid-19 pandemic period. Olde articles were referred to in unpacking the concept of sustainable development. Figure 2 presents a summary of the review protocol.

**Figure 2: Flowchart of the literature review protocol**




**Source: Author's Compilation**

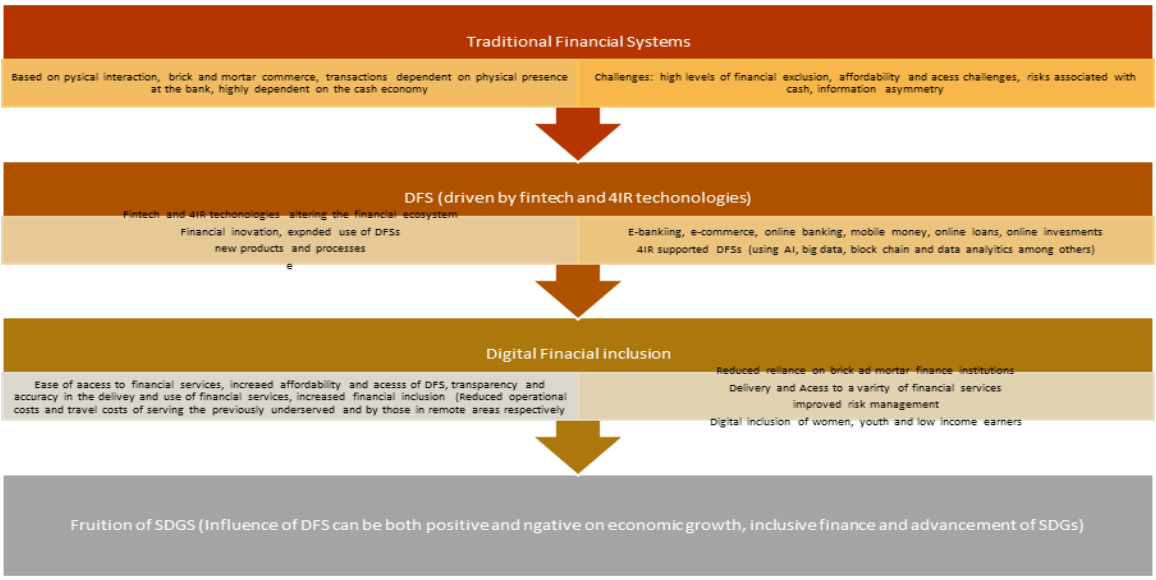
## *4. Results*

### 4.1 Fintech, 4IR technologies, DFI, and Sustainable Development

The use of technology in the financial services sector, supported by fintech and 4IR technologies to effectively deliver DFSs contributes to advancing the concept of sustainable development. In gaining digital skills to access and use DFSs, the future generation is empowered digitally, thus addressing the pervasive issue of digital financial literacy in developing countries. Through digital finance, the future generation can achieve sustainable development, which fosters the concept of 'sustainability'. Sustainable development amalgamates two fundamental aspects. Duran et al (2015) explain this infusion of two aspects "the first phrase, durable, refers to long-term viability and sustainability, whereas development refers to the process of extending or constructing one's potential: progressively bringing one's potential to a fuller, larger or better condition". Sustainable development holds that in undertaking development governments ensure that while addressing the needs of the present generation they do not jeopardise or compromise those of the future generation. Sustainability relates to the responsible use of resources that takes into cognisance the environmental, social, and economic impact, and ensures that a significant portion of productive resources passes from generation to generation (Dasgupta, 2007). Emphasising the need to consider all stakeholders to ensure sustainable development, Rees (1989) articulates that the implementation of sustainable development "requires integrated policy, planning and social learning processes, its political viability depends on the full support of the people it affects through their governments, their social institutions, and their private activities.". Therefore, to foster sustainable development and sustainability, fintech and the use of the 4IR technologies in digital finance must address the needs of all stakeholders.

DFSs encourage responsiveness to the SDGs due to digitalization and contextualized financing. Fintech and stable financial systems are essential to boost capital mobilization and domestic revenue mobilization to achieve sustainable economic growth and development. Digital transformation and the use of financial technologies are reinforcing each other in the digitalization and digitization of the financial sector (Hoang et al, 2022). The findings of the review concerning the interconnectedness can be discussed concerning the schematic conceptualization in Figure 3.

**Figure 3: Conceptualization of the Relationship between Fintech, DFS, DFI, and the fruition of SDGs**




Source: Own Compilation

Just like the risks and challenges associated with digital DFSs affect the various stakeholders such as government, consumers, and financial services providers, the relationship between fintech, the use of 4IR tools in advancing DFI and the attainment of the SDGs affects these stakeholders. Makina (2019) and Ozili (2018) are of the view that there is a need to maintain an equilibrium between innovations, fintech, the use of 4IR technologies, and risks such as system failure challenges, regulatory risks, and cybersecurity risks. Therefore, the discussion focuses on the advantages gained or disadvantages experienced or likely to be experienced by these various stakeholders, including how the pros and cons advance of constraining DFI and the fruition of the SDGs in developing countries.

### 4.2 The Role of Fintech and 4IR in the Fruition of SDGs in Developing Countries

The contribution of fintech to DFI and sustainable development is mixed and controversial as presented in Table 2. Mpofu (2022b) highlighting the inextricable connections between the various SDGs, posits that for example "To achieve good health, the air, the soil and the water need to be clean and sustainable environment, resource utilization needs to be sustainable and revenue mobilization efforts need to be effective. It is also fundamental to note that the interdependence between the SDGs can also result in negative correlations in the attainment of the SDGs (tradeoffs as opposed to synergies)."

Table 2 presents a summary of findings from the review concerning the fulfillment of the SDGs. The table gives a synopsis of the variegated arguments extracted by the researcher from the various studies reviewed. The various perspectives were gleaned from studies that include, Foster et al. (2021), Tay et al. (2022), Asongu, Beikpe, and Cassimon (2021), Vo, Nguyen, and VaN (2021), Wang and He (2020), She, Hung and Hueng (2021), Tram, Lai, and Nguyen (2021), Ozili (2018), Dawei et al (2018) and Chikalipah (2020). Therefore Table 2 foregrounds the brief discussion on the influence of 4IR technologies and Fintech on the achievement of SDGs in developing countries.

**Table 2: The Contribution of Fintech and 4IR technologies to the delivery of the SDGs**

| SDGs | The positive influence of fintech, 4IR technologies on DFI, and SDGs | The negative influence of fintech, 4IR technologies on DFI, and SDGs |
|---|---|---|
| 1: Poverty alleviation | Reduction in the costs of DFSs would increase affordability and access and could thus improve the standard of living of low-income earners and improve access to funding for businesses (SMEs, large and informal businesses) | Financial freedom and access to DFSs such as online gambling can lead to negative consequences through economic losses and risks such as fraud and hacking can lead to financial losses that increase poverty, and lead to excessive and irresponsible consumption. This could negatively influence not only SDG 1, but 12, 3, and 4. |
| 2: Elimination of hunger | Access to funding through DFSs by vulnerable groups such as immigrants, the poor, and smallholder farmers could improve their productivity, ability to invest in equipment, transact as well as send and receive remittances | Algorithm biases can still lead to discrimination founded on historical financial data leading to vulnerable groups such as smallholder farmers failing to access funding. In some cases, digital finance can lead to the over-indebtedness of low-income groups leading to the collapse of small businesses in failing to service the loans. |
| 3: Good health and well-being | In improving the ability to save and make informed financial decisions, citizens can plan and address anticipated and unanticipated health funding needs. Facilitating the affordability of public and private health insurance through DFS could improve health service provision for the poor | Losses due to irresponsible spending might negatively impact good health and well-being |
| 4: Quality Education | Education could be made more accessible and affordable through vulnerable segments of the population through digital finance and platforms such as mobile money parents can pay for the education of children. For educational institutions, better financial management decisions can be made possible. | Digital transformation, fintech, and digital finance place a heavy dependence on technology that is its rapidly advancing, education and literacy in some developing countries, regions, and segments of the population would be further characterized by heightened inequality thus |

| | | |
|---|---|---|
| | Therefore, DFSs can improve access to quality education, and financial management decisions and may assist in the transparent and fair allocation of financial resources to stakeholders such as educators, learners, administrators, and equipment to enhance teaching and learning especially in this era of digital transformation. | influencing not only SDG4 but 1 and 10 as well. |
| 5: Addressing gender Equality | Women may be better equipped with digital, finance and digital finance skills through digital finance. They can also have greater financial independence, control their funds, increase their savings and assets as well as expand their businesses. This would facilitate economic development, empowerment, and gender equality. | DFSs have also fueled e-commerce, the digital economy, and online sales through social media. This could further widen the digital divide for women and vulnerable communities and groups. This would negatively impact gender equality, reduction of inequalities, and building of strong communities (SDGs 5, 10, and 11) |
| 6: Provision of clean water and sanitation | With access to DFSs and digital finance even vulnerable communities in developing continents such as Asia and Africa can now pay for water and sanitation more conveniently. Service providers of these services can also now serve these communities in a way that is affordable and minimizes operational costs, thus facilitating sustainable development. | If the digital financial exclusion is increased algorithm biases and affordability and access are compromised through complexity in DFSs, digital financial illiteracy, and taxes, this would affect SDGs 1, 2, 8, 9, 12, and 11 among others |
| 7: Clean, affordable, and modern energy | Digital finance and DFS could allow vulnerable groups of the population to purchase clean energy in affordable ways, for example through mobile technology. Power supply companies can serve those in remote and rural areas more profitably and conveniently | In developing countries, fossil fuels such as crude oil, coal, and natural gases are critical energy sources. Green fintech while seeking to encourage spending that is conscious of climate changes, might increase energy costs, energy poverty, and inequalities. |
| 8: Economic growth and decent work | The low-cost business models and strategies driven by digital finance and the 4IR technologies could facilitate economic growth, domestic revenue mobilization, and employment creation and contribute to improving the GDP in developing countries. | A novel digital divide (digital exclusion) driven by the constantly evolving technologies and DFSs can adversely impact job creation and economic growth as well as industrialization, infrastructure building, and innovation. This affects SDGs 8 and 9 respectively |
| 9: Industrialization, resilient infrastructure, and innovation | SMEs can improve their asset bases, infrastructure, and ability to innovate through access to digital finance. This might improve the resilience, productivity, growth, and profitability of the small business, thus improving the capacity to develop, create employment, contribute to GDP, enter new markets, access funding, and attract skilled personnel. | Brick-and-mortar SMEs might be negatively affected and eliminated by digital SMEs leading to job losses. |
| 10: Reduction of inequalities | With fintech and 4IR improving the provisioning of DFSs and digital finance and promoting DFI, equal opportunities can be availed to the population thus, reducing the digital divide and financial exclusion. Financial services could be made accessible and affordable by all, thus advancing financial inclusion | The digital divide associated with the use of technology can increase inequalities. Market algorithms and the use of digital market platforms can lead to access to markets but also negatively influence or lower prices to the detriment of vendors and small traders. This would advance inequality and affect job creation and economic growth. |
| 11: Building sustainable communities and cities | The use of DFSs could reduce the overdependence on cash transactions, collection costs, and other operating costs and ultimately improve revenue collection n local authorities, towns, and cities. | With access to affordable and convenient financial services and loans through digital finance, systemic default risk due to over-indebtedness and negligent financial decisions. This would negatively affect individuals, communities, businesses, and cities |
| 12: Responsible consumption and production | Digital finance can promote responsible consumption patterns and savings mobilization as well as increased production and better manufacturing processes through investing in infrastructure and technological advancements. | DFSs can encourage irresponsible use of financial resources, over-indebtedness, and consumption and production that is unsustainable. For example, the excessive usage of power for cryptocurrency mining and blockchain technology. |

| | | |
|---|---|---|
| 13: Climate and climate change effects | Fintech and the usage of 4IRTtools in digital finance can contribute to efforts towards addressing climate and climatic change effects, through green investments, green finance, green banking, green fintech, and sustainable development finance such as green bonds. Funding could be available to fund efforts to combat greenhouse emissions and environmental damages. | The emergence of unregulated value chains and energy service providers due to the digitalized and invisible nature of digital economies can have unfavorable impacts on the environment, biodiversity, and climate change as carbon emissions may be exacerbated. This would affect SDGs 13, 14, and 15. |
| 14: Life below water | DFSs and digital finance platforms enable the provision of clean energy and preservation of biodiversity and life below water | Water usage for data centers and cooling could have negative effects. |
| 15: Advocates for protecting life on land | Digital finance can also lead to the protection of life on the water (biodiversity) | Even though fintech can support the use of clean energy, sustainability, and climate change management through green finance initiatives, some of the green investments might indirectly fuel deforestation on unsafe energy usage and have an unfavorable effect on SDGs 7, 13, 14, and 15. |
| 16: Justice, peace, and strong institutions | Digital finance does not only promote inclusivity, financial inclusion, and transparency for individuals, it also fosters transparency of government transactions. This reduces corruption, illicit financial flows, and bribery and fosters accountability as there is an audit trail or digital footprints that can be traced. This increases responsiveness, accountability, and good governance in government institutions | Financial system security breaches, failure, and cyber security attacks threaten peace, justice, and the building of strong institutions. In addition, fintech fuels the expansion of the digital economy. The growth of the digital economy erodes the tax base, heightens tax evasion and avoidance, and aids tax non-compliance. All these issues weaken infrastructure and have negative effects on public institutions, government spending, peace, and justice. |
| 17: Partnerships to deliver the SDGs | Fintech can enable the flow of funds between countries both developing and developed in the form of foreign direct investments, donor aid, and grants, thus allowing access to international funding and support for both the public and private sectors | Fintech, the 4IR technologies, and digital finance create an interconnected digital finance ecosystem, business models, and infrastructure that can increase fraud, illegal activities, and illicit financial flows raising interoperability issues and risks that can upset the stability of the regional, continental, and global ecosystems. This would affect the global social, economic, and political networks impeding partnerships for delivering the SDGs. |

Source: Author's Compilation

From Table 2, fintech with the support of 4IR tools can drive financial inclusion, innovation, industrialization, economic growth, and responsible consumption, while promoting employment creation, investment in education, infrastructural development, poverty alleviation, and health. Indirectly these activities address the 2030 SDGs 1 to 16. While the perspectives on the positive attributes of technology use in the financial sector (DFSs) are persuasive, the arguments on the significant but not-so-visible negative externalities are analogously pragmatic. According to Foster et al. (2021) to give a balanced evaluative assessment of the role of fintech in supporting DFI, financial inclusion, and the fulfillment of the 2030 SDGs, researchers need to focus on the four perspectives covered by the SDGs (social, economic, environmental, and political dimensions). Mpofu (2022b) also emphasizes the important roles played by these dimensions in sustainable development. In addition to considering, sustainable development, perspectives, Foster et al. (2021) emphasize the need to consider the impact on infrastructure, business operations and models, financial ecosystems, and value chains.

To illuminate the findings in Table 2, firstly, for example, there is no agreement on whether fintech and DFSs such as mobile money activities and mobile banking erode the tax base in developing countries or help to increase revenue mobilization. In response to perceptions of the erosion of the tax base, African countries have introduced mobile money taxation frameworks to expand the tax base and tax some of the DFSs transactions that happen through the tax base. Countries such as Gabon, Malawi, Zimbabwe, the Republic of Congo, Cote d'Ivoire, and other African countries have resorted to the tremendous growth of mobile money transactions in the continent levying taxes on mobile money

transactions such as withdrawals, transfers, and payments (Clifford, 2020; Pushkareva, 2021). Zimbabwe charges a 2% intermediate monetary tax on local currency transactions and 4% on foreign currency transactions. This tax is levied on transfers and swipe transactions as well as mobile money transactions (Mpofu, 2022a). Similarly, just like on mobile money transactions, there is no consensus among researchers on how these taxes would affect financial inclusion, mobile money usage, revenue mobilization, and ultimately the delivery of SDGs in African countries (Clifford, 2020; Mpofu & Mhlanga, 2022; Pushkareva, 2021; Silue, 2021). The impact of taxing DFs on DFI and the attainment of the SDGs is mixed and controversial. Researchers raise the issue of overborrowing being encouraged by mobile money and mobile money and DFS users being significantly susceptive to data breaches and fraud risks, thus harming SDGs such as 1, 2, 3, 5, 10, and 16 among others (Chikalipah, 2020; Mpofu, 2022a).

Secondly, for example, infringement on data security, confidentiality, and privacy might have an adverse influence on SDG 16. Overborrowing and failure to service loans can perpetuate poverty, upset the stability of financial systems, fuel liquidity crises, and tarnish credit reputations. Collateral, creditworthiness, and access to loans challenges solved by tools such as AI and big data would be negatively affected again. This could affect the performance of financial institutions as well as impact several SDGs (16, 1, 10, 11, 12, and 8).

Thirdly, while fintech is a big driver of the digital economy, the digital economy brings both advantages and disadvantages. The advantages are e-commerce and connectivity, yet the invisibility of and lack of traceability of some of the transactions and suppliers of this economy affects SDG s such as 5,8, 10, and 16. For example fraud cases where people pay for goods, and they don't receive them, or they don't receive the quality and quantity anticipated. In some cases, counterfeit items can be sold without a trace, threatening strong institutions and justice (SDG16) (Foster et al., 2021). The researchers further give examples of platforms such as Uber, Airbnb, and Bolt have contributed to employment creation, poverty alleviation, the reduction of inequality, and easy access to transport, but these platforms have equally perpetuated cases of fraud, robberies, sexual harassment of women, gender discrimination and violence against women. This harms the SDGs that these platforms seek to promote such as SDGs 1, 5, 8, 10, and 16.

Fourthly, digitization of finance might have unanticipated consequences such as the systematic exclusion of vulnerable groups such as the poor, the illiterate, and the elderly as financing decisions and transactions are automated. As much digitalization might promote transparency in financial activities and decisions, it might bring complexities and open doors for illicit financial flows (IFFs). This could result in the ills of IFFs such as loss of financial resources for sustainable development, funding for poverty alleviation efforts, health, education, provision of clean water and sanitation, and economic development. In addition to challenging the attainment of SDGs 1 to 10, IFFs also result in the violation of SDG 16 on peace, justice, and strong institutions.

Lastly, SDGs 1, 8, 9, and 10 can be affected by the effectiveness of financial regulation when discussed in the context of fintech. If the regulation is effective and protective enough, fostering the integrity and stability of financial frameworks (globally and domestically). This could promote sustainable development, poverty reduction, economic growth, innovation, and investment in infrastructure, ultimately reducing inequalities. Innovation can crystallize itself in new financial services, products, and new markets, facilitating access to financially excluded groups, and facilitating green finance (green lending, green banking, and green investments). This would promote sustainable finance and economic growth as well as DFI. Through fintech and the promotion of green finance, digital transformation and sustainable development can be achieved (Chueca Vergara & Ferruz Agudo, 2021). On one hand, ineffective regulations in the financial sector can be detrimental to the fulfillment of the SDGs by opening crevices for the abuse and exploitation of consumers by financial service providers. On the other hand, over-regulating or stringent regulations in the sector might stifle innovation, diversification, and growth in the sector as well as create barriers to entry. Regulations covering the

financial services sector and the provision of DFSs also cover those regulating the telecoms and internet providers because DFSs are dependent on internet connectivity. Therefore, legislation relating to consumer protection and data privacy can promote or discourage use, DFI, trust, and acceptance by customers including ensuring peace, justice, and strong institutions.

### *Conclusion, Recommendations, and Areas of Further Research*

The review established that DFI is an important driver for sustainable development in developing economies. It can lead to safer and more efficient financial systems as well as enhanced risk management. By offering affordable, accessible, diverse, and convenient financial services offered through digital means, DFSs can help financially include vulnerable groups of the population, thus reducing poverty, inequalities, financial exclusion, and gender disparity in financial inclusion. In addition, DFI reduces other economic challenges in society linked to the financial exclusion or lack of access to financial services such as slow economic growth, unemployment, hunger, and poor growth for SMEs, thus promoting the attainment of SDGs. The SDGs focus on protecting the planet and the people while ensuring prosperity, thus ensuring environmental, economic, and social development. Fintech has also been used in conjunction with 4IR technologies to deliver DFSs. Despite the possible favourable outcomes of utilizing fintech and 4IR technologies to promote DFI, the review identified possible negative outcomes associated with the use of these technologies, which unfavourably impact the accomplishment of the SDGs. These include the increase in risks, outcomes such as increased loan defaults that can stabilize financial systems, over-indebtedness that can increase poverty, the complexity of procedures to access DFSs, increase in hidden transaction costs, taxes on DFSs and digital financial exclusion due to digital and financial illiteracy. Therefore, the study concludes that while fintech and the 4IR tools are pivotal to facilitating DFI, the usage of DFSs, and the fruition of the 2030 UN SDGs, several possible unanticipated negative consequences can emerge from the use of technology in the financial sector. This reflects the need for a balanced assessment of technological advancements and the use of technology in the financial sector and in general. The study recommends a close assessment of transaction costs and hidden costs associated with DFSs, reducing the complexity of access procedures, or perhaps putting the instructions on digital platforms in English and local languages as well and perhaps a closer analysis of taxes on DFSs and mobile money taxes on their impact on DFI. Governments and financial service providers can increase awareness and digital financial literacy programs to improve both financial, digital, and digital financial literacy as well as the appreciation of risks linked to DFSs. Digital financial literacy and lack of digital tools are some of the challenges affecting DFI in developing countries.

### *References*

Adalessossi, K., & Kaya, N. (2015). The measure of the financial inclusion in the African countries. *Advances in Management and Applied Economics*, *5*(5), 23.

Adegbite, O. O., & Machethe, C. L. 2020. Bridging the financial inclusion gender gap in smallholder agriculture in Nigeria: An untapped potential for sustainable development. *World Development*, *127*, 104755.

Agur, I., Peria, S. M., & Rochon, C. (2020). Digital financial services and the pandemic: Opportunities and risks for emerging and developing economies. *International Monetary Fund Special Series on COVID-19*, *Transactions*, *1*, 2-1.

Ahmed, S. (2021). A Gender Perspective on the Use of Artificial Intelligence in the African Fintech Ecosystem: Case Studies from South Africa, Kenya, Nigeria and Ghana.

Ardichvili, A. (2022). The Impact of Artificial Intelligence on Expertise Development: Implications for HRD. *Advances in Developing Human Resources*, *24*(2), 78-98.

Arner, D. W., Buckley, R. P., Zetzsche, D. A., & Veidt, R. (2020). Sustainability, FinTech and financial inclusion. *European Business Organization Law Review*, *21*(1), 7-35.

Asongu, S. A., Biekpe, N., & Cassimon, D. (2021). On the diffusion of mobile phone innovations for financial inclusion. *Technology in Society*, *65*, 101542.

Awotunde, J. B., Adeniyi, E. A., Ogundokun, R. O., & Ayo, F. E. (2021). Application of big data with fintech in financial services. In *Fintech with Artificial Intelligence, Big Data, and Blockchain* (pp. 107-132). Springer, Singapore.

Aziz, A., & Naima, U. (2021). Rethinking digital financial inclusion: Evidence from Bangladesh. *Technology in Society*, *64*, 101509.

Babu, M. M., Dey, B. L., Rahman, M., Roy, S. K., Alwi, S. F. S., & Kamal, M. M. (2020). Value co-creation through social innovation: A study of sustainable strategic alliance in telecommunication and financial services sectors in Bangladesh. *Industrial Marketing Management*, *89*, 13-27.

Biallas, M., & O'Neill, F. (2020). Artificial intelligence innovation in financial services. https://openknowledge.worldbank.org/bitstream/handle/10986/34305/Artificial-Intelligence-Innovation-in-Financial-Services.pdf?sequence=1

Chikalipah, S. (2020). The pyrrhic victory of FinTech and its implications for achieving the Sustainable Development Goals: evidence from fieldwork in rural Zambia. *World Journal of Science, Technology and Sustainable Development*.

Chueca Vergara, C., & Ferruz Agudo, L. (2021). Fintech and Sustainability: Do They Affect Each Other?. *Sustainability*, *13*(13), 7012.

Clifford, K. (2020). The Causes and Consequences of Mobile Money Taxation An Examination of Mobile Money Transaction Taxes in Sub-Saharan Africa.

Dasgupta, P. (2007). The idea of sustainable development. *Sustainability Science*, *2*(1), 5-11.

Dawei, L., Anzi, H., & Gen, L. (2018). Big data Technology: application and cases. In *Handbook of Blockchain, Digital Finance, and Inclusion, Volume 2* (pp. 65-82). Academic Press.

Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2018a). The unbanked.

Demirguc-Kunt, A., Klapper, L., Singer, D., & Ansar, S. (2018b). *The Global Findex Database 2017: Measuring financial inclusion and the fintech revolution*. World Bank Publications.

Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2020). The global Findex database 2017: measuring financial inclusion and opportunities to expand access to and use of financial services. *The World Bank Economic Review*, *34*(Supplement_1), S2-S8.

Dickey, G., Blanke, S., & Seaton, L. (2019). Machine Learning in Auditing. *The CPA Journal*, 16-21.

Duran, D. C., Gogan, L. M., Artene, A., & Duran, V. (2015). The components of sustainable development-a possible approach. *Procedia Economics and Finance*, *26*, 806-811.

Ebong, J., & George, B. (2021). Financial Inclusion through Digital Financial Services (DFS): A Study in Uganda. *Journal of Risk and Financial Management*, *14*(9), 393.

Emara, N., & Mohieldin, M. (2021). Beyond the Digital Dividends: Fintech and Extreme Poverty in the Middle East and Africa.

Ferrata, L. (2019). Digital financial inclusion–an engine for "leaving no one behind". *Public Sector Economics*, *43*(4), 445-458.

Foster, K., Blakstad, S., Bos, M., & Gazi, S. (2021). BigFintechs and their impacts on sustainable development. *The Dialogue on Global Finance Digital Finance Governance Project*. https://www.academia.edu/download/76320876/UNDP-UNCDF-TP-1-1-BigFintechs-and-Their-Impacts-on-Sustainable-Development-EN.pdf

Girón, A., Kazemikhasragh, A., Cicchiello, A. F., & Panetti, E. (2022). Financial inclusion measurement in the least developed countries in Asia and Africa. *Journal of the Knowledge Economy*, *13*(2), 1198-1211.

Grant, M. J., & Booth, A. (2009). A typology of reviews: an analysis of 14 review types and associated methodologies. *Health information & libraries journal*, *26*(2), 91-108.

Gutiérrez-Romero, R., & Ahamed, M. 2021. COVID-19 response needs to broaden financial inclusion to curb the rise in poverty. *World Development*, *138*, 105229.

Hentzen, J. K., Hoffmann, A., Dolan, R., & Pala, E. (2021). Artificial intelligence in customer-facing financial services: a systematic literature review and agenda for future research. *International Journal of Bank Marketing*.

Hoang, T. G., Nguyen, G. N. T., & Le, D. A. (2022). Developments in financial technologies for achieving the Sustainable Development Goals (SDGs): FinTech and SDGs. In *Disruptive Technologies and Eco-Innovation for Sustainable Development* (pp. 1-19). IGI Global.

Hughes, L., Dwivedi, Y. K., Misra, S. K., Rana, N. P., Raghavan, V., & Akella, V. (2019). Blockchain research, practice and policy: Applications, benefits, limitations, emerging research themes and research agenda. *International Journal of Information Management*, *49*, 114-129.

Javaid, M., Haleem, A., Singh, R. P., Khan, S., & Suman, R. (2021). Blockchain technology applications for Industry 4.0: A literature-based review. *Blockchain: Research and Applications*, 100027.

Javaid, M., Haleem, A., Singh, R. P., & Suman, R. (2022). Artificial intelligence applications for industry 4.0: A literature-based study. *Journal of Industrial Integration and Management*, *7*(01), 83-111.

Joshi, S., Vibhute, G., Ayachit, A., & Ayachit, G. (2021). Big data and artificial intelligence-Tools to be future ready?. *Indian Journal of Ophthalmology*, *69*(7), 1652.

Klapper, L., El-Zoghbi, M., & Hess, J. (2016). Achieving the sustainable development goals. *The role of financial inclusion. Available online: http://www. ccgap. org. Accessed*, *23*(5), 2016.

Klapper, L., & Singer, D. (2017). The opportunities and challenges of digitizing government-to-person payments. *The World Bank Research Observer*, *32*(2), 211-226.

Kommunuri, J. (2022). Artificial intelligence and the changing landscape of accounting: a viewpoint. *Pacific Accounting Review*, (ahead-of-print).

Kshetri, N. (2021). Blockchain and sustainable supply chain management in developing countries. *International Journal of Information Management*, *60*, 102376.

Kumar, S., Lim, W. M., Sivarajah, U., & Kaur, J. (2022). Artificial intelligence and blockchain integration in business: trends from a bibliometric-content analysis. *Information Systems Frontiers*, 1-26.

Kumar, M., Mishra, R., & Mishra, K. (2019). Correlates of financial literacy: Strategic precursor to financial inclusion. *SCMS journal of Indian Management*, *16*(4), 16-30.

Langley, P., & Rodima-Taylor, D. (2022). FinTech in Africa: an editorial introduction. *Journal of Cultural Economy*, 1-14.

Lehner, O. M., Ittonen, K., Silvola, H., Ström, E., & Wührleitner, A. (2022). Artificial intelligence based decision-making in accounting and auditing: ethical challenges and normative thinking. *Accounting, Auditing & Accountability Journal*, *35*(9), 109-135.

Li, T., Chen, Y., Wang, Y., Wang, Y., Zhao, M., Zhu, H., ... & Yang, Y. (2020). Rational protocols and attacks in blockchain system. *Security and Communication Networks*, *2020*.

Makina, D. (2019). The potential of FinTech in enabling financial inclusion. In *Extending financial inclusion in Africa* (pp. 299-318). Academic Press.

Matthews, B. H. (2019). Hidden constraints to digital financial inclusion: the oral-literate divide. *Development in Practice*, *29*(8), 1014-1028.

McKinsey Global Institute (2016). Digital finance for all: Poverty inclusive growth in emerging economies. McKinsey Global Institute, McKinsey and Company.

Mhlanga, D. (2020). Industry 4.0 in finance: the impact of artificial intelligence (ai) on digital financial inclusion. *International Journal of Financial Studies*, *8*(3), 45.

Mhlanga, D. (2021). Financial inclusion in emerging economies: The application of machine learning and artificial intelligence in credit risk assessment. *International Journal of Financial Studies*, *9*(3), 39.

Mhlanga, D. (2022a). Human-Centered Artificial Intelligence: The Superlative Approach to Achieve Sustainable Development Goals in the Fourth Industrial Revolution. *Sustainability*, *14*(13), 7804.

Mhlanga, D. (2022b). COVID-19 and Digital Financial Inclusion: Policies and Innovation That can Accelerate Financial Inclusion in a Post-COVID World Through Fintech. *African Journal of Development Studies (formerly AFFRIKA Journal of Politics, Economics and Society)*, *2022*(si2), 79-100.

Mpofu, F. Y. (2021). Review Articles: A Critical Review of the Pitfalls and Guidelines to effectively conducting and reporting reviews. *Technium Soc. Sci. J.*, *18*, 550.

Mpofu, F. Y. (2022a). Industry 4.0 in Financial Services: Mobile Money Taxes, Revenue Mobilisation, Financial Inclusion, and the Realisation of Sustainable Development Goals (SDGs) in Africa. *Sustainability*, *14*(14), 8667.

Mpofu, F. Y. (2022b). Green Taxes in Africa: Opportunities and Challenges for Environmental Protection, Sustainability, and the Attainment of Sustainable Development Goals. *Sustainability*, *14*(16), 10239.

Mpofu, F. Y., & Mhlanga, D. (2022). Digital Financial Inclusion, Digital Financial Services Tax and Financial Inclusion in the Fourth Industrial Revolution Era in Africa. *Economies*, *10*(8), 184.

Nan, W., Zhu, X., & Lynne Markus, M. (2021). What we know and don't know about the socioeconomic impacts of mobile money in Sub-Saharan Africa: A systematic literature review. *The Electronic Journal of Information Systems in Developing Countries*, *87*(2), e12155.

Náñez Alonso, S. L., Jorge-Vázquez, J., Echarte Fernández, M. Á., & Reier Forradellas, R. F. (2021). Cryptocurrency mining from an economic and environmental perspective. Analysis of the most and least sustainable countries. *Energies*, *14*(14), 4254.

Ndoro, H., Johnston, K., & Seymour, L. F. (2020). Artificial Intelligence Uses, Benefits and Challenges: A Study in the Western Cape of South Africa Financial Services Industry. *SACAIR 2020*, 58.

N'dri, L. M., & Kakinaka, M. (2020). Financial inclusion, mobile money, and individual welfare: The case of Burkina Faso. *Telecommunications Policy*, *44*(3), 101926.

O'Neal, S. (2018). Ahead of traditional banking: How Africa employs blockchain for financial inclusion. *Retrieved July*, *17*, 2021.

Ozili, P. K. (2018). Impact of digital finance on financial inclusion and stability. *Borsa Istanbul Review*, *18*(4), 329-340.

Ozili, P. K. (2020). Financial inclusion and Fintech during COVID-19 crisis: Policy solutions. *The Company Lawyer Journal*, *8*.

Ozili, P. K. (2021). Has financial inclusion made the financial sector riskier?. *Journal of financial regulation and compliance*.

Ozili, P. K. (2022). Digital financial inclusion. In *Big Data: A Game Changer for Insurance Industry* (pp. 229-238). Emerald Publishing Limited.

Ojo, T. A. (2022a). Digital Financial Inclusion for Women in the Fourth Industrial Revolution: A Key towards Achieving Sustainable Development Goal 5. *Africa Review*, *14*(1), 98-123.

Ojo, T. A. (2022b). Financial Inclusion and Women Empowerment in BRICS Countries: Perspectives on India and South Africa. In *The Political Economy of Intra-BRICS Cooperation* (pp. 175-203). Palgrave Macmillan, Cham.

Ouma, S. A., Odongo, T. M., & Were, M. (2017). Mobile financial services and financial inclusion: Is it a boon for savings mobilization?. *Review of development finance*, *7*(1), 29-35.

Paré, G., & Kitsiou, S. (2017). Methods for literature reviews. In *Handbook of eHealth Evaluation: An Evidence-based Approach [Internet]*. University of Victoria.

Paré, G., Trudel, M. C., Jaana, M., & Kitsiou, S. (2015). Synthesizing information systems knowledge: A typology of literature reviews. *Information & Management*, *52*(2), 183-199.

Peric, K. (2015). Digital financial inclusion. *Journal of Payments Strategy & Systems*, *9*(3), 212-214.

Piliyanti, I. (2019). Fintech achieving sustainable development: The side perspective of crowdfunding platform. *Shirkah: Journal of Economics and Business*, *3*(2).

Puschmann, T., Hoffmann, C. H., & Khmarskyi, V. (2020). How green FinTech can alleviate the impact of climate change—the case of Switzerland. *Sustainability*, *12*(24), 10691.

Pushkareva, N. (2021). Taxing Times for Development: Tax and Digital Financial Services in Sub-Saharan Africa. *Financing for Development*, *1*(3), 33-64.

Putranti, I. R. (2022). Crypto Minning: Indonesia Carbon Tax Challenges and Safeguarding International Commitment on Human Security. *International Journal of Business, Economics, and Social Development*, *3*(1), 10-18.

Rauniyar, K., Rauniyar, K., & Sah, D. K. (2021). Role of fintech and innovations for improvising digital financial inclusion. *International Journal of Innovative Science and Research Technology*, *6*(5), 1419-1424.

Rogan, M. (2019). Tax Justice and the Informal Economy: A Review of the debates.

Salvia, A. L., & Brandli, L. L. (2020). Energy sustainability at universities and its contribution to SDG 7: a systematic literature review. *Universities as Living Labs for Sustainable Development*, 29-45.

Sampene, A. K., Agyeman, F. O., Robert, B., & Wiredu, J. (2022). Artificial Intelligence as a Path Way to Africa's TransformationS. *Artificial Intelligence*, *9*(1).

Sanz-Bas, D., del Rosal, C., Náñez Alonso, S. L., & Echarte Fernández, M. Á. (2021). Cryptocurrencies and fraudulent transactions: Risks, practices, and legislation for their prevention in Europe and Spain. *Laws*, *10*(3), 57.

Sebele-Mpofu, F. Y. (2021). Informal Sector Taxation and Enforcement in African Countries: How plausible and achievable are the motives behind? A Critical Literature Review. *Open Economics*, *4*(1), 72-97.

Sebele-Mpofu, F., Mashiri, E., & Schwartz, S. C. (2021). An exposition of transfer pricing motives, strategies and their implementation in tax avoidance by MNEs in developing countries. *Cogent Business & Management*, *8*(1), 1944007.

Schuetz, S., & Venkatesh, V. (2020). Blockchain, adoption, and financial inclusion in India: Research opportunities. *International journal of information management*, *52*, 101936.

Shili, N., & Panjwani, K. (2022). Revolution of Financial Inclusion through Fintech in the Digital Age. In *Digitalization and Economic Development* (pp. 141-160). Routledge.

Shipalana, P. (2019). Digitising financial services: a tool for financial inclusion in South Africa?.

Silue, T. (2021). *E-money, Financial Inclusion and Mobile Money Tax in Sub-Saharan African Mobile Networks* (No. hal-03281898).

Simatele, M. (2021). E-payment instruments and welfare: The case of Zimbabwe. *TD: The Journal for Transdisciplinary Research in Southern Africa*, *17*(1), 1-11.

Singh, B. P., & Yadava, A. K. (2022). Technical efficiency of financial inclusion and human development: Insights from the Indian states. *Economic Notes*, *51*(2), e12199.

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of business research*, *104*, 333-339.

Tavera Romero, C. A., Ortiz, J. H., Khalaf, O. I., & Ríos Prado, A. (2021). Business intelligence: business evolution after industry 4.0. *Sustainability*, *13*(18), 10026.

Tay, L. Y., Tai, H. T., & Tan, G. S. (2022). Digital financial inclusion: A gateway to sustainable development. *Heliyon*, e09766.

Tram, T. X. H., Lai, T. D., & Nguyen, T. T. H. (2021). Constructing a composite financial inclusion index for developing economies. *The Quarterly Review of Economics and Finance*.

Uglum, M. K. (2021). Consideration of the ethical implications of artificial intelligence in the audit profession.

United Nations (2021). First Person: Figting for women's financial freedom. Available at https://news.un.org/en/story/2021/03/1086162

Unterhalter, E. (2019). The many meanings of quality education: Politics of targets and indicators in SDG 4. *Global Policy*, *10*, 39-51.

Van Hove, L., & Dubus, A. (2019). M-PESA and financial inclusion in Kenya: of paying comes saving?. *Sustainability*, *11*(3), 568.

Vo, D. H., Nguyen, N. T., & Van, L. T. H. (2021). Financial inclusion and stability in the Asian region using bank-level data. *Borsa Istanbul Review*, *21*(1), 36-43.

Wang, X., & He, G. (2020). Digital financial inclusion and farmers' vulnerability to poverty: Evidence from rural China. *Sustainability*, *12*(4), 1668.

Wang, R., & Luo, H. R. (2022). How does financial inclusion affect bank stability in emerging economies?. *Emerging Markets Review*, *51*, 100876.

World Bank (2018). Financial Inclusion is a key enabler to reducing poverty and boosting prosperity. Available at https://www.worldbank.org/en/topic/financialinclusio/overview

Yadav, R. S., & Siva Reddy, K. (2021). Banking or Under-banking: Spatial Role of Financial Inclusion and Exclusion. *International Journal of Rural Management*, 09730052211037110.

Yasir, A., Ahmad, A., Abbas, S., Inairat, M., Al-Kassem, A. H., & Rasool, A. (2022, February). How Artificial Intelligence Is Promoting Financial Inclusion? A Study On Barriers Of Financial Inclusion. In *2022 International Conference on Business Analytics for Technology and Security (ICBATS)* (pp. 1-6). IEEE.

Yawe, B. L., Ddumba-Ssentamu, J., Nnyanzi, J. B., & Mukisa, I. (2022). Role of Mobile Money and Digital Payments in Financial Inclusion for Sustainable Development Goals in Africa. In *Globalization and Sustainability-Recent Advances, New Perspectives and Emerging Issues*. IntechO pen.

Zhang, Y., Chen, J., Han, Y., Qian, M., Guo, X., Chen, R., ... & Chen, Y. (2021). The contribution of Fintech to sustainable development in the digital age: Ant forest and land restoration in China. *Land Use Policy*, *103*, 105306.