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SCHOOL OF ECONOMICS AND BUSINESS

MASTER THESIS

**FINTECH TOOLS, REGULATIONS AND LIMITATIONS IN
ACHIEVING SUSTAINABLE DEVELOPMENT GOALS**

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„U skladu sa članom 54. Pravila studiranja za I, II ciklus studija, integrisani, stručni i specijalistički studij na Univerzitetu u Sarajevu, daje se

IZJAVA O AUTENTIČNOSTI RADA

Ja, Nejra Omeragić, studentica drugog (II) ciklusa studija, broj index-a 74462-5047 na programu Management,

smjer Financial Management, izjavljujem da sam završni rad na temu:

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pod mentorstvom prof. dr. Azre Zaimović izradila samostalno i da se zasniva na rezultatima mog vlastitog istraživanja. Rad ne sadrži prethodno objavljene ili neobjavljene materijale drugih autora, osim onih koji su priznati navođenjem literature i drugih izvora informacija uključujući i alate umjetne inteligencije.

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ABSTRACT

The world we live in is crying out for change. Every day we become more aware that planet B does not exist and that major changes are necessary in order to guarantee a brighter upcoming future for not only ourselves but also for future generations. The United Nations Agenda 2030 for the Promotion of Sustainable Development represents a plan which does not offer a solution for every global problem, but it is a good guide to a brighter future for both people and the planet. The Agenda, which endorses the establishment of the Sustainable Development Goals, was approved and recommended by the United Nations on September 25th, 2015, by the 193 United Nations Members' states. The Sustainable Development Goals, widely known as SDGs, are 17 Sustainable development objectives that are small components of an action plan with 169 related initiatives that must be accomplished in the social, environmental, institutional, and economic domains by 2030. In addition to other tools, The Sustainable Development Goals can be substantially aided by FinTech. The term "financial technology" (also known as FinTech) refers to revolutionary technology. This technology strives to improve and streamline the provision of financial services. The main research methodology relies on literature review and qualitative analysis of available agendas, regulation etc. It is based on an examination of relevant regulations and recently released academic publications on the FinTech and the SDGs. This thesis gives a brief review of the relationship between FinTech tools and SDGs. This thesis provides an insight into FinTech industry and tools as well as their impact on achieving SDGs. Among that FinTech regulations and limitations have been presented within this thesis. It has been concluded that FinTech has enormous potential for accelerating the SDGs' development. FinTech can advance financial inclusion, sustainable finance, and sustainable investment while harnessing innovations in technology and financial services to help accomplish the SDGs. Governments, legislators, financial institutions, and tech firms must work together to establish a supportive climate that takes advantage of the revolutionary potential of FinTech while assuring that it is used responsibly. Main concern related to FinTech is cybersecurity. FinTech represents a modern technology that has the capability to significantly contribute to sustainable development. By doing this it has a capacity to foster a more inclusive, more equitable society. The thesis will produce valuable insights on how FinTech may help advance particular SDGs, such as eradicating poverty, promoting gender equality, tackling climate change, or increasing access to high-quality education. These observations can help us comprehend the procedures, effects, and difficulties involved in integrating FinTech and SDGs more thoroughly. Policymakers, financial institutions, and other stakeholders may use these insights as benchmarks to help them develop and carry out effective and long-lasting FinTech actions.

Keywords: FinTech, SDGs, FinTech Regulations, FinTech Limitations, Financial Inclusion, Poverty Eradication, Gender Equality, Cybersecurity

SAŽETAK

Svijet u kojem živimo vapi za promjenom. Svakim danom postajemo sve svjesniji da planet B ne postoji i da su neophodne velike promjene kako bi se osigurala bolja budućnost, ne samo za nas nego i za našu djecu i sve ljude koji će živjeti nakon nas. UN Agenda 2030 za održivi razvoj je plan koji ne nudi rješenje za svaki globalni problem, ali je dobar vodič za svjetliju budućnost kako za nas tako i za planetu. Generalna skupština UN-a usvojila je Agendu, koja postavlja ciljeve održivog razvoja (SDG), nakon što su je 25. septembra 2015. godine potpisale vlade 193 članice UN-a. Ciljevi održivog razvoja ili SDGs su sačinjeni od 17 ciljeva za održivi razvoj koji su dio većeg akcionog plana sa 169 povezanih inicijativa koje se moraju ostvariti u društvenim, ekološkim, institucionalnim i ekonomskim domenima do 2030. godine. Pored drugih alata, FinTech ima značajan potencijal da pomogne u postizanju ciljeva održivog razvoja. Nova tehnologija koja ima za cilj da unaprijedi i automatizuje pružanje finansijskih usluga naziva se „finansijska tehnologija“ (poznatija kao FinTech). Glavna metodologija istraživanja oslanja se na pregled literature i kvalitativnu analizu dostupnih planova, propisa itd. Zasniva se na pregledu relevantnih propisa i nedavno objavljenih akademskih publikacija o FinTech-u i SDGs. Ova teza daje kratak pregled odnosa između FinTech alata i SDGs. Ova teza pruža uvid u FinTech industriju i alate kao i njihov utjecaj na postizanje SDGs. U okviru ove teze prikazani su FinTech propisi kao i ograničenja. Zaključeno je da FinTech ima ogroman potencijal za ubrzanje razvoja SDGs. FinTech unaprijeđuje finansijsku inkluziju, održivo finansiranje i održivo ulaganje, dok iskorištava inovacije u tehnologiji i finansijskim uslugama kako bi pomogao u postizanju ciljeva održivog razvoja. Vlade, zakonodavci, finansijske institucije i tehnološke firme moraju raditi zajedno kako bi uspostavile povoljno okruženje za iskorištavanje revolucionarnog potencijala FinTech-a, istovremeno osiguravajući da se on koristi odgovorno. Glavna briga vezana za FinTech je sajber sigurnost. Osim osiguranja ličnih i finansijskih podataka, potrebno je osigurati da nema dodatnog pritiska na siromašne zbog digitalnog jaza i nemogućnosti pristupa uslugama koje FinTech nudi zbog loše internetske veze ili ograničenog pristupa tehnologiji. FinTech ima potencijal da igra značajnu ulogu u pokretanju održivog razvoja i stvaranju inkluzivnije i uspješnije budućnosti za sve ako se pažljivo razmotri i koristi na pravi način. Ova teza će dati vrijedne uvide o tome kako FinTech može pomoći u unapređenju određenih SDGs, kao što su iskorjenjivanje siromaštva, promicanje rodne ravnopravnosti, suočavanje s klimatskim promjenama ili povećanje pristupa kvalitetnom obrazovanju. Ova zapažanja nam mogu pomoći da shvatimo procedure, efekte i poteškoće uključene u integraciju FinTech-a i SDGs. Zakonodavci, finansijske institucije i drugi stakeholder-i mogu koristiti ove uvide kao mjerila koja će im pomoći da razviju i sprovedu učinkovite i dugotrajne FinTech akcije.

Ključne riječi: FinTech, SDGs, FinTech regulative, FinTech ograničenja, finansijska inkluzija, iskorjenjivanje siromaštva, rodna ravnopravnost, sajber sigurnost

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1. INTRODUCTION

1.1. Definition of the problem

The problem discussed in this thesis is the ongoing disparity among the financial needs of underprivileged groups and the accomplishment of the Sustainable Development Goals (SDGs) set by the United Nations. The formal financial system continues to leave out a sizable portion of the world's population. By doing this it is leaving them without access to basic financial services, credit, and investment possibilities, despite international efforts to support sustainable development and alleviate poverty. That absence of financial inclusion impedes progress toward the SDGs, which include a variety of linked together targets. Some of them are lowering poverty rates and enabling excellent schooling. Ofcourse we can't forget sexual equality and renewable energy which represent modern problems. last but certainly not least we need to mention long-term economic growth. Traditional financial systems frequently fail in reaching marginalized communities, leaving them with no opportunities to engage fully in the financial system and benefit from growth-oriented initiatives. In order to close this gap, build inclusive financial ecosystems, and promote sustainable development which is compatible with the goals provided by UN, it makes a vital point to investigate and take use of the exciting possibilities of financial technology (FinTech). The purpose of this research is to look into the function of FinTech in solving this problem, exploring the potential and difficulties it brings, and recommending solutions to harness FinTech for achieving the SDGs and boosting financial inclusion.

The main questions to which this paper answers are:

- What are the effects of FinTech tools in terms of accomplishing the SDGs?
- What are dangers and restrictions which can be associated with FinTech tools?

1.2. Research objectives

The following are the main study goals of this master's thesis:

- to provide a comprehensive evaluation of the existing research on FinTech as well as the SDGs;
- to investigate the impact of FinTech tools on SDG accomplishment; these tools include but are not limited to e-money, blockchain technology, crowdfunding, P2P lending and digital banking;
- to to study FinTech's constraints in reaching the SDGs;
- to provide a detailed overview of the regulations governing FinTech;
- to provide a summary of the key FinTech tools available on the domestic market that contribute toward attaining the UN's Sustainable Development Goals.

1.3. Methodology

The main research methodology relies on literature review and qualitative analysis of available agendas, regulation etc. It is based on an examination of relevant regulations and recently released academic publications on the FinTech and the SDGs. Most of the data needed for this thesis has been collected from secondary sources. Various sources were utilized to perform this research. They consist of: books, laws governing FinTech, journal articles, and scientific research papers. Web of Science, Scopus and Google Scholar have been used as sources of scientific research papers. Web of Science is considered to be arguably the best academic publishing database. This makes it a good source of scientific works that will be analyzed in this paper. To find relevant scientific works in the aforementioned databases, the following keywords were used: FinTech Tools, FinTech Categories, FinTech Industry, Sustainable Development Goals, FinTech and SDGs, FinTech and Sustainability, FinTech and Financial Inclusion, FinTech and Poverty, FinTech and Gender Equality, FinTech and Climate Change, FinTech and Agriculture, FinTech and Cybersecurity, FinTech Limitations, FinTech Regulations. This thesis focuses on unification and detailed analysis of tools, regulations and findings of previously published scientific works.

1.4. Scientific contribution of the work

The scientific contribution of a thesis related to FinTech and SDGs consists of enhancing our knowledge of the connection which exists between financial technology and the SDGs, and providing observations that can inform policy, practice, and further research. The thesis may help close the gap between the use of financial technology and the Sustainable Development Goals by assisting to the development of a theoretical structure that brings together FinTech along with SDGs. The thesis produces valuable insights on how FinTech may help advance particular SDGs, such as eradicating poverty, promoting gender equality, tackling climate change, or increasing access to high-quality education. These observations can help us comprehend the procedures, effects, and difficulties involved in integrating FinTech and SDGs more thoroughly. The thesis may identify and examine successful FinTech projects' best practices and accomplishments that have significantly advanced the achievement of particular SDGs. Policymakers, financial institutions, and other stakeholders may use these insights as benchmarks to help them develop and carry out effective and long-lasting FinTech actions. These suggestions can serve as a roadmap for the creation of laws and policies that support an environment that encourages innovation in FinTech, financial inclusion, as well as sustainable development. The thesis can give insight on the ethical and social consequences of FinTech's integration with the SDGs. It may explore challenges such as cybersecurity, algorithmic biases, digital divide, and social disparities, offering important perspectives regarding the possible threats and difficulties related to FinTech solutions. Those findings can be used by policymakers to formulate strategies which can mitigate potential harmful impacts of FinTech. Overall, the

thesis' scientific contribution consists of widening the academic discussion, providing new understanding, and offering practical insights that might promote the goal for sustainable development and influence various levels of decision-making.

1.5. Limitations

FinTech is a constantly developing industry, with new platforms, technology, and rules appearing often. Research results might suddenly become outdated. The SDGs include a wide range of interrelated targets, making it difficult to determine how FinTech efforts are affecting each one individually. Because FinTech and SDGs are local in nature, findings from one geographic location or cultural situation may not be directly relevant to other regions or circumstances. Different nations and regions have different FinTech laws and practices. The conclusions may not be applicable to all regulatory circumstances since the thesis may not cover all regulatory environments. The convergence between FinTech with the SDGs necessitates an interdisciplinary approach that draws on expertise from a variety of disciplines, including technology, finance, economics, sociology, and environmental studies. Although difficult, integrating several viewpoints and approaches is necessary for a thorough understanding.

2. FINTECH INDUSTRY AND TOOLS

Financial technology (FinTech) has been defined by Schueffel (2016) as a new financial industry that applies technology to improve financial activities” (p. 45). The term "financial technology" (better known as FinTech) refers to new, in some places almost unavailable, technology that strives to improve and streamline the distribution of financial services. FinTech, at its core, employs sophisticated algorithms and programs that run on computers and, increasingly, smartphones. By doing this it helps organizations, company owners, and people to better manage their financial activities, operations, tasks and affairs (Zeidy, 2022).

When the term "FinTech" first debuted in the twenty-first century, it had a very different meaning. It was used to characterize technology encountered in the back-end systems of respected financial firms. However, the emphasis has moved since then to include far more consumer-focused services and goods. FinTech now encompasses a wide range of sectors and enterprises, including commercial banking, educational institutions, investment management, and charitable fundraising (Ghahroud *et al.*, 2021). FinTech activity has increased since it first began. It started with lending through peer-to-peer, crowdfunding as a whole, mobile payment methods, and money transfers. It has expanded since to include the more recent areas such as cryptocurrencies, blockchain and robo-investing (Goldstein *et al.*, 2019).

Technology and finance have long been linked, and this relationship has evolved through different historical periods (Arner *et al.*, 2015). The birth of FinTech is linked to the construction of the first Trans-Atlantic transmission cable on 16 August 1858. In addition to cutting the delivery time of messages by ship from ten days to 17 hours, the connection permitted the establishment of the global telex as well as later enhancements to related financial goods and services, which is additionally referred to as FinTech 1.0. In a nutshell, the creation of enabling technologies and the growth of FinTech are closely linked. During FinTech 1.0, development of technology was the main factor. Mainframe computer systems, transatlantic transmission lines, and other similar technologies were considered the key technologies that contributed to the development of FinTech. Financial technology related goods like SWIFT and ATMs are manufactured by the help of these new technologies. It is important to emphasize that two new technologies were related. Those technologies were Internet of Things and internet. But these were not the only new technologies. Big number of new technologies are being developed during FinTech 3.0 (Leong & Sung, 2018).

"FinTech 4.0" refers to the fusion of digitalization. This includes new players (especially BigTechs), and the creation of significant digital financial platforms. The period between 2019-2020 is considered the beginning of a new era of FinTech - FinTech 4.0. FinTech 4.0 has both enormous advantages and a growing number of risks for growth and sustainable development. It is no surprise that the platform economy and, more lately, the platformization of finance have both benefited from digitization and datafication's enormous potential. This new FinTech stage heralds a period of prevailing digital financial platforms. Through innovative business models that offer access to cutting-edge sources of finance and increased financial inclusion, these major trends present enormous prospects for sustainable development, especially in developing and emerging markets (Arner *et al.*, 2022).

Customers are typically drawn to FinTech is distinguished by its computerized, transparent, intuitive, and efficient products and processes. FinTech's rapid development is being fueled by favorable laws, information technology, and other factors. Thanks to all this favorable factors, it is regarded to be one of the biggest and most significant financial industry innovations. FinTech promises to disrupt and transform the financial industry by lowering costs, improving the quality of financial services, and promoting a more diverse and stable financial environment (Moro-Visconti *et al.*, 2020).

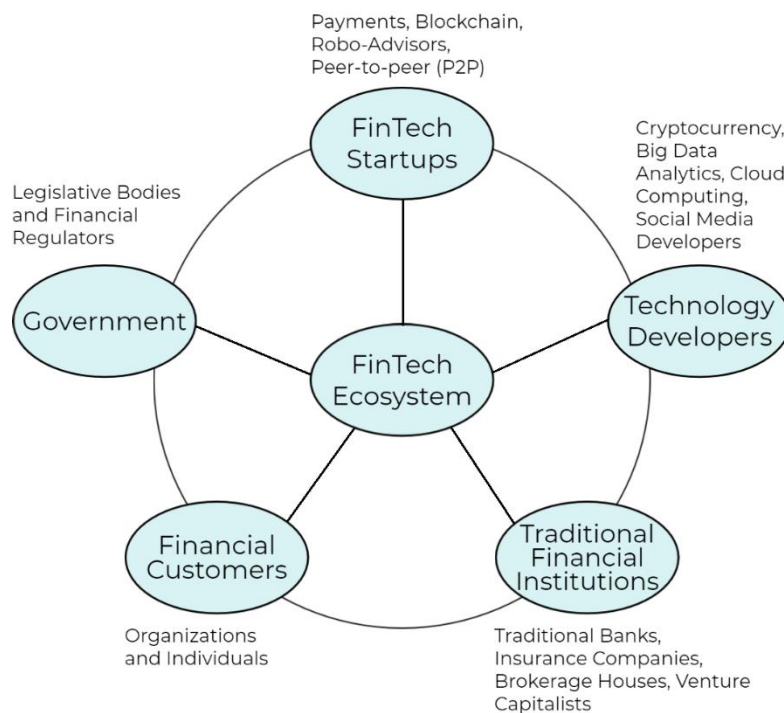
FinTech offers several major benefits, including lower costs and the opportunity to facilitate and monitor all actions in real-time, thanks to the ability to use big data and modern automation advances. Financial technologies aim to improve the manner in which customary services are provided and increase customers' access to, efficiency with, and the cost-effectiveness of financial services. Therefore, FinTech refers to the the digital transformation of the financial industry. Conventional financial institutions are making

new moves. They are expanding their stakes in cutting-edge start-ups. This is necessary in order to stay competitive and to remain competitive in the financial market, which has resulted in a noticeable shift from conventional financial products to FinTech solutions. FinTech companies and established players can collaborate in a variety of ways (e.g., outsourcing, partnerships or venture capital investments). Today, customers can choose the company offering the best service from a wide range of options (Hommel & Bican, 2020).

There are numerous FinTech applications, and those applications can be divided into multiple categories. In their research paper titled "FinTech (Financial Technology): What is It and How to Use Technologies to Create Business Value in Fintech Way?", Leong & Sung (2018) grouped FinTech applications into four main operational business processes. FinTech applications have been divided in following categories: payment, advice service, financing, and compliance (Leong & Sung, 2018).

According to Lee and Shin (2018) there are five components of the FinTech ecosystem: “FinTech startups, technology developers, government, financial customers and traditional financial institutions” (p. 37) (see *Figure 1*).

Figure 1. The five elements of the FinTech ecosystem



Source: Lee, I., & Shin, Y. J. (2018). Fintech: Ecosystem, business models, investment decisions, and challenges. Business horizons, 61(1), 35-46.

These factors are working together. They are promoting economic growth, encouraging collaboration and competition in the financial sector. Ultimately, this benefit consumers

who use financial services. At the core of the FinTech industry we can see startups. These businesses, which are primarily entrepreneurial, have contributed significantly to innovations. The innovations have been seen in the areas of payments, lending, fundraising, managing one's wealth, capital markets, and insurances. They impose lower operating costs, concentrate on more niche markets, and provide more individualized services than traditional financial firms. One of the key factors influencing growth in the FinTech industry is the capacity to unbundle services because in this situation, conventional financial institutions find themselves in a disadvantage. Consumers are beginning to pick and choose the FinTech services they need rather than depending entirely on one financial institution for all of their needs (Lee & Shin, 2018).

Technology developers offer applications including social media, big data analytics, artificial intelligence (AI), mobile devices, and mobile services. Technology creators provide an environment that enables financial institutions to rapidly roll out innovative services. Robo-advisor investment management services can employ algorithmic trading tactics as their foundation. This allows them to charge cheaper fees than conventional wealth management services. The widespread availability of mobile devices has displaced the advantages of physical distribution. This is in close connection with social media, which has made it easier for organizations to form in the peer-to-peer lending and crowdfunding sectors. Mobile network providers are also a significant factor. They provide affordable infrastructure for the creation of services offered by FinTech firms, such as mobile banking and payment. In exchange, technology developers are making profit thanks to the FinTech sector (Lee & Shin, 2018). Entrepreneurs are now using social media for purposes more than just marketing, such as business networking, information research, and business crowdfunding. This has had a substantial impact on the improvement of business performance and the enhancement of innovation (Olanrewaju *et al.*, 2020).

Different governments provide varying levels of legislation. This has a significant impact on FinTech enterprises, promoting FinTech growth and increasing global economic competitiveness, based on the national development objectives and economic policies. FinTech companies are able to provide customers more specialized, affordable, and convenient financial services than traditional institutions because of the looser regulatory limitations that are placed on them (Lee & Shin, 2018).

FinTech companies get revenue from their financial customers. Although large organizations are significant revenue sources, the bulk of the clientele are small and medium-sized enterprises, as well as individuals, who represent revenue sources for FinTech companies (Lee & Shin, 2018).

A significant element of the FinTech ecosystem is also represented by conventional banking institutions. Traditional financial institutions have been reevaluating their present business strategies and formulating plans to include innovations related to FinTech as a

consequence of understanding the potentially disruptive effects of FinTech. They are becoming aware of the rapidly closing window of opportunity to mitigate FinTech's influence on the market. Although these rapidly expanding FinTech companies were once viewed as threats by traditional financial institutions, they have since turned their attention to working with FinTech startups with a variety of funding options (Lee & Shin, 2018). A timely FinTech integration into operational processes gives financial institutions a competitive advantage in the rapidly changing market (Románova & Kudinska, 2016).

2.1. FinTech Categories

The value of FinTech innovation has been researched in a paper by Chen *et al.* (2019). They presented FinTech typology that (1) separates FinTech innovation from other types of scientific or economic creativity, and (2) recognizes essential technological characteristics between various FinTech innovation examples. Chen *et al.* (2019) have formulated a wide typology of FinTech containing seven categories: “cybersecurity, mobile transactions, data analytics, blockchain, peer-to-peer (P2P), robo-advising, and Internet of Things (IoT)” (p. 2067) (Chen *et al.*, 2019). Below is *Table 1*, which includes the essential technology and examples from real-world applications linked with each of these FinTech categories, along with brief explanations of each (Chen *et al.*, 2019).

Table 1. Categories of FinTech

Category definition	Key technologies	Real-world examples
Cybersecurity: Software or hardware used to prevent electronic fraud or theft or to preserve financial privacy	Authentication, biometrics, tokenization, encryption	Mastercard Biometric Card, Multi-factor authentication, Data encryption, Firewalls, Anti-Virus/Anti-Phishing
Mobile transactions: Technologies that enable payments using mobile devices; these include cellphones, tablets, smartwatches, NFC, mobile wallets	Near-field communication, digital wallets, smartphone wallets	PayPal, Google Pay, Samsung Wallet, Apple Pay, Revolut, N26
Data analytics: Technologies and techniques that make it easier to analyze data from transactions and consumer financial data	Cloud computing, machine learning, artificial intelligence, big data	Big Data Scoring Ltd, Equifax NeuroDecision credit scoring, S&P Global Market Intelligence
Blockchain: Technology for distributed ledgers, primarily used in the financial services industry	Directed acyclic graphs, smart contracts, proof-of-work, cryptocurrency	Bitcoin, Chainalysis, Ripple, BlockFi

Peer-to-peer (P2P): Software, systems, and platforms that enable consumer-to-consumer financial transactions	Peer-to-peer lending, customer-to-customer transactions, crowdfunding	GoFundMe, StartEngine, Kickstarter, Indiegogo
Robo-advising: Computer systems and software that provide automated investing advice to consumers and portfolio managers	Machines learning, big data, artificial intelligence	Betterment, Vanguard Digital Advisor, SoFi Automated Investing, Wealthfront, Morgan Stanley Access Investing
Internet of things (IoT): Smart gadgets that gather information in real time and communicate through the internet are examples of technologies	Smart devices, wireless sensor networks, near-field communication, actuators	Google Cloud IoT, Cisco IoT Cloud Connect, Microsoft Azure IoT Suite, Oracle IoT

Source: Author's creation based on Chen, M. A., Wu, Q., & Yang, B. (2019). How valuable is FinTech innovation?. The Review of Financial Studies, 32(5), 2062-2106.

2.1.1. Cybersecurity

The concern that FinTech services may raise the danger of privacy and data breaches for institutions as well as private individuals is one of the most prevalent worries over the rapid adoption of FinTech. Because of the fast expansion of digital platforms, the FinTech sector is becoming increasingly vulnerable to breaches in digital network security (Kaur *et al.*, 2021).

The term "cybersecurity" refers to the planning, development, and use of technologies, procedures, and practices to safeguard intellectual property, customer data and organizational assets from deliberate or unintentional breaches by unauthorized individuals. Cybercriminals are another name for the unauthorized individuals. It is inaccurate that only unauthorized individuals can be responsible for sensitive data breaches, nevertheless. There are several instances of authorized individuals violating the code of conduct by stealing vital organization data for their own purposes. Simply described, cybersecurity refers to a group of tools, procedures, and methods used to guard against authorized access and misuse of organizational assets. Hackers, state activists, as well as script kiddies are examples of unauthorized personnel; malicious insiders are examples of authorized personnel who abuse their privileges (Kaur *et al.*, 2021).

Regardless of the simple fact that all sectors within the economy are vulnerable to cyberattacks, some are more vulnerable than others. These sectors include government, finance, retail, food and health care industries. Every organization's primary goal

constitutes of guaranteeing the reliability of the information, privacy and accessibility based on motivations behind cyberattacks (Kaur *et al.*, 2021).

Cybersecurity threats are defined as everything that can damage an operating system, server, or computer network. Threats to cybersecurity may or may not materialize, however they have the power to seriously harm the organization's assets. They might trigger cyberattacks. Organizations may encounter a variety of cybersecurity dangers. Malware, extortion, phishing, hacked passwords, cyber fraud, as well as disturbance to essential operations represent just some of the most prevalent security threats that companies are forced to cope with (Kaur *et al.*, 2021).

In reaction to possible FinTech fraud, a number of cybersecurity activities are seen as essential to prevent and mitigate such new threats in an IT-driven business and environment. Tools, practices, or methods to combat fraud factors are referred to as antifraud measures. An effective way to eliminate the opportunity factor is to have appropriate internal controls in place. Even though the basics of fraud remain unchanged, cybercriminals are progressively using contemporary technology and methods targeting FinTech (Ng & Kwok, 2017).

Conventional internal controls may be unable of maintaining pace with the online setting of the FinTech business. Identity identification is a key barrier versus fraud and privacy problems in FinTech. In order to control potential frauds a variety of commonly referred RegTechs have been suggested. Traditional password logins may not be as secure as authentication techniques like digital certificates, smart phone certificates, and biometric identification. The forthcoming internet based technologies and tools can present a pivotal protection. This primarily refers to antifraud countermeasures fighting unusually fast progression in FinTech environments. Numerous analytics are available to assess user activity and data behavior (Ng & Kwok, 2017). Ng & Kwok (2017) have presented some typical methods used to combat cyberthreats, such as analyzing link patterns, monitoring screens, and recording keystrokes:

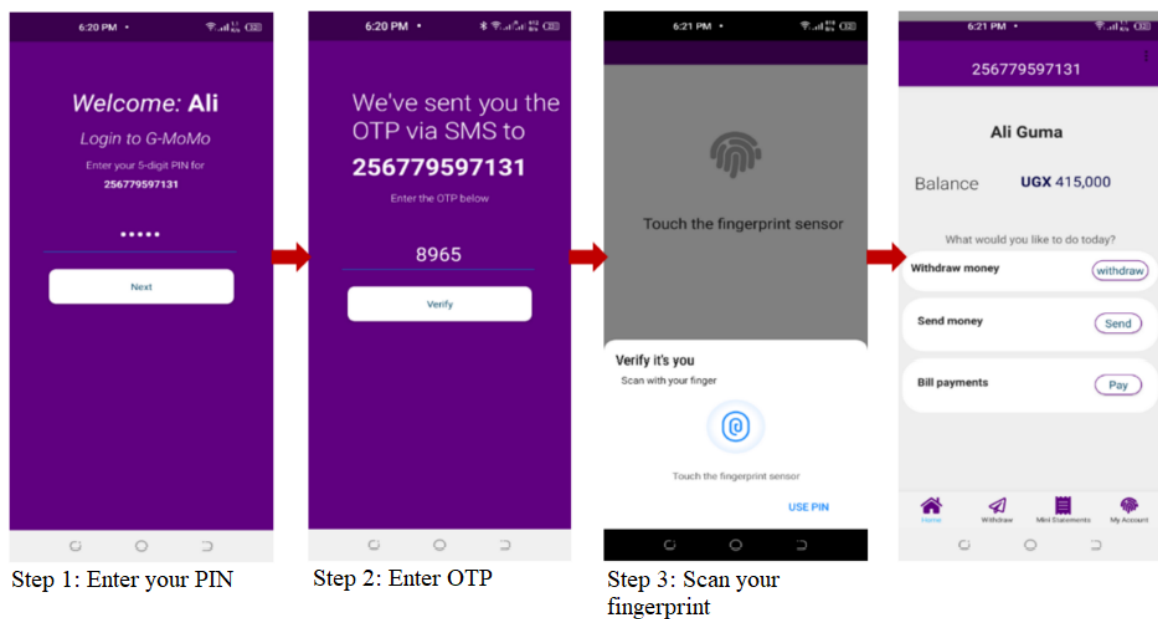
1. lacking, incorrect, double, or inconsistent records, references , as well as control totals;
2. withdrawals, contributions, as well as other offset entries made from the same accounts or using the same IP address;
3. inquiries or logins made at unusual times, dates, or IP addresses;
4. deviations from the norm that are statistically significant (i.e., extraordinary highs as well as lows or swinging values outside of the norm);
5. data from several sources with values that are comparable or even match (which include addresses, names, demographic information, and account numbers) but which should not be similar (Ng & Kwok, 2017).

Additional specialized detection methods include:

1. immediate warnings for abnormalities and quick reactions to halt any data and asset losses;
2. inspecting log files and monitoring network traffic in real-time;
3. employing investigative tools to recreate user activity's links, screen and keystrokes (Ng & Kwok, 2017).

In order to address several security issues linked to FinTech, Ali *et al.* (2021) have suggested a reliable and effective multiple-factor authorization technique implemented in digital payment software. It employs biometric fingerprints, PINs (personal identification number), and OTPs (one-time password) as authentication identifiers. In order to verify mobile money withdrawals, mobile money users must also scan their fingerprint along with the a quick response code of their electronic payment providers (see *Figure 2*). In the authentication algorithm proposed by Ali *et al.* a personal identification number and one time password security has been guaranteed through the secure hashing algorithm-256 (SHA-256), fingerprints by Fast IDentity Online (FIDO) which employs the conventional widely known essential encryption approach (RSA), and Fernet cryptography in order to protect quick response codes along with information stored in the records. Their security analysis proved that the suggested multi-factor authentication algorithm provides reliable and secure authentication, guarantees data confidentiality, user anonymity, trustworthy, renouncement and discretion, and boosts speed. It offers protection against brute-force assaults, PIN-guessing attacks, phishing threats, social engineering attacks and shoulder-surfing attacks (Ali *et al.*, 2021).

Figure 2. Multi-Factor Authentication Algorithm



Source: Ali, G., Dida, M. A., & Elikana Sam, A. (2021). A Secure and Efficient Multi-Factor Authentication Algorithm for Mobile Money Applications. *Future Internet*, 13(12), 299.

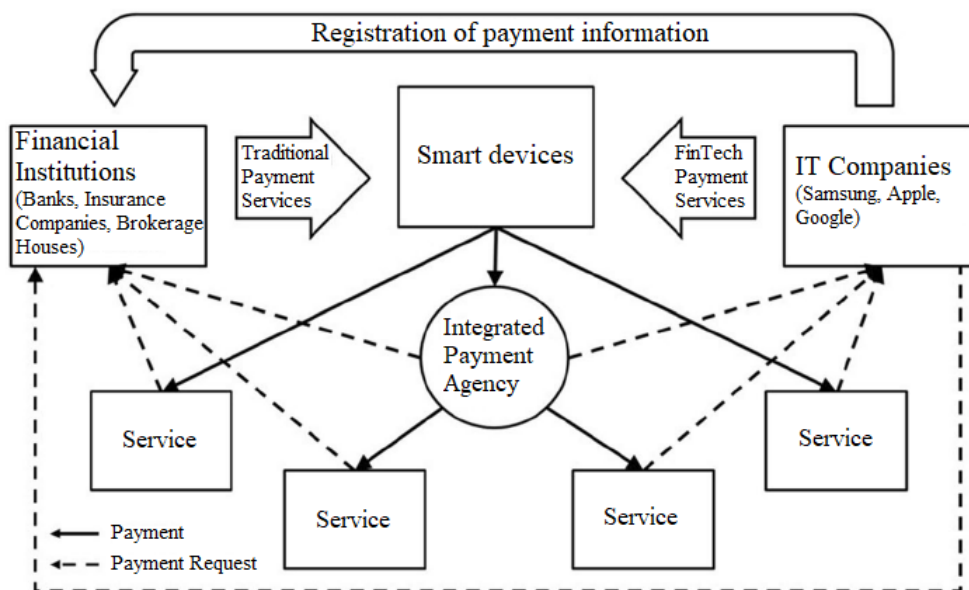
2.1.2. Mobile transactions

The demand for mobile FinTech payment services which make both online and offline payments simple has grown, especially in light of the fast expanding online market and availability of mobile devices (Kang, 2018). FinTech payment innovations appear to have great promise for transforming how we pay and transfer money (Chiu, 2017).

Electronic payments represent transactions that aren't made in cash carried out through electronic channels. They consist of online and mobile point-of-sale (POS) transactions. Digital commerce is the term used to characterize customer settlement that have a direct connection with online orders for products and services that may be paid for utilizing a number of different payment methods, including credit and debit cards and online payment enablers such as PayPal and AliPay. Mobile point-of-sale transactions are those made using "mobile wallets" like M-Pesa, where the payment is made through a contactless link which connects a smartphone app and a suitable payment device that belongs to the retailer. Emerging Markets and Developing Economies are experiencing an increase in both mobile payments and digital commerce (Agur *et al.*, 2020).

Traditional payment methods that communicate directly with banking organizations and FinTech transaction methods that do so via IT companies are the two categories of mobile banking services. Payments can be made in both cases, either directly to the service provider or through an outside contractor that accepts both conventional and FinTech ways of paying. The schematic representation of Mobile payment infrastructure in FinTech environment is given in *Figure 3* (Kang, 2018).

Figure 3. Mobile payment infrastructure in FinTech environment



Source: Kang, J. (2018). Mobile payment in Fintech environment: trends, security challenges, and services. Human-centric Computing and Information sciences, 8(1), 1-16.

Due to its connections to both conventional banking institutions along with an electronic payment infrastructure built on internet technology, FinTech payment services provide a far simpler and more adaptable payment alternative than conventional payment services. Users can utilize the payment service independently from the banking institution's system by registering their payment details with the financial institution. Additionally, the client can use different payment services provided by financial institutions that are linked with numerous financial institutions utilizing a single payment mechanism without having to be specialized for one particular financial institution. For instance, if a user has provided the FinTech payment service with information for numerous bank accounts and credit cards, consumer is able to finish the financial transaction through choosing a particular payment organization. In addition, FinTech companies may customize their services to meet the demands of both customers and sellers, as opposed to traditional services, so it has a wider range of uses and purposes (Kang, 2018).

Digital wallets, like as PayPal, do not require POS devices or any admission of bank account information, in contrast to cards. Customers can pay merchants by scanning their Quick Response code or utilizing applications to deposit money into their e-wallets or even physical machines at designated bank locations (i.e., Uber services). It has been hypothesized that using digital wallets would result in the integration of a number of current transaction alternatives, including boarding passes, peer-to-peer transfers, and keys for vehicles and accommodations (Agarwal & Zhang, 2020).

In recent times, three different payment innovation types have been hailed as having disruptive potential. New developments in commercial payment methods and interfaces at the moment of purchase, including smartphone or smartwatch payments, may replace the usage of bills and debit cards. Second, retailers and companies could begin to accept Bitcoin and other digital currencies as valid forms of payment methods. Third, emerging technologies like autonomous organization or distributed ledgers may take the place of the current infrastructure of payment clearing as well as settlement systems (Chiu, 2017).

Central banks must explore uncharted waters in order to promote payment innovation and enable a thriving FinTech sector. Globally, central banks are working to strike the correct balance between encouraging payment innovation, creating an environment that supports FinTech businesses providing innovative payment solutions, and maintaining the security of the national payment system. For central banks, implementing the right FinTech strategy is a new challenge. It necessitates comprehension and evaluation of both domestic and international FinTech advancements. In a situation where many central banks' resources have already been stretched thin, it also necessitates a consideration of the regulatory and supervisory consequences (World Bank & International Monetary Fund, 2022).

Both in developed areas like the US and UK and in emerging regions like Latin America, Africa and Southeast Asia, investment in the payments sector is booming. Because of the dynamics of the world's turnaround in the economy and the evolution of technology which is being hastened by COVID-19, there has been an incredibly high amount of investment by venture capitalists throughout 2021. High value merger and acquisition deals remained to be accounted for by the payments sector in 2022. Adoption of real-time payments was a significant factor in driving investments in Asia, especially in China and South Korea. Servicing the unbanked as well as underbanked has been a top priority in Southeast Asia and Africa. OPay, a Nigerian payments company, secured \$400 million in the second half of 2021, making it the largest startup raise in African history (KPMG, 2022).

Cross-border financial transfers conducted by migrants via the internet are known as digital remittances. Between 2017 and 2019, the value of digital remittances—including those transferred from developed economies to Emerging Markets and Developing Economies and among EMDEs—rose by 55%. Digital remittance users increased from approximately 5 to 7 million over this time (Agur *et al.*, 2020).

There is an increasing amount of evidence that supports the claim that digitization and solutions offered by FinTech are having a major influence in improvement of the living standards regarding both residents of developed countries and residents of developing countries. The most interesting examples of the impact of FinTech tools on improving the living standards of residents, as well as examples of the use of FinTech tools to achieve the Sustainable Development Goals, will be discussed in the following section of this thesis.

2.1.3. Data analytics

The term "data analytics" refers to the use of technology for analyzing vast volumes of information in order to support decision-making. A wide variety of different scientific disciplines, including data collection, operations research, recognizing patterns, machine learning and artificial intelligence, are all included into the extremely multidisciplinary topic of data analytics. Data analytics makes it possible to find relevant data, frameworks, and patterns as well as fresh perspectives, cause-and-effect analysis, future development forecasting, and action plan recommendations (Runkler, 2020).

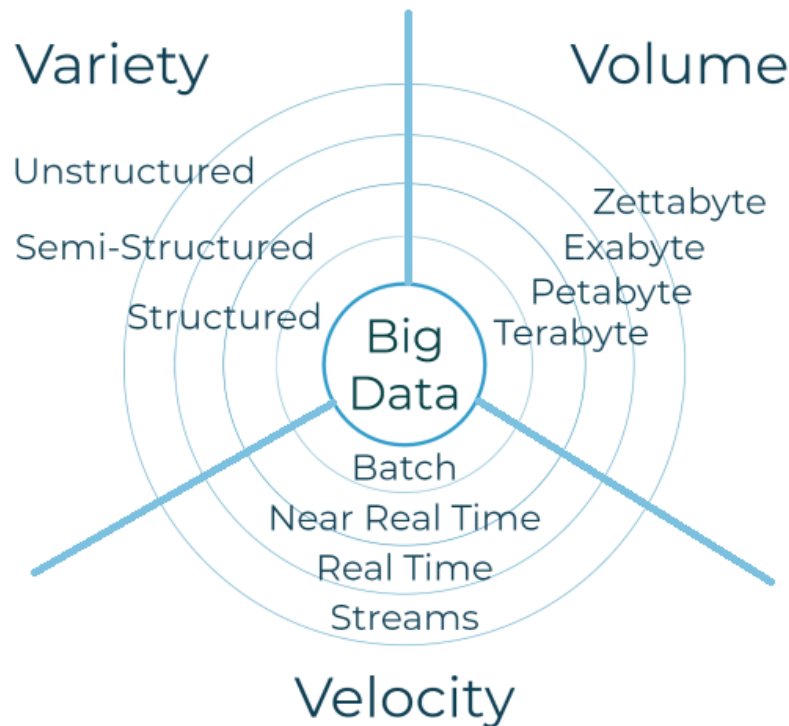
Data analytics, foundation technology advancements, big data, and mobile device technological ameliorations enable FinTech companies to compete directly with established financial institutions by offering distinctive, specialized, and individualized services. Analysis of big data may be utilized to provide highly personalized services to customers. Financially constrained FinTech firms could be capable of deploying internet-based services utilizing cloud computing for just a portion of the cost of building out their own computing facilities. The use of data analytics to price credit risks represents an example of how FinTech innovation can be used lending process (Lee & Shin, 2018).

Modern ITs and data analysis techniques can help banks enhance their risk evaluation procedures (data-driven lending) (Románova & Kudinska, 2016). FinTech uses technologies like blockchain and AI and also big data analytics. By doing this, FinTech can help companies evaluate and lessen their environmental impact (Bittini *et al.*, 2022).

FinTechs strive to promote a stronger relationship between the insurance provider and the customer in insurance FinTech business models. Thanks to the FinTech tools such as data analytics customers are offered products that will satisfy their requirements. The pool of potential customers grows and data analytics are used to calculate and match risk (e.g., life, healthcare, car, or causality insurance). FinTech tools, especially data analytics also make health care financial processes more effective. The approach to business for the insurance FinTech sector seems to be most well-suited for conventional insurance companies. By extending the data sources they use to collect information, the technology helps insurers to complement their conventional models and improve risk assessments (Lee & Shin, 2018).

Big Data takes an innovative approach beyond traditional data analysis because of its three key components—variety, velocity, and volume (see *Figure 4*). Due to its diversity, big data is exceptionally big. Big data often comes from a variety of sources. It can be classified as structured, semi-structured, or unstructured. Unstructured data is disorganized and difficult to examine. On the contrary, structured data is tagged as it reaches a database and can readily be sorted. Instead of using set groups, semistructured data uses tags to separate the different parts of the information they contain. In the present day, data volume or amount of data is enormous. It goes beyond terabytes and petabytes. The enormous bulk and rapid increase of data make it impossible for traditional techniques of storing and analyzing information to keep up. Velocity is necessary for all operations, not just those handling big data. To maximize the use of large data for processes with a limited time frame, it's crucial to utilize it as it enters the company (Sagiroglu & Sinanc, 2013).

Figure 4. Big data's three Vs



Source: Sagioglu, S., & Sinanc, D. (2013, May). *Big data: A review*. In 2013 international conference on collaboration technologies and systems (CTS) (pp. 42-47). IEEE.

Due to its key components, analytics for large amounts of data, processes, and programs in finance encounter a variety of difficulties. These challenges include: (1) cooperation and effective big data handling in business; (2) continually seeking business opportunities through big data analytics in finance; (3) utilizing innovative big data techniques to address traditional concerns relating to money, such as trading at high volumes, risks associated with credit, financial predictions, feelings, risk assessment and legislation, among others; (4) utilizing a wide range of diverse data from different perspectives; (5) despite the availability of big data, to safeguard both the privacy of persons and to ensure the safety and stability of financial institutions. In-depth work is required on both market financing and data analysis innovation in order to overcome these barriers (Awotunde *et al.*, 2021).

The banking sector, unlike the majority of other sectors, relies heavily on organized data analysis for its operational activities. Big data apps, however, allow processing of the data available in a number of data types, including unstructured and semi-structured sources. For almost every business, big data is a developing model. Finance big data (FBD) is one of the industry's most fascinating governance and management topics. Financial firms are witnessing a significant change in their market models. The financial sector generates a lot of data, including customer data, reports from their financial products, transaction details, and other helpful information, like Facebook data and website addresses, that can be used to help make decisions. Big data technologies are widely used in the financial industry for

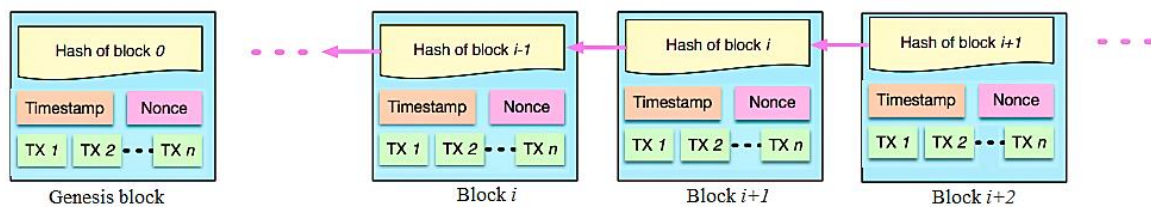
online analytics, risk evaluation, corruption recognition, and security intelligence. The collection that consists from data or text processing are two possible methods for extracting knowledge from the massive volume of information. The application of large data in targeted marketing is crucial. Big data enables the financial sectors to constantly and in real time monitor consumer behavior. The real-time application of big data analysis results and the making of strategic decisions are advantageous for the financial sectors (Awotunde *et al.*, 2021).

2.1.4. Blockchain

Arrival of the Bitcoin, a decentralized cryptocurrency for internet use, is inextricably connected to the development of the technology known as blockchain (Peters & Panayi, 2016). Nakamoto (2008) explained the way a network of users might perform safe peer-to-peer financial operations, doing away with the need for middlemen and lowering the cost of sending money abroad.

According to Nofer *et al.* (2017), a blockchain is constructed from data sets which are composed of a number of information packages (blocks) that each include several transactions. Each block refers to the block that came before it through its parent block reference, which is essentially a hash value of the previous block (Zheng *et al.*, 2018). The blockchain, which acts as an exhaustive record of all transactions, grows with each new block. Blocks can be verified by the network's members using cryptographic methods. Each block additionally contains a nonce, a random number required to validate the hash. It also contains a timestamp, and the hash number of the block before it. This theory ensures the dependability of the whole blockchain by means of the "genesis block" (Nofer *et al.*, 2017). The initially created block in a blockchain is called the genesis block, which lacks a parent block (Zheng *et al.*, 2018). An illustration of a blockchain is given in *Figure 5*. Because modifications to a block in a chain immediately affect the matching hash value, hash values are distinctive and may successfully prevent fraud (Nofer *et al.*, 2017).

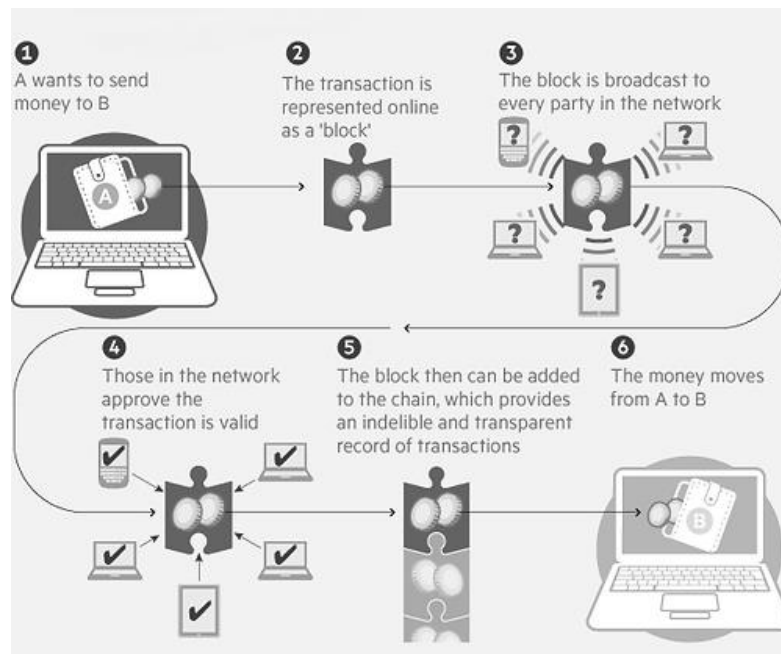
Figure 5. An illustration of a blockchain



Source: Zheng, Z., Xie, S., Dai, H. N., Chen, X., & Wang, H. (2018). Blockchain challenges and opportunities: A survey. International journal of web and grid services, 14(4), 352-375.

A block is permitted to be added to the chain if a sizable portion of the network's nodes agree through a consensus process that the block's transaction and the block itself are legitimate. The ledger is not immediately updated with new transactions. Instead, the consensus mechanism makes sure that these events are kept in a block for a set amount of time (10 minutes in the context of the Bitcoin blockchain) before being recorded. After then, the blockchain data that was previously editable cannot be changed. Blocks are produced by "miners" in the instance of Bitcoin, who receive Bitcoins in exchange for verifying the blocks. The Bitcoin illustration demonstrates that the blockchain's basic idea goes beyond simply altering how transactions are carried out. People from across the globe can trust one another and conduct peer-to-peer online asset transfers using cryptography (see *Figure 6*) (Nofer *et al.*, 2017).

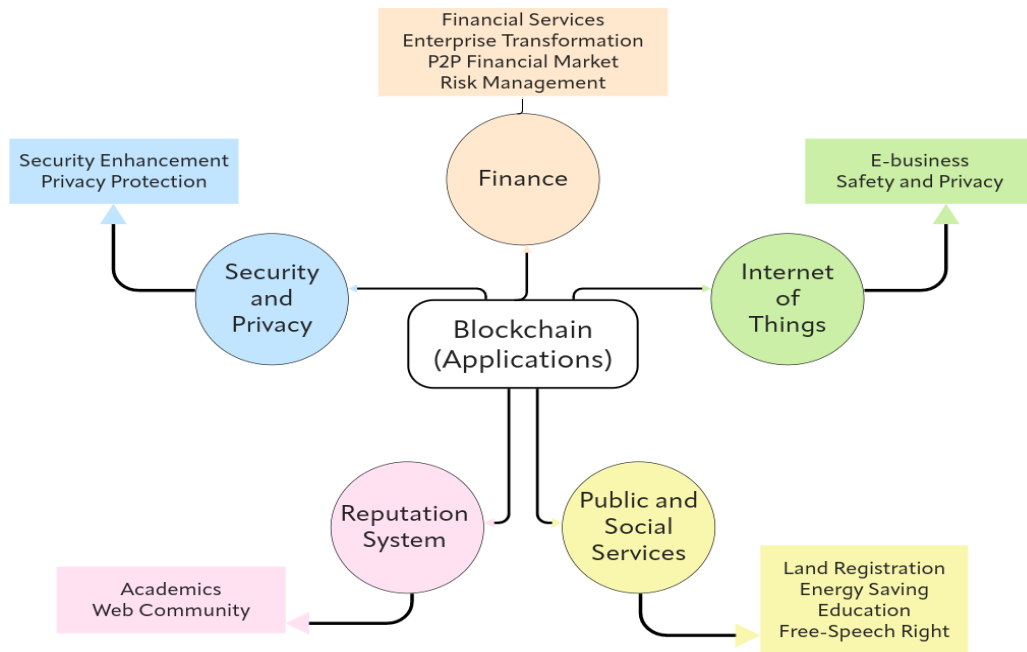
Figure 6. An example of a financial transaction using blockchain technology



Source: Crosby, M., Pattanayak, P., Verma, S., & Kalyanaraman, V. (2016). Blockchain technology: Beyond bitcoin. Applied Innovation, 2(6-10), 71.

The widespread adoption of blockchain technology has made a lot of conventional offline activities simple and safe (see *Figure 7*) (Nasir *et al.*, 2021). Blockchain and other distributed ledger technological advancements have driven a wide range of initiatives in several industries. But the blockchain concept is largely applied in the finance industry (Nofer *et al.*, 2017).

Figure 7. Examples of blockchain application areas



Source: Zheng, Z., Xie, S., Dai, H. N., Chen, X., & Wang, H. (2018). Blockchain challenges and opportunities: A survey. *International journal of web and grid services*, 14(4), 352-375.

In addition to the financial sector, blockchain technologies have found their application in the following areas: Internet of Things, interpersonal and public sector services, reputation management, and security and confidentiality (Zheng *et al.*, 2018). Rao *et al.* (2021) have shown in their paper how a blockchain such as Ethereum can be used for e-voting. Given the rapid global population growth, e-voting is a newly emerging issue linked to online services. Due to its smart contract technology, blockchain stands out as one of the greatest solutions for electronic voting since they make it easy, economical, safe, and transparent. To totally safeguard the confidentiality of voters and to eliminate counterfeit votes from being cast, a computerized voting system must be completely secure and blockchain technology has ability to support all the mentioned (Rao *et al.*, 2021).

2.1.5. Peer-to-peer (P2P)

Any tools, platforms, or systems that allow customer-to-customer monetary transactions, as offered by technologies like crowdsourcing, peer-to-peer lending, and customer-to-customer payments, are considered peer-to-peer (Chen *et al.*, 2019). Consumers all over the globe can trust one another and conduct peer-to-peer online asset transfers using cryptography (Nofer *et al.*, 2017). Through the collection or sharing of additional information, peer-to-peer platforms allow users to trade digital goods. It is important to recognize that blockchain has done something that no other computer-based technology has done before: it has increased information interaction while maintaining data privacy

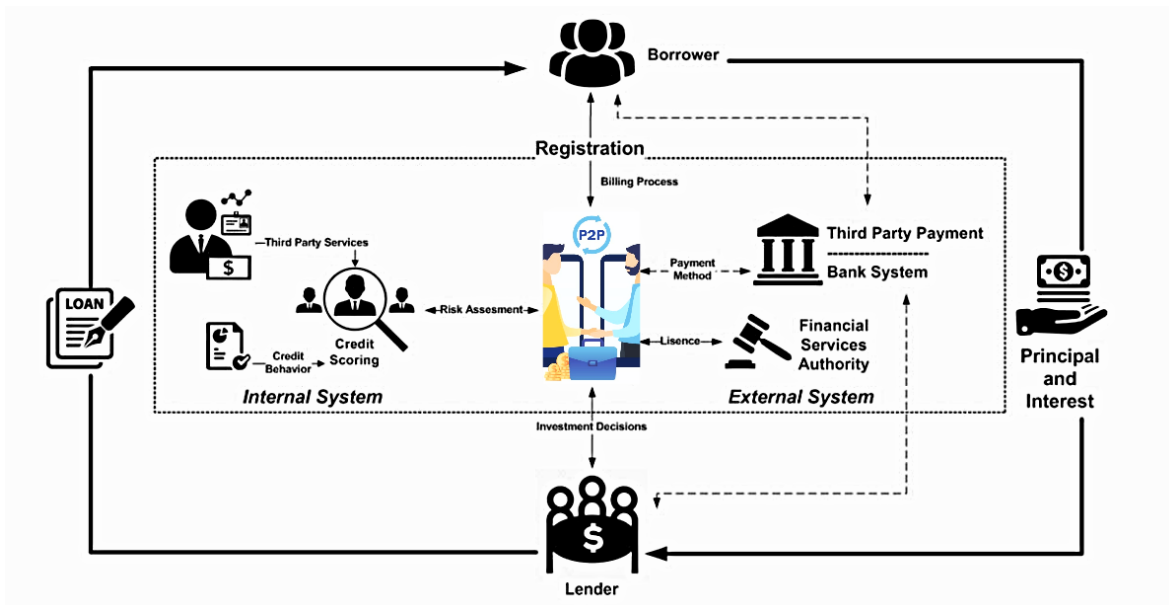
(Kosba *et al.*, 2016; An *et al.*,2021). Peer-to-peer payment models might be argued to be essential for offering current payment systems genuinely disruptive competition. With the ability to initiate, verify, clear, and settle payments, a peer-to-peer methods might function as closed payment systems on their own (Chiu, 2017).

In the past, traditional banks were considered to be the only institutions capable of lending. Lending is now not just restricted to conventional financial services, though. Online peer-to-peer financial services (P2P) are widely utilized. Platforms for peer-to-peer financing assess the creditworthiness of borrowers and lenders and deal with informational imbalances between them. By managing lending, identifying different levels of credit risk, and discovering fraud, AI-based platforms help with lending choices. FinTech platforms enhance the ability to forecast debt default (An *et al.*,2021).

Since the 2008 financial crisis, peer-to-peer lending (P2P), widely and better known as "crowdfunding" as well as "marketplace lending", has emerged and is quickly gaining popularity in private and small business financing. The P2P lending strategy is unique in that it matches borrowers with lenders directly through a digital platform, without the need for an intermediary, such as a financial institution, to start lending funds to both individuals and companies. In order to enable the matching of investors and borrowers, the lending platforms are built to offer an inexpensive, standardized loan application procedure. Prospective borrowers provide information about the venture for which they want to collect money, and the platform verifies some of the self-provided data by requesting additional documentation. Employees of the platform do not directly interact with borrowers. After a lender and investor have been paired, they contract for the debt directly, which makes the investors take the risk rather than the platform. Following loan origination, the credit platform services the loan on behalf of the investors in exchange for continuing fees. The platform handles the recovery of unmet commitments, collects borrower repayments, transfers funds to investors, and manages record keeping (Agarwal & Zhang, 2020).

A schematic view of the P2P lending process is shown in *Figure 8* (Suryono *et al.*, 2019).

Figure 8. The basic business process of P2P lending



Source: Suryono, R. R., Purwandari, B., & Budi, I. (2019). Peer to peer (P2P) lending problems and potential solutions: A systematic literature review. *Procedia Computer Science*, 161, 204-214.

The expansion of P2P lending has also resulted in significant platform failures and other alarming occurrences in a variety of jurisdictions have highlighted the need of customers, either as investors or lenders, for learning about and managing new and heightened risks. The negative effects of several of these developments on clients have been extensively covered by the media. In many jurisdictions, they have also led to substantial regulatory responses. Therefore, it is not surprising that fraud was identified as the greatest danger related to peer-to-peer financial services in the most recent regulator survey (Boeddu *et al.*, 2021).

Crowdfunding does not represent a new concept, it represents concept of people uniting their resources to achieve a mutual objective while dividing duties and responsibilities (Brüntje & Gajda, 2016). The premise of crowdfunding is based on the principle of crowdsourcing, which uses the "crowd" to collect ideas, opinions, and techniques in order to establish commercial ventures. The purpose of crowdfunding is to raise capital for investments, and it frequently does so through exploiting social networks, primarily the Internet. The people who crowdfund (donate the money) may occasionally also take part in strategy choices or even carry voting rights. Offering entrepreneurs a different means of raising money is the primary goal of crowdfunding (Belleflamme *et al.*, 2010).

In their article, Belleflamme *et al.* (2010) demonstrated that crowdfunding involves more than just funding. Crowdfunding may also assist businesses in testing, promoting, and selling their products, in learning more about the preferences of their customers, or in

developing entirely new goods or services because it appeals to consumers and makes use of Web 2.0 tools (Belleflamme *et al.*, 2010).

Crowdfunding has the power to encourage creativity by opening up fresh means of finance for creative enterprises and therefore bridging the financial gap for start-ups. Additionally, it gives input to the entrepreneur. This way crowd can take part in the development of innovations through crowdfunding. This feedback might take many different forms, include making improvements to the product ideas during as well as following the campaign (in the context of crowdsourcing), and giving insightful data on the demand for the newly introduced item in the future (Hervé & Schwienbacher, 2019).

When discussing crowdfunding, it can be distinguished between crowdsupporting (giving money without expecting anything in return), crowdfunding (investing for rewards), and peer-to-peer lending projects. There are differences between different crowdfunding projects, including: the project's goal (political, business, artistic, or social); the funder's objective (non-financial reward, donation, financial reward, or loan repayment) and the underlying tax structure (for profit, non-profit) (Röthler & Wenzlaff, 2011).

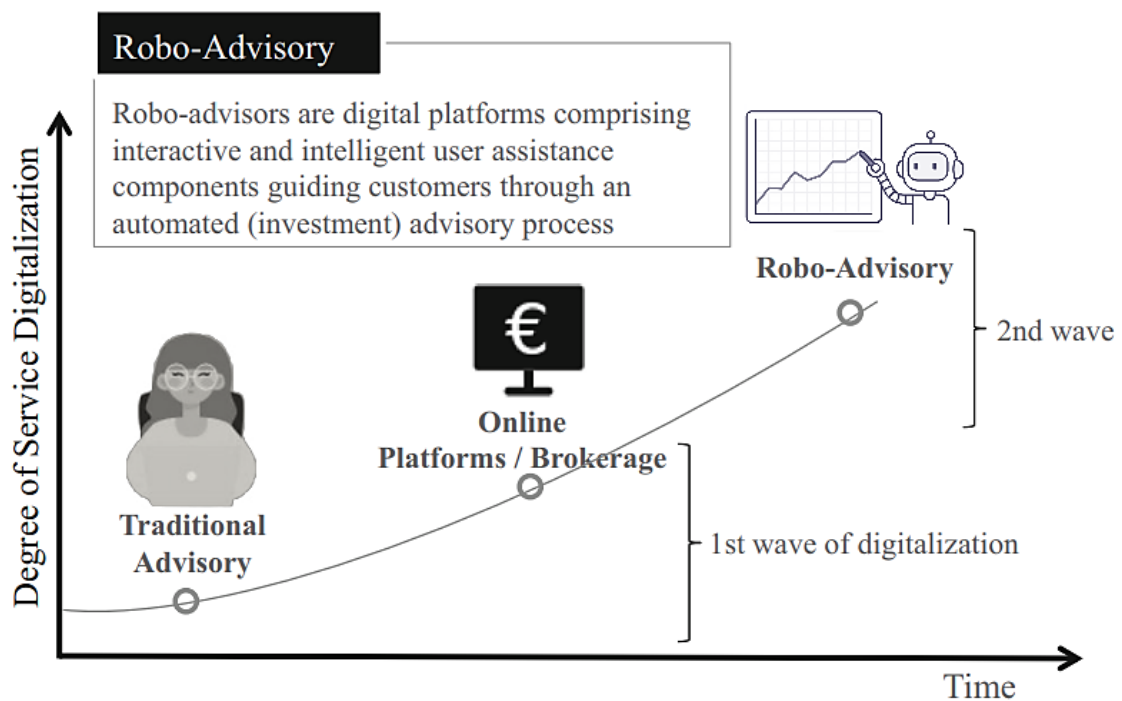
2.1.6. Robo-advising

Without the aid of experts, most people on their own find it challenging to take financial risks. In both commercial and private banking sectors worldwide, computerized financial counseling services, particularly robo-advisors, are becoming more and more popular. These tools support their users' financial decision-making by helping them with risk evaluation, choosing a portfolio, and rebalancing (Jung *et al.*, 2019). Robo-advisors are artificially intelligent solutions for investing that engage individuals through digital tools that provide a sophisticated customer experience, assisting them in internal assessment and leading their investing choices toward fundamental goal-based choices, effectively backed up by portfolio rebalancing methods through algorithms for trading that utilize passive asset allocation and diversification strategies (Sironi, 2016).

Currently, the word "robo-advisor" is generally typically used in connection with recommendations about financial investments, where robo-advisory is gradually taking the place of the conventional client counseling techniques in retail. But the fundamental principle that underlies robo-advisory might be extended to other sectors, like healthcare or real estate (Jung *et al.*, 2018). Due to their lower cost than conventional financial advisory services, ease of access, attractiveness to new customers, and ability to fill a previously unmet need, robo-advisors have been recognized as disruptive innovations. It's possible for disruptive innovation to take place in marketplaces that seem too tiny or faraway to be appealing to established and powerful organizations. Robo-Advisors did this by focusing on retail customers who were deemed to have a "small" enough market in terms of potential income (Sironi, 2016).

Individual investment guidance has historically been a luxury enjoyed only by very wealthy investors, in part due to the exorbitant fees frequently associated with this type of advice (Jung *et al.*, 2019). Since their introduction in the 1970s, discount brokers have increased their share of assets under management and made financial guidance available to the US middle class. Even more self-directed investors were given access to online trading in the 1990s, though it was actually only accessible to a select group of people who were trading-focused. *Figure 9* shows the historical path from traditional advisors to robo-advisors. The trend of digitalization has the most influence on the growth of financial advisory services. Today's robo-advisors appear to have what discount brokers did about 40 years ago: the potential to significantly lower the expenses and complexity of the entire investment procedure (Sironi, 2016).

Figure 9. The digitalization of financial advisory services towards digital platform



Source: Jung, D., Dorner, V., Glaser, F., & Morana, S. (2018). Robo-advisory: digitalization and automation of financial advisory. Business & Information Systems Engineering, 60, 81-86.

Fundamental characteristics of robo-advisory are presented in *Table 2*.

Table 2. Fundamental characteristics of robo-advisory

Assessments of Customers	<p>Target segment: Private households</p> <p>The targeted market is unaffected by actual wealth There is no pre-selection or customer screening procedure Simple registration on a public online platform</p> <p>Automated customer profiling</p> <p>Quantifying a person's profile through self-reporting Measurement of risk attitude using a questionnaire Self-assessment questionnaires are used to evaluate preferences, goals, and special interests</p>
Customer Portfolio Management	<p>Automated investment process</p> <p>Robo-advisors' entire investment process is computerized, necessitating no human interaction for profile creation or portfolio management Quantitative optimization serves as the foundation for asset allocation Rebalancing of the portfolio: active (customer interaction) vs. passive (quantitative only) Evaluation: Static (fixed after initial procedure) vs. dynamic (customer adjustments)</p> <p>Passive investment products</p> <p>There are no actively managed investments available for reducing expenses Instruments have transparent cost structure Widely used: exchange-traded funds (ETF) and exchange-traded commodities (ETC)</p>

Source: Author's creation based on Jung, D., Dorner, V., Glaser, F., & Morana, S. (2018). *Robo-advisory: digitalization and automation of financial advisory. Business & Information Systems Engineering*, 60, 81-86

Exchange-traded funds, or ETFs, have gained popularity in terms of assets invested by robo-advisors because they are excellent instruments for the concept of a passive, long-term, and diversified investment. ETFs can make investing simpler because they frequently have low transaction costs and high liquidity (Xing *et al.*, 2019).

In 2018, Fulk *et al.* (2018) conducted a study in U.S. in order to compare the features of the community that uses and does not utilize robo-advisory services. The results of their study showed that users of traditional financial advisory services tended to be older and to have greater net worth levels, whereas users of robo-advisors typically had lower net worth levels. Additionally, those who reported using traditional financial planning services stated that an inheritance made up a larger portion of their total net worth, compared to users of robo-advisors, who disclosed a lower percentage. According to the findings, users of robo-advisory assistance often (1) had lower incomes, (2) had a lower level of net worth, (3) received no or less inheritance than average, and (4) were more prudent with their money (Fulk *et al.*, 2018).

When talking about robo-advising numerous legal issues and worries are brought up due to the character of the relationship between the user and the machine and it is still uncertain

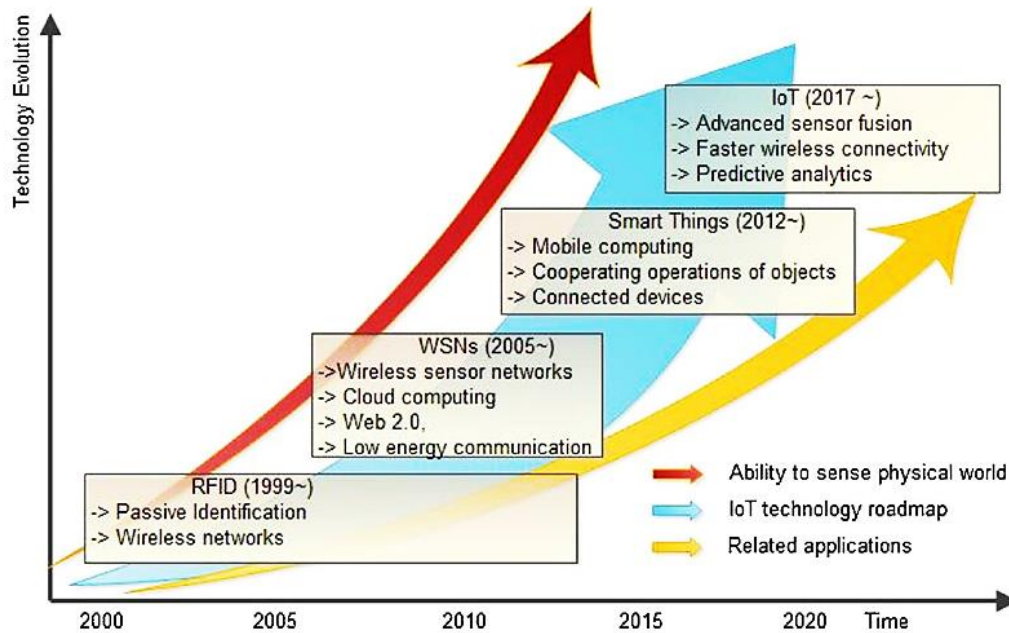
how regulators ought to handle the situation. Different strategies have been used by regulators across several major countries (Maume, 2019). Maume (2019) concluded in his research paper that financial markets regulators must consider methods for implementing current regulations in a manner that considers the unique requirements of robo-advisors. This is necessary due to the potential gains in market efficiency. All market participants do not have to be regulated by precisely the same set of rules in order for the concept of fairness to be realized as an equal playing field. The idea of an equal playing field suggests that robo-advisors need to be free to provide their advisory services to clients without being constrained by the conventional and possibly inappropriate interpretation of current law (Maume, 2019). Maume (2019) also pointed out that investor protection does not imply that at all costs, investors must be shielded from all possible losses.

2.1.7. Internet of Things (IoT)

The term "Internet of Things" typically describes scenarios where internet connectivity and computing power are made available to items. This includes sensors, and everyday household items that aren't usually thought of as computers. This allows these devices to create, distribute, and use data with minimal or no human intervention. Internet connectivity and significant data analytics capabilities are being combined with soft goods, hard goods, motor vehicles, industrial and utility elements, sensors, and various other everyday items in a way that promises to change fundamentally how we work, live, and entertain (Rose *et al.*, 2015).

IoT development can be represented by several stages, as illustrated in *Figure 10*. RFID (Radio Frequency Identification) technology, which is widely used in retail, pharmaceutical manufacturing, logistics, and other industries, is considered as a catalyst for the Internet of Things. Due to the advancement of wireless perceptual technologies, which have significantly improved the sensory capabilities of devices, the original concept of the Internet of Things is now extending to encompass ad hoc intelligence in addition to autonomous control. RFID, Wireless sensor networks (WSNs), NFC, QR codes, smart detecting, cloud computing, energy-efficient wireless communication, and other technologies are now utilized in IoT. The Internet of Things (IoT) is the term used to characterize the subsequent generation of the Internet, which will allow physical objects to be identified and accessed remotely (Li *et al.*, 2015).

Figure 10. Development of the IoT



Source: Li, S., Xu, L. D., & Zhao, S. (2015). *The internet of things: a survey*. *Information systems frontiers*, 17, 243-259.

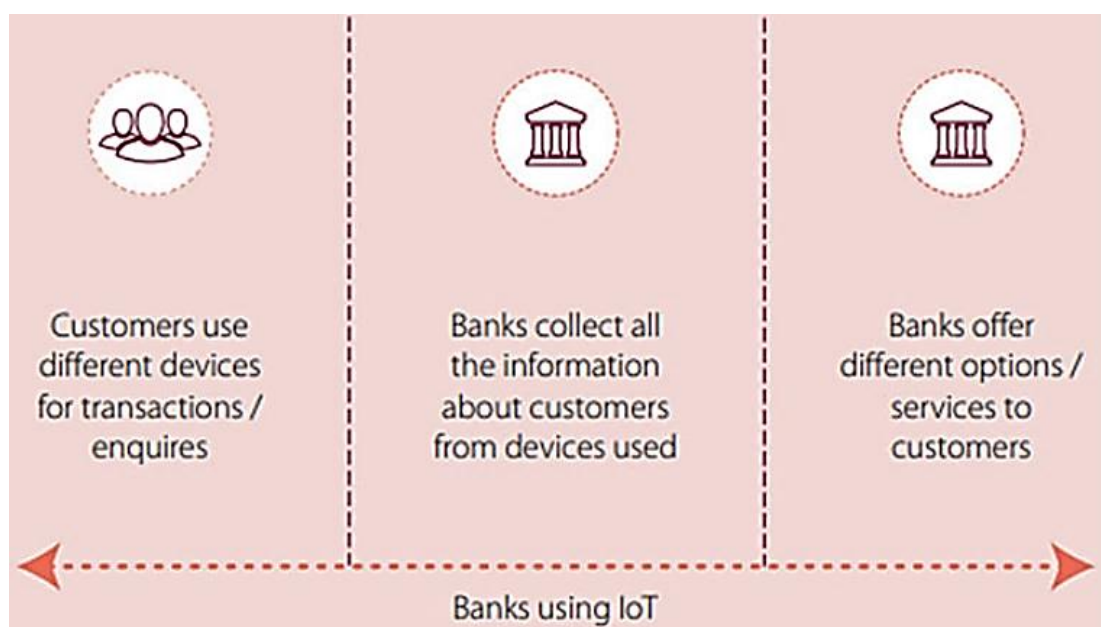
New businesses are being developed by financial engineers by utilizing data from social media, mobile devices, and billions of innovative sensors. From analyzing to funding to production, artificial intelligence (AI) must be viewed as enhanced intelligence that supports all of us in making better financial decisions. Traditional positions in all financial organizations are being replaced by IoT in a similar manner to how traditional farmers were compelled to relocate to cities and acquire new skills as a result of significant technological advancements in irrigation, planting, and harvesting. The current challenge is to enable individuals working in financial sector who previously performed "manual labor" in the industry such as making phone calls, entering big datasets into Excel, trading cumbersome derivatives or stocks in lots that require T+3 delivery time or analyzing financial statements, to acquire new skills and integrate into a new ecosystem. In essence, IoT-related challenges present a need for skill-set expansion for employees in all areas of financial organizations. Traditional methods for funding, valuing, trading, and counting assets have undergone significant change. For instance, the data analyst's tools are replacing the actuary's conventional ones because they can gather real time data on a person's health, routines, exercise, preferences, nutrition, drug use, genetics, and other factors in a matter of minutes. This provides a picture that is much more detailed and precise than even the most experienced actuary could have predicted (Schulte & Liu, 2017).

By utilizing IoT, an insurance provider for agricultural businesses will be able to collect environmental data from farms in real-time and assess the root of crop failure. In addition

to improving the utilization of resources, this will also improve the effectiveness of reimbursements, compensations, and premium modifications. By fairly evaluating the situation, a smart insurance plan will increase customer happiness overall and lessen the likelihood that the financing company will suffer a loss (Bhat *et al.*, 2023).

Making debit and credit cards available for quick access to bank services is the key advantage of IoT in the banking industry. Additionally, the bank can assess how frequently ATMs are used in the area in question to decide whether to increase or decrease ATM installations. All customer information is kept in IoT devices while being used (see *Figure 11*). Therefore, the bank takes advantage of this chance to assist the customer in identifying their business requirements, such as suppliers, retailers, as well as suppliers (Suseendran *et al.*, 2020).

Figure 11. How to connect client, bank, and Internet of Things devices



Source: Suseendran, G., Chandrasekaran, E., Akila, D., & Sasi Kumar, A. (2020). Banking and FinTech (financial technology) embraced with IoT device. In Data Management, Analytics and Innovation: Proceedings of ICDMAI 2019, Volume 1 (pp. 197-211). Springer Singapore.

2.2. FinTech regulations

Without a doubt, sound regulatory framework is essential to the continued success of the financial services industry as a whole and of FinTech specifically. Furthermore, there are unheard-of opportunities for regulatory change that could result in the creation of fresh enterprises. The effectiveness of financial services sector could be increased, systemic risk could be decreased, and economic benefits could result from harmonizing financial

legislation across numerous jurisdictions and developing innovative automated analytics and reporting standards (Treleaven, 2015).

There are new kinds of risk along with the enormous FinTech benefits. Regulators from all over the world are working hard and carefully to prevent the development of an environment that is either overly or inadequately regulated. The ideal FinTech regulations would find the right equilibrium regarding protecting customers and ensuring financial stability, while also offering enough incentives for FinTech growth (Jagtiani & John, 2018). The so-called "pacing problem" describes how regulation frequently struggles to keep up with technical development (Butenko & Larouche, 2015). Innovations such as FinTech have the potential to disrupt established industry structures, enable strategic disintermediation (for example, through the use of decentralized blockchains with cryptocurrencies), and open up financial services to all. However, they also pose significant regulatory, privacy, and law enforcement challenges. For instance, authorities now have to balance protecting users with ensuring that all players have a level playing field (Bittini *et al.*, 2022).

“Consumer Risks in FinTech: New Manifestations of Consumer Risks and Emerging Regulatory Approaches”, a recent World Bank policy research paper (2021), identifies important emerging kinds of consumer dangers introduced by four main FinTech technologies (P2PL, electronic micro lending, digital currency, and investment-based fundraising), and offers examples of emerging international regulatory approaches that regulators can take into account when formulating regulatory policy to address such risks. The risks identified by the aforementioned research include: fraud or wrongdoing by a FinTech operator, vulnerability or unreliability of the platform or technology, customer disclosure and reliability in a digital environment, heightened potential for product unsuitability, FinTech business models that are in conflict contribute to behavior that is not in the interests of the consumers, and the possibility for unfair outcomes caused by algorithmic decision-making. The following regulatory strategies are used to handle these risks: vetting of FinTech companies before authorizing them; platform operators are obligated to implement risk management and control; putting constructive demands on FinTech companies to control and eliminate conflicts of interest; FinTech companies have responsibilities to handle systems- and technology-related risks as well as outsourcing-related risks; requirements for timely disclosure of important information in a structure that is consistent, clear, and retainable by consumers; impose creditworthiness evaluation standards on administrators, irrespective of whether they represent the lender of record (Boeddu *et al.* 2021).

Treleaven (2015) concluded that all approaches to FinTech regulation result in the following:

- Dynamic regulation – a collaborative as well as principles-based regulatory approach to regulation, in which the regulator states what they hope to accomplish and members of the financial or FinTech community make suggestions on how to achieve it.
- Automated regulation – FinTech is used as a beginning point for the application of the RegTech online, data science, and big data paradigms to regulation.
- Open-source regulation framework - Software firms can offer commercial apps for data analysis as well as visualization that would be accessible to all stakeholders, while the open-source part may provide an XML-based system construction and database architecture for sending data towards the regulator (Treleaven, 2015).

The European Union (EU) policy- and lawmakers have approved and launched a number of initiatives, such as on payment services, crowdfunding, data protection, and regulatory sandboxes, to address multidisciplinary challenges like data and consumer protection concerns, as well as the risk of worsening financial volatility or cybercrime. All dimensions of FinTech are not covered by a single piece of EU regulation. FinTech businesses that offer financial services, including as lending, financial advising, insurance, and payments, are obligated to meet the same legal requirements as other businesses that provide similar services (Stamegna & Karakas, 2019).

In 2018, the Payment Services Directive II (PSD II) went into effect in response to the payments sector's technological advancements (Stamegna & Karakas, 2019). Compared to PSD I, PSD II provides a more practical method for controlling online payments (Donnelly, 2016). The new guideline imposes the same criteria on payment service providers as it does on any other kind of financial organizations. In return, banks must let third parties, such as FinTech firms, access to an application programming interface. Then, non-banks would be permitted to access customer data (with the customer's consent) (Stamegna & Karakas, 2019). The EU Payment Service Directive II (PSD II), that permits businesses that are not financial institutions to start providing a variety of financial services to bank customers, is projected to disrupt the current financial services landscape and oblige traditional providers of financial services, especially banks, to embrace new, imaginative business strategies in order to remain competitive. As a result, the payment landscape will change, posing new risks for the financial industry (Románova *et al.*, 2018).

Regardless of some experts' statements that PSD II would even out the playing field and might significantly contribute to the growth of the transparent banking system, there's plenty of skepticism regarding it. According to some analysts, the question regarding who ought to pay for the infrastructure required for such interconnectivity arises when bank account data can be accessed by third parties. Also, the risk of cyberattacks would increase with the exchange and utilization of client identification information (Stamegna & Karakas, 2019).

Romānova *et al.* (2018) concluded in their research that collaboration between the financial services sector and FinTech providers would guarantee increased service quality and efficiency, stimulate the creation of innovative services and goods related to finance, promote uniformity, and reduce the overall price of certain banking commodities and goods (Romānova *et al.*, 2018).

How to protect personal data is covered under the General Data Protection Regulation (GDPR). This regulation became effective on May 25, 2018. GDPR addresses how to secure people's privacy when processing their personal data and moving that data freely (Stamegna & Karakas, 2019). For FinTech companies to comply with GDPR requirements, the company must not only have that person's express consent before collecting his biometric information, but also take further security precautions to secure it (Pathak *et al.*, 2022).

The Anti-Money Laundering Directive provided by European Union (EU) controls measures to prevent both the laundering of money and the financing of terrorism. The European Union has been committed to combating money laundering since the early 1990s, and over the course of 20 years, five Directives and other provisions have reflected this commitment. Known as Directive No. 2018/843, the Fifth Anti-Money Laundering Directive supersedes Directive No. 2015/849. It is important to note that The European Parliament and Council approved it on May 30, 2018. Prior to the Fifth Directive, neither digital portfolio service providers nor companies whose main line of business is the provision of exchange services between virtual and traditional currencies were required to recognize and report suspicious conduct. Because of this systemic vulnerability, terrorist organizations have frequently handled substantial financial flows in complete secrecy, masking transactions with exchanges between digital currencies. As a result, it was necessary to amend and broaden the scope of Directive 2015/849's application in order to add these digital wallets and providers of exchange services on the list which is consisted of companies which should be in check with money laundering responsibilities (Faccia *et al.*, 2020).

The Markets in Financial Instruments Directive II (MiFID II) governs many facets regarding financial activity both inside and outside the boundaries of the European Economic Area (EEA), which include amid other things, algorithmic transactions, best implementation, client categorization assessments, higher management duties, foreign country effect (extraterritorial) restrictions, and trading requirements for derivative investments and securities, transparency, as well as transaction reporting. FinTech firms that offer investing services are required to acquire authorisation from government agencies and follow regulations relating to transparency and reporting. (Sheridan, 2017).

The legal foundation for regulating the usage of digital currency in EU member states is provided by Directive 2009/110/EC. Digital currency issuance within the European Union is

governed by the Electronic Money Directive (Directive 2009/110/EC). FinTech businesses that issue e-money must receive national authority approval and adhere to regulations on capital needs and consumer protection. (Directive 2009/110/EC, 2009).

It is quite clear that there is no single legal act in the area of Europe or the European Union that regulates all aspects of FinTech. Considering the continuous development and progress of FinTech tools, it is necessary to regularly revise the laws that regulate FinTech, in order to maintain the security of the economic system and protecting consumers while continuing to permit the utilization of the potential afforded by FinTech instruments.

FinTech regulations are changing at a rapid pace to keep up with new developments and business models in this constantly evolving field. The following are some of the most recent changes in FinTech regulations:

1. **Digital identification:** As greater numbers of virtual financial transactions take place, and digital identity is becoming more significant in the FinTech industry. Regulators are aware of how crucial reliable digital identity systems are. They are especially important for combating fraud and protecting client data. As an illustration, the eIDAS law of the European Union offers a framework for the use of digital identities, whereas the Aadhaar system of India is a nation's digital identification system.
2. **Open Banking:** Banks employ the open banking paradigm to provide innovative financial goods and services, which involves sharing client data with outside vendors. Open banking is being supported by regulators in many nations as a means of boosting innovation and competition in the financial services industry. For instance, Australia's Consumer Data Right Act offers a framework for sharing information across many sectors, while the EU's PSD II regulation mandates banks to exchange customer information with third-party suppliers.
3. **Cryptocurrencies:** A new asset class, cryptocurrencies present significant regulatory difficulties. To address difficulties with safeguarding consumers, laundering of money, and financial stability, many nations are enacting new legislation. For instance, the AMLD5 rule of the European Union mandates that cryptocurrency exchanges carry out consumer due diligence, whereas a patchwork of laws at the federal as well as state levels have been implemented in the US regarding cryptocurrencies.
4. **Regulatory Sandboxes:** Using frameworks called regulatory sandboxes, FinTech companies are able to try out new services and products within a controlled environment. Sandboxes can speed up innovation and assist FinTech startups in navigating difficult regulatory frameworks. Several nations, such as the UK, Singapore, and Australia, have enacted regulatory sandboxes.
5. **International Coordination:** Because FinTech is a worldwide sector, authorities are aware that it is important to work internationally to resolve international problems.

International guidelines for FinTech regulation are being developed by groups like the International Organization of Securities Commissions and the Financial Stability Board (Sanction Scanner, 2020).

When it comes to encouraging innovation and regulations affecting FinTech, regulatory sandboxes play a special role. Governments and regulatory agencies use regulatory sandboxes to encourage creativity within the FinTech sector while ensuring consumer safety and conformity to current legislation. Under the watchful eye of authorities, these sandboxes provide FinTech startups and businesses a regulated setting to test their cutting-edge goods, services, or business strategies (Everhart, 2020).

One of the earliest regulatory sandboxes was introduced in 2016 by the Financial Conduct Authority (FCA) of the UK. The UK sandbox provides a welcoming environment for FinTech companies to test their novel concepts, goods, or services around real customers while the regulators keep a tight eye on the activities. The "Fintech Regulatory Sandbox," run by the Monetary Authority of Singapore (MAS), is a well-known regulatory sandbox. It permits financial businesses to test out their products within set parameters, while decreasing some regulatory restrictions. MAS offers direction and assistance throughout the sandbox process. A regulatory sandbox called the "Innovation Hub" was launched by the Australian Securities and Investments Commission (ASIC) in 2015. It enables financial firms to evaluate their business plans and products in a controlled environment. The ASIC provides direction and support throughout the sandbox process and aids FinTech companies in navigating the regulatory environment. The "FinTech Hive" regulatory sandbox has been developed by the Dubai International Financial Centre (DIFC). It provides a location for financial companies to experiment with their merchandise in a regulated setting. In order to reap the advantages of participating FinTech companies, the DIFC provides access to mentors, shareholders, and industry professionals. The "SC Digital Innovation Lab" is a regulatory sandbox run by the Securities Commission Malaysia (SC). While getting regulatory guidelines, it enables FinTech businesses to test and evaluate their creative ideas. To promote innovation in the industry, the SC encourages cooperation between FinTech companies and conventional financial institutions (Chen, 2020; Everhart, 2020; Kunhibava & Muneeza, 2021; Schilirò, 2021).

3. SUSTAINABLE DEVELOPMENT GOALS

3.1. The 2030 Agenda for Sustainable Development

The world we live in is begging for improvement. Every day we become more aware that planet B does not exist and that major changes are necessary in order to guarantee a brighter upcoming future for not only ourselves but also for future generations. The United Nations Agenda 2030 for the Promotion of Sustainable Development represents a plan which does not offer a solution for every global problem, but it is a good guide to a

brighter future for both people and the planet. The UN General Assembly endorsed the Agenda, that sets SDGs, after it was signed on September 25th, 2015, by the 193 United Nations Members' states. The Sustainable Development Goals, widely known as SDGs, are 17 Sustainable development objectives that are small components of an action plan with 169 related initiatives that must be accomplished in the social, environmental, institutional, and economic domains by 2030 (United Nations, 2015). The agenda recognizes a connection between diverse issues, including hunger, poverty, education, medical care, gender equality, and degradation of the environment, and that these issues can only be addressed collectively. The SDGs' implementation as one "indivisible whole" will serve as the 2030 Agenda's true litmus test. The main challenge is putting into practice a more holistic approach to sustainable development, which involves new governance structures for encouraging and monitoring systemic changes. The main concern of this theme problem is whether and to what extent the SDGs lead to social transformation processes. At all legislative levels, cooperation between governments and non-governmental groups is crucial for achieving these objectives (sub-national, national, regional and global), in various society's areas (politics, economy and society), as well as in different industries (energy, food, transportation, etc.) (Weiland *et al.*, 2021). In addition to other tools, The Sustainable Development Goals can be substantially aided by FinTech.

3.2. Seventeen Goals for Sustainable Development

The United Nations adopted the Sustainable Development Goals (SDGs), also known as the Global Goals, in 2015 as an international appeal for action to eliminate poverty, protect the planet's resources, and ensure that by 2030, every single one of us will enjoy prosperity, peace, and security (UNDP, 2022). The SDG narrative focuses on what the majority of people desire by 2030: peaceful, inclusive and sustainable societies (SDG Action Campaign, 2022).

The 17 Sustainable Development Goals (see *Figure 12*) defined by the United Nations (2015) are given below along with their brief explanation provided by the National Geographic Society (2022):

Goal 1: No Poverty: Eliminate every kind of poverty worldwide. It is crucial to raise significant amounts of money from a variety of sources, including improved development cooperation, in order to give nations in development, particularly those with the lowest levels of development, the necessary and dependable means for carrying out policies and programs intended to end impoverishment in all of its various forms. Create efficient legislative mechanisms at all levels (national, regional, and global) that are based on supportive of the poor and gender-appropriate development policies to stimulate higher investment in projects aimed at reducing poverty. The most important targets are to eradicate extreme poverty, reduce poverty by 50%, put social protection mechanisms in

place, guarantee that everyone has equitable access to economic resources, and increase resistance to climate-related catastrophic events and shocks.

Goal 2: Zero Hunger: Achieving food security, improving nutrition, putting an end to hunger, and advancing sustainable agriculture. More funds should be allocated to infrastructure in the countryside, farming research and development services, progress in technology, gene banks for livestock and plants, and other areas in order to boost agricultural production in developing countries, particularly those with low levels. In order to achieve the goal of the Doha Development Round, trade barriers and market imbalances in the world's agricultural markets must be removed and prevented. This includes simultaneously doing away with all types of export subsidies for agricultural products and any export policies that have a similar effect. In order to assist the lessening the extreme volatility of food prices, implement methods to ensure the efficient operation of the markets for food commodities and their derivatives as well as to encourage quick access to market knowledge, particularly information about reserves of food. By 2030, the most crucial goals are to eliminate malnutrition and starvation, double the productivity of farmers and small-scale food producers' incomes, ensure environmentally friendly agricultural practices, preserve genetic diversity, and encourage access to and equitable distribution of the advantages derived from biological assets and related traditional knowledge.

Goal 3: Good Health and Well-being: Ensuring healthy lives and promoting wellbeing for everyone, regardless of age. help ensure that everyone has access to inexpensive necessary medications and immunizations. Increase health expenditure significantly and work to retain and attract medical professionals in developing nations, particularly in the least developed nations and tiny island developing states. Increase the capacity of all countries, especially emerging ones, to control risks, provide early warning, and address global health issues. The most crucial elements are to eliminate preventable infant and child mortality, reduce the premature death rate from non-communicable diseases, and reduce the number of deaths and injuries caused by traffic accidents worldwide. Additionally, the global maternal mortality ratio must be lowered to less than 70 per 100,000 live births.

Goal 4: Quality Education: Ensure that everyone obtains an inclusive, equitable, high-quality education, and promote possibilities for lifelong learning. Build and enhance educational facilities that are gender-, child-, and disability-sensitive and provide safe, non-violent, accessible, and efficient environments for learning for everyone. By 2020, there should be a substantial rise in the number of grants available for people from developing countries for advanced studies, technical education, and programs in STEM fields in developed and other developing countries, through focusing on countries that are least developed, tiny island developing countries, and African nations. Before 2030, a noticeable rise in the number of qualified teachers available is expected, thanks partially to

international cooperation for educator training in developing countries, especially in less developed nations and tiny island developing nations. The most important targets are that by 2030, all girls and boys should receive free, equitable, and high-quality elementary and secondary schooling, access excellent preschool and pre-kindergarten education, have an equal opportunity to affordable, high-quality technical, vocational, and higher education, possess the necessary skills for a decent job, and business ownership, get rid of gender inequalities in schooling, reach proficiency in literacy and mathematics, and support sustainable development.

Goal 5: Gender Equality: Achieving gender equality and empowering all women and girls. In accordance with national legislation, make reforms to guarantee that women have equal rights to monetary resources, such as land ownership and management, monetary services, inheritance, and earth's resources. Increase the use of supportive technology, especially communications and informational technology, to promote women's empowerment. The accomplishment of gender equality and a sense of empowerment for all girls and women through all levels should be supported by the adoption and strengthening of sensible policies and enforced laws. Ending every kind of prejudice, abuse, and detrimental behaviors against women and girls, recognizing and valuing unpaid domestic work, ensuring women's full involvement and equal chances for leadership, and ensuring widespread access to health care regarding sexuality and rights related to reproduction are the most important goals.

Goal 6: Clean Water and Sanitation: Make certain that everyone is given access to clean drinking water and efficient sewage management. In programs and activities related to water quality and sanitation, including technologies for water extraction, desalination, water utilization, wastewater treatment, reuse and recycling, and reuse, the objective is to expand international collaboration and capacity-building support. Support and boost neighborhood engagement in bettering water and sanitation practices. By 2030, the goal should be to provide everyone with access to clean, cheap drinking water, appropriate sanitation and hygiene, better water quality, more efficient use of water, coordinated management of water assets, and the preservation and restoration of ecosystems that are associated to water.

Goal 7: Affordable and Clean Energy: Make sure that all individuals have means of obtaining modern, cost-effective, and ecologically sustainable energy. To make it simpler for individuals to have access to research and advancements in the area of renewable energy, increase international cooperation by 2030, including cleaner and more advanced fossil fuel technologies, energy efficiency, and alternative energy sources. Encourage investment in energy infrastructure and eco-friendly energy technology as well. To provide cutting-edge, environmentally friendly energy services to all developing countries, particularly the least developed, tiny islands in the emerging economies, and isolated developing countries, in accordance with their specific support programs, infrastructure

must be expanded and technology must be modernized by the year 2030. By the year 2030, make certain that all individuals have access to energy services that are contemporary, affordable, and reliable. By the year 2030, greatly increase the amount of energy derived from environmentally friendly sources in the global energy mix. By 2030, global energy efficiency growth will have doubled.

Goal 8: Decent Work and Economic Growth: Promote equitable and productive work and dignified job opportunities for all. One option to expand aid for trade support for developing countries, especially for least developed countries, is through the Enhanced Integrated Framework for Trade-Related Technical Assistance to Least Developed Countries. By 2020, develop and put into practice a worldwide youth employment plan and the worldwide Jobs Pact of the International Labour Organization. The most crucial goals are to maintain each person's economic growth, increase economic productivity, advance policies focused on development, enhance global resource efficiency, and attain full and profitable employment, reduce the percentage of young people who are not in paid work, education, or training; eradicate forced labor; put an end to modern slavery; promote sustainable tourism; and improve the ability of local financial organizations to promote and increase access to banking, insurance, and financial services.

Goal 9: Industry, Innovation, and Infrastructure: Encourage innovation, stimulate inclusive and sustainable industrialization, and build resilient infrastructure. Infrastructure development in developing countries will be aided by enhanced monetary, technological, and technical support to African countries, least developed countries, developing countries without coastlines, and tiny islands. Support the development of indigenous research, innovation, and technology in developing countries, particularly by providing favorable regulatory frameworks for, amid other objectives, industrial diversification and the enhancement of commodity value. All least developed countries should have widespread, affordable Internet connectivity by the year 2020, and access to technological devices for communication as well as knowledge should be considerably increased. To promote economic growth and societal well-being, provide infrastructure that is high-quality, trustworthy, sustainable, and resilient. Increase availability of financial services and encourage inclusive industrialisation. Infrastructure improvements and industry retrofits are needed to make them sustainable. Promote innovation and raise investment on research and development, improve scientific research.

Goal 10: Reduced Inequality: Reduce inequality both within and between countries. Implement the World Trade Organization's agreements to ensure that developing nations, particularly the least developed ones, receive special and differential treatment. In accordance with their own national strategies and initiatives, they urge the influx of foreign direct investment along with official aid for development to the countries that have the most significant needs, especially those that are least developed, such as African countries, small island developing states, and landlocked developing countries. By 2030, cut migrant

remittance transaction costs in half and shut down remittance routes with costs greater than 5%. The top priorities include raising and maintaining the incomes of the bottom 40% of the population, empowering and promoting social, economic, and political inclusion, ensuring equality of opportunity, adopting policies, enhancing developing countries' representation and voice, and facilitating orderly, safe, regular, responsibly managed migration and mobility.

Goal 11: Sustainable Cities and Communities: Make human settlements and cities inclusive, safe, durable, and sustainable. To facilitate links between cities, periurban areas, and rural regions that are advantageous in regards to economic, social, and environmental factors, regional and national development strategy will need to be improved. According to the Sendai Framework for Disaster Risk Reduction 2015–2030, a significant number of cities as well as human settlements should implement and put into effect integrated policies and plans by 2020 that support diversity, resource conservation, adaptation to and mitigation of climate change, disaster resilience, and the creation and execution of full disaster risk management at all levels. By offering financial and technical support, you may assist the least developed countries in building long-lasting structures with the use of local resources. The most crucial goals are to guarantee access to essential amenities like appropriate housing and transportation, to promote equitable urbanization, and to maintain and preserve the world's natural and cultural heritage, lower the amount of fatalities and financial losses brought on by catastrophes, lessen the negative environmental effects of cities on a per-person basis, and ensure that everyone has access to areas that are safe, inclusive, and accessible.

Goal 12: Responsible Consumption and Production: Ensure sustainable production and consumption habits. Encourage developing countries to strengthen their technology and intellectual capacities so they can change their production and consumption habits to be more ecologically friendly. Create and put into place tools to monitor the impact of environmentally friendly tourism on the regional economy, employment, and goods. The 10-year framework of programs on environmentally friendly consumption and manufacturing aims to achieve the responsible and effective utilization of natural resources, minimize chemical-based and waste releases, minimize the production of waste, encourage businesses to adopt environmentally friendly procedures, promote public procurement practices, and ensure that people have the appropriate knowledge and understanding for sustainable development. The global food waste per person is also intended to be cut in half.

Goal 13: Climate Action: Combating climate change as well as its impacts by taking urgent actions. Implement the pledge signed by developed-country groups regarding the United Nations Framework Convention on Climate Change to a target of mobilizing \$100 billion annually from all sources by 2020 to address the immediate requirements of developing countries regarding the context of substantial mitigation efforts and

accountability on implementation. Also, fully execute the Green Climate Fund through its capitalization as soon as possible. Encourage mechanisms that will improve the capability of least developed countries and small island developing nations to effectively plan for and control climate change, with a focus on women, youth, local, and disadvantaged communities. Incorporating climate change mitigation measures into national planning, strategy, and policies, increasing global flexibility and resilience to climate-related dangers and natural disasters, and improving the capacity of institutions and individuals for reducing the impact, early warning, and adaptation are the most crucial goals.

Goal 14: Life Below Water: Protection and responsible use of marine resources, oceans and seas to achieve sustainable development. The Intergovernmental Oceanographic Commission's criteria and guidelines must be followed in order to increase scientific expertise, build research capacity, and transfer marine technology in order to improve ocean health and boost the advantageous contribution of biodiversity in the oceans to the general development of nation-states that are developing, particularly small island developing nations and least developed countries. For small-scale artisanal fishermen, access maritime resources and markets. As indicated in The Future We Want's paragraph 158, implementing international law, as set forth in UNCLOS, which serves as the legal basis for the preservation and sustainable exploitation of oceans and their resources, would aid in improving the preservation of the oceans and resource sustainability. Preventing and reducing marine pollution, managing and protecting marine and coastal ecosystems, reducing ocean acidification, regulating harvesting and ending overfishing, conserving at least 10% of coastal and marine areas, banning certain types of fisheries subsidies, and increasing the revenue generated to Small Island Developing States and developing nations that are least developed from the responsible utilization of marine resources are the most important goals.

Goal 15: Life on Land: Protect, recover, and encourage the sustainable use of terrestrial ecosystems. Maintaining forests responsibly. Combat the spread of deserts. Stop soil degradation and reverse it. Encourage the mobilization and considerable growth of funding for the safeguarding and efficient utilization of ecosystems and biodiversity from all sources. Provide developing nations with sufficient incentives to enhance the sustainable use of forests, which includes both conservation and reforestation, by mobilizing significant funds from every source available and at all levels. By offering local populations additional opportunities to pursue sustainable forms of income, you may increase international support for programs that aim to, among other things, eliminate the trade in and poaching of protected species. The most crucial goals are to ensure the preservation, restoration, and sustainable utilization of aquatic and terrestrial ecosystems and the goods and services they provide, to support the sustainable management of every kind of woodlands, to combat deforestation, to preserve mountain ecosystems, to reduce habitat degradation, to protect and prevent the extinction of threatened species, to encourage an equal distribution of genetic assets, to end illicit trade and poaching in

protean resources, and to end the use of genetically modified organisms (GMOs) as a weapon, to implement steps to stop the spread of invasive alien species, lessen their effect, and include environmental and biodiversity benefits into organizing, processes for development, poverty reduction initiatives, poverty reduction strategies and accounts.

Goal 16: Peace, Justice, and Strong Institutions: In order to maintain societies throughout time, it is important to foster inclusive and peaceful communities, guarantee that all individuals have access to justice, and build inclusive institutions that work well at all sizes. In order to build capacity at all levels, especially in developing countries, to stop brutality and fight criminal activity and terrorist attacks, it is important to reinforce national institutions which are appropriate, notably through international collaboration. In the best interests of sustainable development, promote and support rules and regulations that are inclusive of all people. Reduced murder and violence rates, the abolition of kidnapping, exploitation, trafficking in children, and brutal treatment, the advancement of the rule of law, the reduction of unlawful financial and armament flows, the fight against organized crime, the abolition of graft and corruption, the development of efficient institutions, legal identity for all, protection of fundamental freedoms and the promotion of responsive choice-making are the most important goals.

Goal 17: Partnerships to Achieve the Goal: Boost the global collaboration for sustainable development and strengthen its implementation methods. The main goals are to increase domestic resource mobilization, carry out commitments to provide development assistance, raise additional funds, aid developing nations in achieving long-term debt sustainability, adopt and put into practice investment promotion regimes, improve North-South, South-South, and international collaboration on and access to innovations in science, technology, and innovation, and promote the development, transfer, and dissemination of knowledge, significantly boost exports of developing nations, achieve prompt execution of market access without duties or quotas for the least developed nations, and respect one another's institutional coherence and policies. The worldwide partnership regarding sustainable development, effective public, public-private, and social partnerships, data, monitoring, and accountability, encouragement of developing countries' capacity-building efforts, and building on already-existing initiatives to create metrics for sustainable development progress that go beyond gross domestic product are the most crucial initiatives. These programs are all necessary for ending poverty and promoting sustainable development (United Nations, 2015; National Geographic Society, 2022).

Figure 12. Seventeen Goals for Sustainable Development



Source: <https://www.undp.org/cambodia/speeches/virtual-webinar-sdg-impact-standards>

3.3. Action plan for achieving the SDGs

In some ways, the world's status in terms of sustainable development is worse now than it was seven years ago, when the UN unveiled the 17 Sustainable Development Goals (SDGs) for 2030. As an illustration, in 2022, the World Bank raised the extreme poverty level coming from USD 1.90 per individual for each day to USD 2.15 per individual for each day due to rising global costs. This implies that more people who weren't previously deemed to be severely poor will now meet that definition (Mohieldin, 2022).

Although development is still moving too slowly, gender equality is necessary in order to accomplish all of the SDGs. Fixing the numerous issues preventing women and girls from realizing their potential is critically needed for the future of humanity. Gender equality and growth, resilience, poverty reduction, stability, and social cohesion are all closely related. Females, in all facets that makes up their being, have the key to solving our shared problems when they reach their full potential. To achieve that goal, we don't need to change women; instead, we need to change the institutions and structures which are currently impeding advancement and roll back the outdated social conventions that are restricting women's rights and prohibiting their full and significant involvement. To overcome these significant obstacles, it will take widespread political will, commitment on the part of both the commercial and public sectors, as well as quick action in crucial areas,

including the utilization of technologies and special initiatives as well as better data, financing, and legal frameworks. In order to make the progress we want, we must make certain that women and girls are sufficiently educated as well as actively represented in all areas of life and decision-making. This year, the Commission on the Status of Women in New York is debating ways to address the current inequalities and quicken development through innovation and technology. These include putting girls and women at the forefront of innovation and closing the gender gap in digital technology as a crucial step in advancing women's leadership, economic empowerment, and educational opportunities. Digital inclusion as well as literacy abilities are essential for the success of women and girls, even though they do not provide a complete solution on their own. They open up new doors for education, earning, and leading because they are strong boosters of their voice and leadership. However, there is still a large access gap to be closed: three billion people, mostly women and girls, lack connectivity to the internet. Technology cannot allow for a violent or abusive future, nor can it allow for an era of inequity. Social media activism and campaigns like #MeToo have shown the potential of civil society and collective digital action to bring about change and enhance the responsibility for human rights abuses (Bahous, 2023).

Extreme weather brought on by climate change alone cost about USD 170 billion in losses in 2021. Africa and other nations and populations that have made the smallest contributions to the climate issue are suffering first and worst, and have the lowest means to adapt. Less than 3% of the world's emissions come from Africa. Less than 1% comes from small island developing nations. Yet these nations endure the most suffering. Up to five times as much money as is spent on healthcare in the majority of African nations is necessary for coping with the negative consequences of climate change. It is imperative that the world avoids looking back in either fifty or one hundred years and realizing that mankind had the opportunity but failed to advance sustainable development and take action on climate change. The dial can turn with COP27. However, it requires everyone to act with a comprehensive, SDG-aligned action in mind, working together with one another, and most importantly, with ambition. This includes authorities, nations, regions, towns, businesses, financial institutions, and others (Mohieldin, 2022).

By 2030, it is obvious that action must significantly increase if the Sustainable Development Goals are successful in being met and a catastrophic global climate event is to be avoided. According to experts, the Goals cannot be achieved at the present rate of investment. According to some estimates, the SDGs won't be achieved until 2092. To put the globe back on track, drastic action is required (Koundouri & Akinsete, 2022). The following actions have been suggested by Koundouri and Akinsete (2022):

- incorporating SDGs in all areas of business
- creating a worldwide strategy to fund the SDGs
- utilizing post-pandemic data advances and new collaborations
- understanding how the SDGs function as an indivisible system

- utilizing the six SDG Transformations like a framework to explore for cross-sectoral synergies (Koundouri & Akinsete, 2022).

In order to advance practical answers for sustainable development, which includes the achievement of the Sustainable Development Goals (SDGs) and the Paris Climate Agreement, SDSN engages the world's scientific and technological expertise. To assist states on their path to attaining their SDG commitments, the UN SDSN Global Climate Hub (GCH) has been established. The GCH is an SDSN Thematic Network that makes use of the skills and abilities of individuals and SDSN Network participants. The GCH strives to offer recommendations based on science for addressing the climate catastrophe and halting further deterioration. It accomplishes this by creating and carrying out country-specific action plans (Koundouri & Akinsete, 2022).

4. THE ROLE OF FINTECH TOOLS IN ACHIEVING SDGS

A crucial and substantial role in reaching the Sustainable Development Goals may be played by FinTech and digital finance. The allocation of current financial resources to enable sustainable development is one method they do this. This is done via business strategies, incentives, rules, and regulations that reroute financial resources locally and worldwide to provide SDG-related services (Chueca Vergara & Ferruz Agudo, 2021).

In November 2018, the UN launched Task Force on Digital Financing of Sustainable Development Goals. Achim Steiner, the Task Force's co-chair, highlighted promising instances of FinTech-driven strategies that promote sustainability, from directing individual savings into long-term investment instruments like government bonds to utilizing blockchain and tokenization to endorse the development of renewable energy sources (United Nations Secretary General, 2018).

Seven out of the 17 Sustainable Development Goals have recognized financial inclusion as a crucial facilitator, contributing to reduce poverty and increase prosperity. Financial inclusion is the provision of practical and reasonably priced financial products and services, such as purchases, transactions, deposits, loans, and insurance, for both individuals and enterprises that are also supplied in a sustainable and morally upstanding way (The World Bank, 2022). It's critical to realize that financial inclusion and FinTech are both tools for creating a sustainable future rather than standalone goals (Arner *et al.*, 2020). FinTech solutions, including internet banking, mobile wallets and online money transaction platforms, have become extremely popular among developing countries as a result of conventional financial institutions' inability to offer financial products and services to those in the most impoverished parts of society (N'dri & Kakinaka, 2020).

Benefits of financial inclusion include raising people's standards of living, but it is also a powerful weapon in achieving the SDGs. Financial inclusion supports the first SDG, which

is to end extreme poverty, by giving the poor the services they require to manage investments and unplanned expenses (Klapper *et al.*, 2016).

Loans, insurance coverage, and savings accounts are examples of financial products that can aid in achieving the second Sustainable Development Goal of decreasing hunger and improving food security. The aforementioned financial services help farmers to ensure greater production and food security through improved productivity thanks to investments in infrastructure. In addition, having access to agricultural insurance enables farmers to take on bigger and riskier bets, thereby increasing profits. Farmers who live in areas that traditional banks don't regularly serve gain a lot from online banking services that don't need them to visit a bank office (Klapper *et al.*, 2016).

To achieve good health and well-being is the Third Sustainable Development Goal. By enabling individuals to cope with medical bills and recover from a health crisis, financial inclusion, through health insurance, affects wellbeing and health. Moreover, new tools such as a mobile health wallet that uses digital payment technologies may reduce medical costs and improve the transparency of health subsidies (Klapper *et al.*, 2016).

In order to encourage high-quality education, which is the fourth Sustainable Development Goal, FinTech tools can help. It is easy to imagine a young person who wants to start his academic education, and who, in addition to everything else, needs financial resources. Today, thanks to FinTech tools, it is easier than ever to raise the funds needed to start quality education. Thanks to tools like Mobile Payments, Digital Lending, Crowdfunding and Peer-To-Peer Lending, it is possible to collect funds needed for education or take a student loan more simply and with better conditions than with traditional financial institutions. It is interesting that very often there are relatives, friends or acquaintances who live nearby or abroad and who, with low transaction costs and simple transactions made possible by FinTech tools, would consent to assist in funding young people's education. Digital payment services allow users to have more influence over how money sent to friends or family is spent. A device that would enable remittance senders to directly pay for school expenses back home was enthusiastically embraced by over one quarter (27%) of participants in a field study of Filipino migrants in Rome. The same study found that just designating remittances as being toward education caused them to grow by more than 15% (De Arcangelis *et al.*, 2015; Klapper *et al.*, 2016).

FinTech solutions allow more women to access financial services and provide them with greater financial autonomy, increasing their bargaining power at home and positively affecting family well-being, and thus help promote gender equality, which is the Fifth Sustainable Development Goal (Emara & Mohieldin, 2021). The research conducted by Pandey *et al.* (2022) demonstrated that FinTech and automation are important catalysts for financial inclusion. They have measured sustainable growth by customers' opinions regarding the accomplishments of financial inclusion by means of the accomplishment of

the SDGs, namely SDGs 1, 3, 5, 8, 9, 10, 11, and 17, particularly related to reducing poverty, removing gender inequality, and promoting growth in industry, and came to the conclusion that customers must keep continuing to be aware of changes in technological advancement and FinTech with the goal to enhance financial inclusion and its transmission to sustainable growth (Pandey *et al.*, 2022).

The first Sustainable Development Goal, established by the UN in 2015, aims to eliminate all types of poverty by the year 2030. This aim served as the driving force for Appiah-Otoo and Song's study (2021), in which the implications of financial technology (FinTech) were examined both directly and indirectly as well as associated sub-measures of loan and payment from outside sources on poverty as assessed by family consumption per capita. They employed a sample of 31 Chinese provinces between 2011 and 2017. According to the findings, these secondary measures and FinTech help China's poor. The findings also demonstrated how FinTech works in conjunction with financial development and economic growth to alleviate poverty in China (Appiah-Otoo & Song, 2021).

Theoretically, financial system flaws such as payment fees and information asymmetries prohibit the poor from escaping poverty by limiting their capacity to use traditional banking services. Financial services offered via mobile devices step out as the FinTech category, nevertheless, as a result of recent events, and FinTech has become recognized as a crucial facilitator of financial inclusion, most capable of bringing the unbanked into the traditional banking environment (Demir *et al.*, 2022). For a sample of 140 countries, Demir *et al.* analyzed questionnaire responses from the Global Findex waves of 2011, 2014, and 2017 to look at the relationships involving financial technology, financial inclusion, and income inequality. Three main conclusions may be drawn from their findings. First, FinTech indirectly reduces income inequality by enhancing financial inclusion. Second, financial inclusion reduces inequality generally, with its effects being more noticeable at the higher quantiles of the distribution of inequality. Last but not least, inequality is negatively impacted by financial inclusion, although higher-income countries are mostly responsible for these effects (Demir *et al.*, 2022).

4.1. Poverty alleviation and FinTech

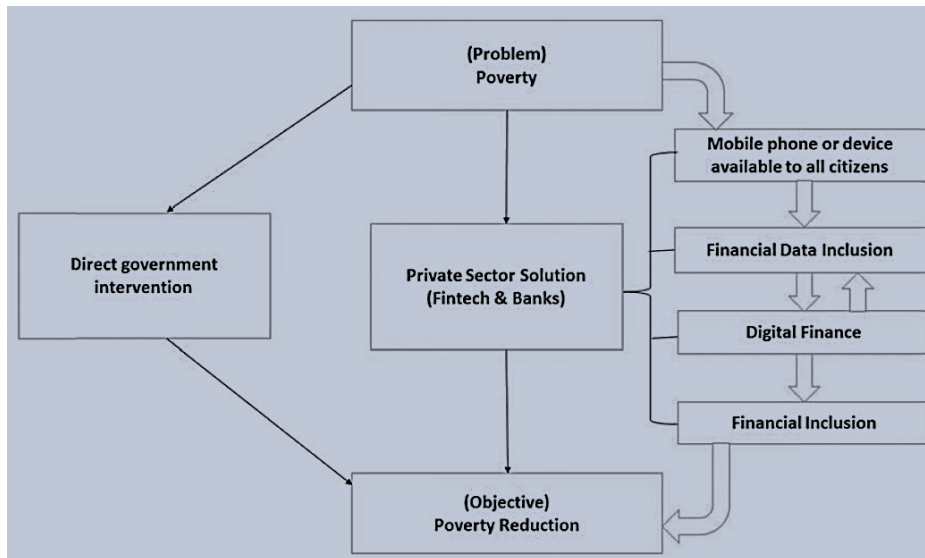
Poverty represents a lack of resources, which is linked to disease, the creation of negative social groups, a lack of recreational activities, unfair treatment, a low standard of living, financial issues, and inadequate nutrition. Eliminating poverty in all its forms is a primary objective for those making decisions and international organizations, such as the UN and the World Bank. Finance development is unquestionably necessary to reduce poverty (Ho & Iyke, 2018; Appiah-Otoo & Song, 2021). To eradicate poverty, two strategies must be implemented: First, by attending to the requirements of diverse areas, safeguard low-income families and community organizations. Second, provide them with education to help them fight to end poverty (Fauzi & Rokhim, 2022).

In the first SDG, the availability of financial services is highlighted as being crucial to eliminate extreme poverty. People who engage in financial activities are better equipped to escape poverty by making investments in their enterprises or education. In India, a government drive to create banks in rural areas helped to reduce poverty there by 14 to 17 percent. In households in Nepal that created free bank accounts, spending on costs associated with attending school rose by 20%. Additionally, financial inclusion maintains people out of poverty by reducing the burden of unplanned expenses. A savings account for yourself could possibly be one and only thing standing between a family's stability and poverty when a breadwinner passes away. When under financial strain, individuals might also utilize online payment systems to collect funds from far-flung relatives and friends (Klapper *et al.*, 2016).

Access to money is frequently cited as a crucial element in the long-term reduction of poverty. Accessing the poor more widely remains a major issue for financial institutions. Consequently, there is a lot of optimism regarding the ability of electronic financial inclusion to accelerate change (Wang & He, 2020). Fauzi & Rokhim (2022) came to the conclusion that FinTech lending platforms had a favorable effect on lowering poverty (Fauzi & Rokhim, 2022).

According to research, financial inclusion is a major factor in wellbeing and poverty eradication. It is essential to have access to secure, convenient, affordable savings accounts, coverage, financing, and other financial services in order to reduce risk, act as a cushion against economic shocks, offer social security, foster financial and social inclusion, and spur economic progress (Pinto & Arora, 2021). Banks, governments, and FinTech companies all play significant roles in reducing poverty and promoting financial inclusion (see *Figure 13*). Digital finance and financial inclusion are beneficial to everyone: customers, digital finance suppliers, governments, and the economy. For instance, there is a rise in overall government spending and a decrease in the cost of financial intermediation for banks and FinTech companies, as well as enhanced access to credit for the poor (Ozili, 2018).

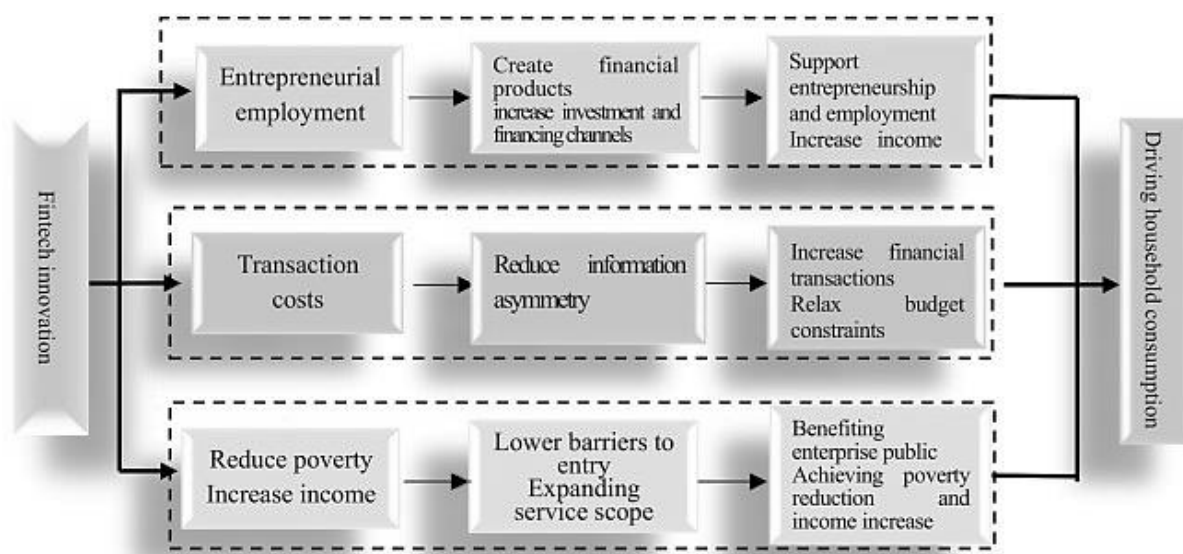
Figure 13. Impact of digital finance on financial inclusion and stability



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

FinTech advancements may lead to new financial services and products, enhanced transaction efficiency and decreased transaction expenses. Individuals and small and medium-sized enterprises alike who are becoming increasingly prevalent, are expected to benefit from FinTech. As a result, locals' incomes will eventually rise, household spending will increase, and economic growth will be encouraged. FinTech combines the benefits of finance and technology. In order to finance medium-sized businesses, it develops innovative financial services. FinTech innovation may promote entrepreneurship and employment (see *Figure 14*). Through these methods, FinTech will promote consumer spending and possibly economic growth. FinTech might increase citizens' income from the perspective of methods for reducing poverty and increasing revenue, minimize poverty rate as well as decrease income disparity and reduce the disparity between towns and countryside (Sarma & Pais, 2011; Anand & Chhikara, 2013; Luo *et al.*, 2022).

Figure 14. The mechanism of influence of FinTech innovations on household consumption



Source: Luo, S., Sun, Y., & Zhou, R. (2022). Can fintech innovation promote household consumption? Evidence from China family panel studies. *International Review of Financial Analysis*, 82, 102137.

FinTech does not mandate that banks act as a middleman between borrowers and lenders. P2P lending involves connecting lenders and borrowers online so that lenders may assess borrowers' creditworthiness based on the information they have provided and decide which loans to offer. With gratitude to FinTech, small and medium-sized enterprises (SMEs) have a better chance of getting loans with cheap interest rates. FinTech also speeds up the credit application procedure, facilitating faster loan approval for customers, perhaps increasing the capacity of SMEs to utilize money on the scheduled date. FinTech similarly reduces the cost of helping SMEs with their investment management. This encourages efficiency, which is likely to decrease poverty. FinTech has the potential to help those who are marginalized by increasing access to financial services. These services promote trade, reduce the cost of money transfers, provide the opportunity to amass wealth, and even off volatility in income. Through improving financial access, disseminating knowledge and developing social connections, and promoting rural e-commerce, FinTech reduces the danger of rural farmers falling into poverty (Guo *et al.*, 2016; Odinet, 2017; Zhang *et al.*, 2020; Wang & He, 2020; Abbasi *et al.*, 2021; Appiah-Otoo & Song, 2021)).

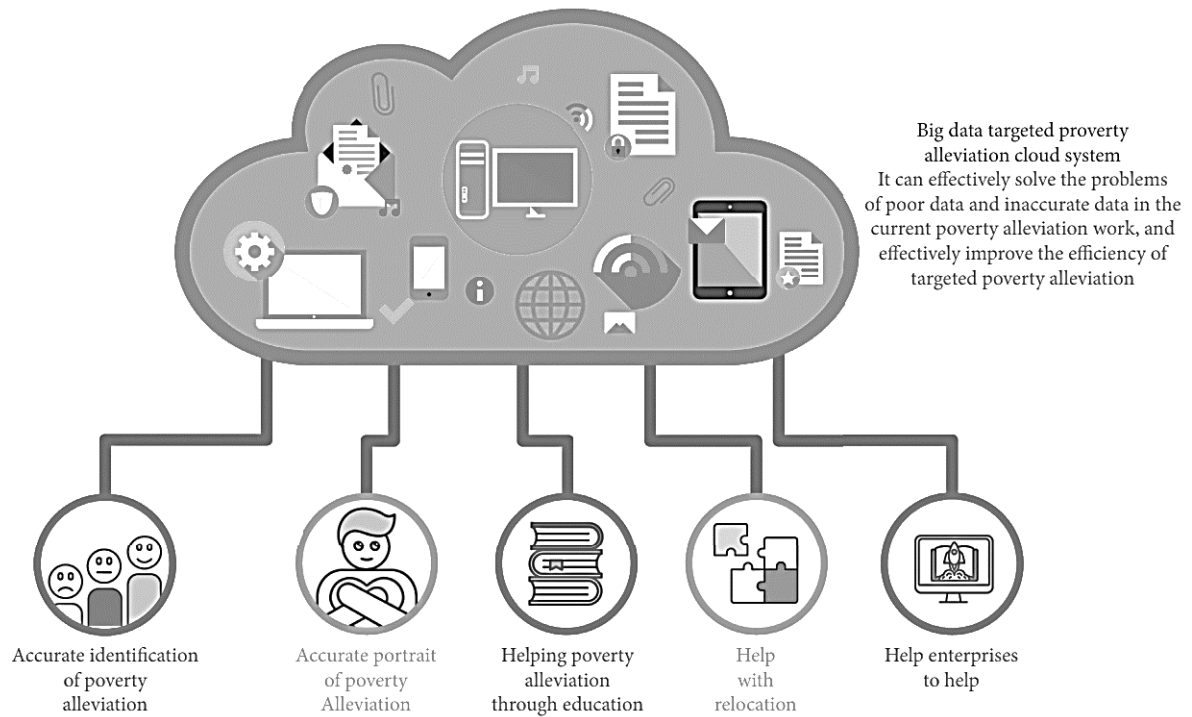
Mobile money is mostly used for sending and receiving monetary transactions. Sub-Saharan African adults who don't have a bank account now make up around a quarter of the market for cash or OTC (over-the-counter) funds. As a response to the alert that OTC operations continue to perform better than mobile money solutions in the majority of sub-Saharan Africa when it comes of cost-effectiveness, mobile money peer-to-peer (P2P) transfers have developed. Customers have the option to utilize cellular monetary tools to make deposits and withdrawals of money, move funds from a single individual to another,

pay various taxes, collect money from organizations and officials, save, lend, borrow, receive insurance, and invest as the reach of mobile money platforms expanded. This helped non-banking organizations become more widely integrated into the financial system. Through increased efficiency, the delivery of these services may benefit the SDGs related to eradication of poverty (SDG 1), health (SDG 3), education (SDG 4), and employment (SDG 8) (Ma el al., 2017; Ramos-Soler *et al.*, 2019; Zhao *et al.*, 2019; Hoang *et al.* 2022).

According to Suri and Jack (2016), adoption of the M-PESA mobile payment system in Kenya increased consumption per person and assisted 194,000 people, or around 2% of Kenyan families, in escaping poverty. The effects, which are more apparent in female-headed households, seem to be impacted by shifts in economic actions, particularly increased financial resilience and saving, as well as the results in the job market, such as choosing an occupation, especially for women who moved from agriculture to business. Mobile money has consequently enhanced labor allocation efficiency while also enhancing consumption allocation efficiency over time, greatly lowering poverty in Kenya (Suri & Jack, 2016). Kenyans frequently utilize M-Pesa, a mobile banking application that enables clients to save and transfer money using their smartphones. It has been shown that M-Pesa lowers poverty among Kenyans by 2%. Alternative financial services, which are akin to M-Pesa, have allowed peer-to-peer (P2P) lending and other crowdsourcing solutions in developing nations and support small enterprises and low-income people while fostering the growth of the financial sector (Van Hove & Dubus, 2019; Markus & Nan, 2020; Hoang *et al.*, 2022).

The core goal of targeted alleviation of poverty is to fundamentally remove the obstacles that keep people from overcoming poverty. To do this, the government must identify impoverished families and individuals, investigate the origins and extent of poverty and offer useful assistance. The nation's income level is dangerously out of balance due to the fast economic development. It has been decades since the former large regional technique of alleviating poverty was effective. The broad utilization of big data technologies should serve as the new paradigm for eradicating poverty and boosting its effectiveness (see *Figure 15*). The challenges of inaccurate and faulty data in the current work on poverty alleviation could potentially be successfully overcome by a large-scale data targeted for poverty elimination cloud system, which can also significantly improve the effectiveness rate of focused poverty alleviation activities (Gaye *et al.*, 2021; Gao *et al.*, 2022).

Figure 15. The integration of a big data mining algorithm with targeted poverty alleviation



Source: Gao, M., Li, L., & Gao, Y. (2022). *Statistics and Analysis of Targeted Poverty Alleviation Information Integrated with Big Data Mining Algorithm. Security and Communication Networks, 2022.*

To comprehend the relationship between FinTech and eradicating poverty in 31 Chinese regions, Ye *et al.* (2022) performed study. They used the technologies of web crawlers and word statistical analysis to construct new variables that represent the technological level of the financial industry, then they applied standardization and aggregation methods to create a FinTech index for each and every Chinese province. China's clustering results for the FinTech index revealed that different provinces have had different rates of FinTech development. In order to determine if the proliferation of FinTech across provinces has an impact on the decrease of poverty, they developed a novel sparse support vector quantile regression. The FinTech index's clustering findings in China showed that provincial areas have seen varying degrees of FinTech growth. They put out a unique sparse support vector quantile regression to examine if the spread of FinTech across provinces has an influence on poverty reduction in order to solve the issue of heterogeneity among distinct provincial regions. The data they presented in their paper demonstrates that FinTech has had a significant role in reducing poverty in every Chinese region. Additionally, low-income provinces have seen considerably greater benefits from FinTech in terms of reducing poverty than provinces with high incomes. More specifically, a one-point rise in the usage of FinTech causes poverty to decrease by 10% in high-income provinces and 20% in low-income provinces (Ye *et al.*, 2022).

Important policy consequences flow from Ye *et al.* (2022) insightful study findings. Initially the development of stronger electronic financial technology platforms should be a major focus of financial sector policies with the goal of reducing poverty in China, such as through the widespread implementation of blockchain technology, big data, artificial intelligence, and cloud computing. Furthermore, given the greater effects of FinTech on decreasing poverty in economically disadvantaged provinces, policymakers and practitioners must prioritize boosting investment in electronic financial technology systems in regions with weak FinTech development, notably in Ningxia, Qinghai, and Gansu. In low-income provinces, increasing access to financial services considerably reduces poverty. Third, policymakers should support the development of new financial technologies that directly help low-income populations by enhancing access to monetary institutions for them. Last but not least, financial literacy needs to be promoted, especially in rural areas where it is as crucial as infrastructure (Ye *et al.*, 2022).

4.2. Transformation of agriculture and FinTech

For the citizens of any nation, agriculture is crucial for guaranteeing sustainability and availability of food. However, farmers frequently struggle to attain a satisfactory level of sustainability due to a lack of capital and constrained distribution options. By encouraging the creation of services like FinTech and digital marketplaces, agriculture's sustainability is likely to be increased. FinTech-enabled digital marketplaces have the capacity to improve the financial and commercial viability of agriculture's industry structure. FinTech provides farmers with easy options to access finance sources through crowdsourcing and electronic payment systems. Therefore, a web-based marketplace can act as a foundation for incorporating FinTech's cutting-edge financial solutions into a larger agricultural ecosystem (Anshari *et al.*, 2019).

In view of the Agenda for Sustainable Development, agricultural transformation is essential. When we talk about, for example, SDG 12, in particular, largely accountable manufacturing, financial technology and the partnership of FinTech along with supplementary (green) methods together alongside electronic agriculture, serve as an essential part because they can reduce compromises while improving collaborations among both the ecological and social SDGs, such SDGs 1 and 15, in addition to boosting profitability without utilizing additional natural resources (Hinson *et al.*, 2019).

By connecting stakeholders and advancing environmental and social SDGs, such as minimizing food waste, digital marketplaces can be built using farm-level data on digital platforms. These marketplaces are reachable via text-based cell phones and other digital devices. Hello Tractor, which operates in Kenya, Mozambique, and Nigeria in addition to numerous Asian nations, is one intriguing case of an emerging digital marketplace for inputs. Through a digital interface, Hello Tractor enables farmers to engage and transact with owners of smart tractors while renting or purchasing smart tractors (Hinson *et al.*,

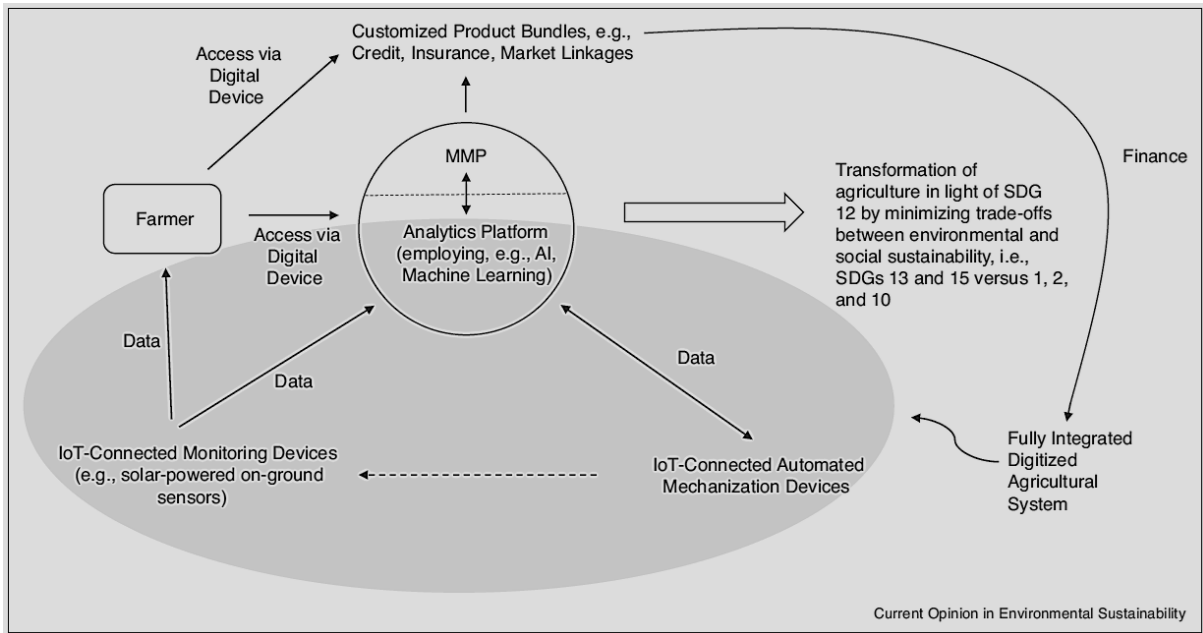
2019; Okunlola & Adenmosun, 2017). According to various studies, FinTech may assist farmers in two ways: by facilitating payments and by facilitating consumption (Grossman & Tarazi, 2014).

Anshari *et al.* (2019) discovered in their investigation that the financial technology (FinTech) solution AgroPay gives investors the tools they need to transact successfully, wherever they are and whenever they want. Crowdfunding allows investors to choose from a variety of agricultural products using their smartphone. Customers are also given the ability to check prices immediately, compare the prices of various agriculture products offered, and make direct payments via AgroPay, another FinTech initiative. Due to increased pricing rivalry among suppliers of agricultural products, FinTech will enhance the sustainability of agricultural products (Anshari *et al.*, 2019).

Recent initiatives integrate innovative technologies—typically designed for agricultural settings—with centralized online services that can store and analyze data obtained from ground sensors, aerial surveillance, and farmer surveys. The results of such an analysis may be used by farmers to inform the choices they make, sometimes through technologies that provide immediate feedback and other times via organizations that provide agronomic advice. A perfect example is a current initiative in Uganda, which combines meteorological alerts with loans, market links, and catastrophe insurance and sends SMS messages to farmers. The technology leverages data gathered by satellites and compares it to data gathered from conventional data sources to offer farmers customized agronomic advice (Hinson *et al.*, 2019).

The Kenyan system offered by Illuminum Greenhouses, which integrates solar-powered sensors, statistical analysis of data, and automatic drip irrigation systems, is an example of an agricultural system that is (almost) entirely digitized. The end user can receive and apply agronomic information via text-based phone. In their most sophisticated configuration, fully integrated electronic farming structures include data collection tools like in-ground and ground-level sensors linked to the Internet of Things (IoT), which upload information in real time to a statistical analysis platform using machine learning and AI to provide prescriptive recommendations. These recommendations are then sent to fully computerized mechanization devices linked to the IoT (see *Figure 16*). While such systems alone are capable of boosting productivity and conserving resources simultaneously (for instance, reducing drinking water utilization), seamless integration and synergy among mobile money platforms and such systems symbolizes an absolute game changer when it comes to developing cultivation in light of SDG 12 through lowering trade-offs between both social and environmental sustainability, namely, SDGs 13 and 15 versus 1, 2, and 10. The issue of inaccurate data can be dealt with, and accessibility to loan and insurance services may increase significantly, if financial service providers are able to get data on agricultural conditions via mobile money platforms being connected with the analytics platform (Lee *et al.*, 2017; Hinson *et al.*, 2019).

Figure 16. Interoperability among mobile money platforms and fully integrated digitized agricultural systems



Source: Hinson, R., Lensink, R., & Mueller, A. (2019). Transforming agribusiness in developing countries: SDGs and the role of FinTech. *Current Opinion in Environmental Sustainability*, 41, 1-9.

In the instance of smart farming, the data collected by sensors aids in creating the farm's virtual twin. This digital twin can incorporate intelligence, analytics, and prediction tools with regard to finance and the particular vertical (in the case of agriculture, the environment). The model will provide feedback to the real world, such as the agricultural process, to modify it. As an illustration, the irrigation system may need to be instructed to sprinkle extra water by the virtual replica of a farm in order to prevent production loss, therefore the sensors would manage the value. In a different scenario, advise the farmer about selling the product at a location that, based on its quality, will pay the highest price for it that day. These services will make it possible for financial analysts or FinTech companies to give consumers services at competitive pricing (Bhat *et al.*, 2023).

Up to 70% of all freshwater consumption worldwide is consumed by agriculture, which strengthens the need for efficient oversight of water with the goal to ensure the worldwide population's accessibility to both food and drinking water (Food and Agriculture Organization of the United Nations, 2016; Kamienski *et al.*, 2019). Agriculture demands the efficient use of freshwater for precision irrigation in order to boost agricultural output, reduce costs, and promote environmental sustainability. Technology is widely used as a means of giving plants the exact quantity of water they need. The Internet of Things (IoT) is the obvious choice for efficient water management systems. Although there is still work to be done in the seamless integration of several technologies, the Internet of Things (IoT) is a great choice for efficient water management systems (Kamienski *et al.*, 2019).

Tools for risk management as well as digital payments give smallholder farmers the chance to connect more closely to the value chains of agriculture. According to data gathered by Global Findex, over fifty percent of the adult population in Kenya sell agricultural products, and thirty percent of them receive payment for their items through a smart phone-based wallet. Furthermore, digital financial services help spread knowledge more effectively, which actively encourages agricultural extension initiatives (Gilissen *et al.*, 2015; Seetharam & Johnson, 2015; Klapper *et al.*, 2016). Since cash payments are made for farm goods in developing countries, where 440 million adults lack access to a bank account, farming repayments offer a further chance for boosting entry to the banking system (Klapper *et al.*, 2016).

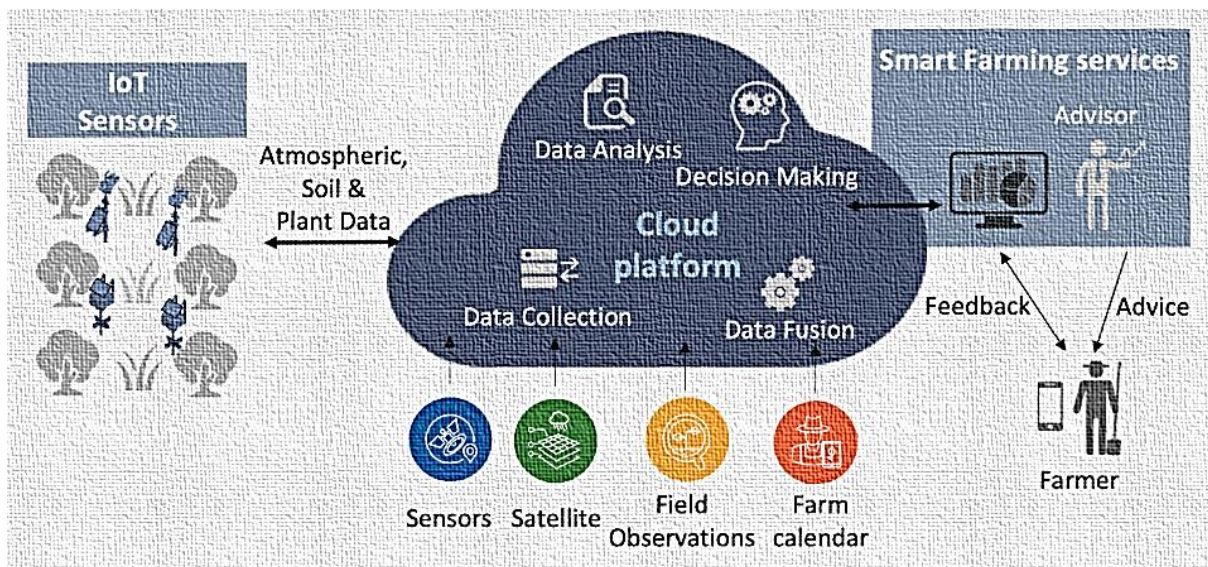
Researchers in Niger discovered that sending social welfare payments to recipients via mobile phones rather than having them go pick them up in person resulted in a reduction of travel and waiting times by 75%. Consequently, people have more time to devote to activities that are more productive. Based on agricultural incomes, the authors estimated that switching to digital payments saved recipients enough time and money to cover a day's worth of food for an entire household of five (Aker *et al.*, 2014; Klapper *et al.*, 2016).

The fundamental developments as well as specific FinTech solutions, including mobile carrier-provided microfinance, electronic payments and contract systems, and loans for agriculture with better terms for underbanked farmers, were presented by Bayram *et al.* in 2022. These innovations assisted Turkey accomplish a significant degree of financial inclusion and a growing trend towards sustainable manufacturing and consumption. Turkish FinTech solutions contributed to financial inclusion from the supply side by providing payment-oriented FinTech solutions like developing mobile apps to use smartphones as POS devices and enabling SMEs to utilize financial services to interact with customers who prefer to make payments with credit cards as opposed to cash. Providing farmers with access to loans with favorable interest rates and terms, FinTech programs for agricultural financing also help to enhance financial inclusion. Turkish FinTech payment system solutions also help SMEs lower operational and other costs and improve their ability to access financial resources more effectively than conventional banking solutions. Turkish FinTech businesses have significantly impacted Turkey's financial sector and have shown significant growth in this area (Finance Office of the Presidency of Türkiye, 2021; Bayram *et al.*, 2022).

The use of smart contracts, a transaction mechanism that automatically performs, controls, and documents legally significant events and activities, is made possible by blockchain technology and artificial intelligence (AI). With the aid of this application, farmers from all around the world will be able to safely communicate and carry out their sales agreements (Goldenfein & Leiter, 2018; Cong & He, 2019; Singh *et al.*, 2020; Hoang *et al.*, 2022).

IoT-based smart farming enables crop producers to collect information on watering and plant protection practices in real-time with the aim of boosting output, enhancing product quality, and detecting illnesses while expediting agricultural operations. IoT devices have the capacity to collect massive amounts of data on the performance of the environment, soil, and crops, providing a sequence of data that can be analyzed to forecast and generate recommendations and provide farmers with essential information in real time (see *Figure 17*). From the perspective of a farmer, the additional advantage is that these smart farming methods can increase sustainability in agricultural production since they are based on a strategy that is more precise and environmentally conscious in the varied and complicated agricultural environment (Adamides *et al.*, 2020).

Figure 17. Smart Farming Techniques



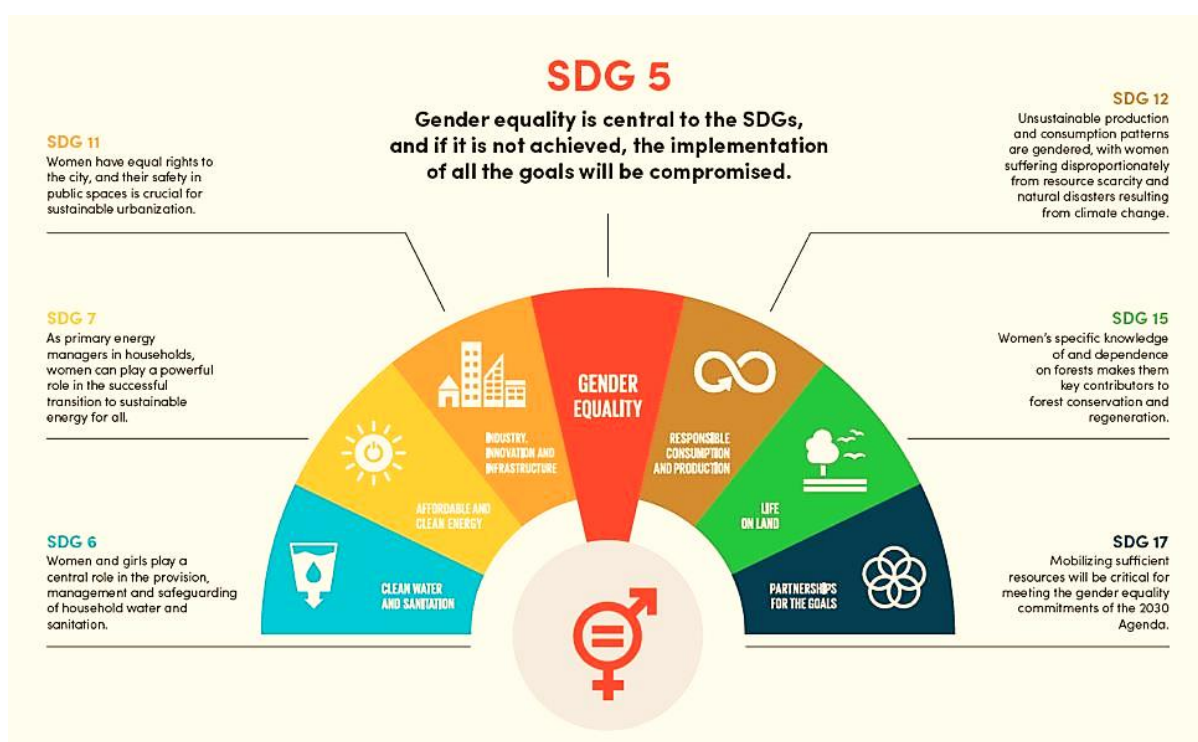
Source: Adamides, G., Kalatzis, N., Stylianou, A., Marianos, N., Chatzipapadopoulos, F., Giannakopoulou, M., Papadavid, G., Vassiliou, V., & Neocleous, D. (2020). Smart Farming Techniques for Climate Change Adaptation in Cyprus. Atmosphere, 11(6), 557.

The UN Sustainable Development Goals state that all people shall have access to economic progress that results in the eradication of poverty (SDGs 8 and 1) by the year 2030. Utilizing technology to expand the financial sector is crucial in this regard. For instance, weather forecasting and IoT-enabled agriculture could assist farmers in increasing productivity. Additionally, IoT and smartphone apps will even help farmers market their agricultural products for the highest return, resulting in increased economic activity and the eradication of poverty (Bhat *et al.*, 2023). By assisting farmers in managing costs and risks, banking services such as savings accounts, digital financial services, and agriculture insurance support SDG 2 — achieving a secure food supply and eliminating hunger — by boosting crop yields (Emara & Mohieldin, 2021).

4.3. Gender Equality and FinTech

Gender equality represents the the foundation for a prosperous, peaceful, and sustainable planet (United Nations, 2015). Despite the fact that development is still too slowly, equality between sexes is a prerequisite for accomplishing all of the SDGs (see *Figure 18*). The future of humanity necessitates that we take immediate action to address the numerous issues preventing women and girls from reaching their full potential (Bahous, 2023). Women still face numerous hurdles despite the impressive advancements made over the past few decades, including greater rates of unemployment, poverty, and various other economic troubles. Women remain to be underrepresented across all levels, especially in the global financial sector, from borrowers and depositors to executives and authorities (Sahay & Cihak, 2018; IMF, 2021; Loko & Yang, 2022).

Figure 18. A Catalyst for Sustainable Development: Gender Equality



Source: <https://unglobalcompact.ca/gender-equality-a-catalyst-for-sustainable-development/>

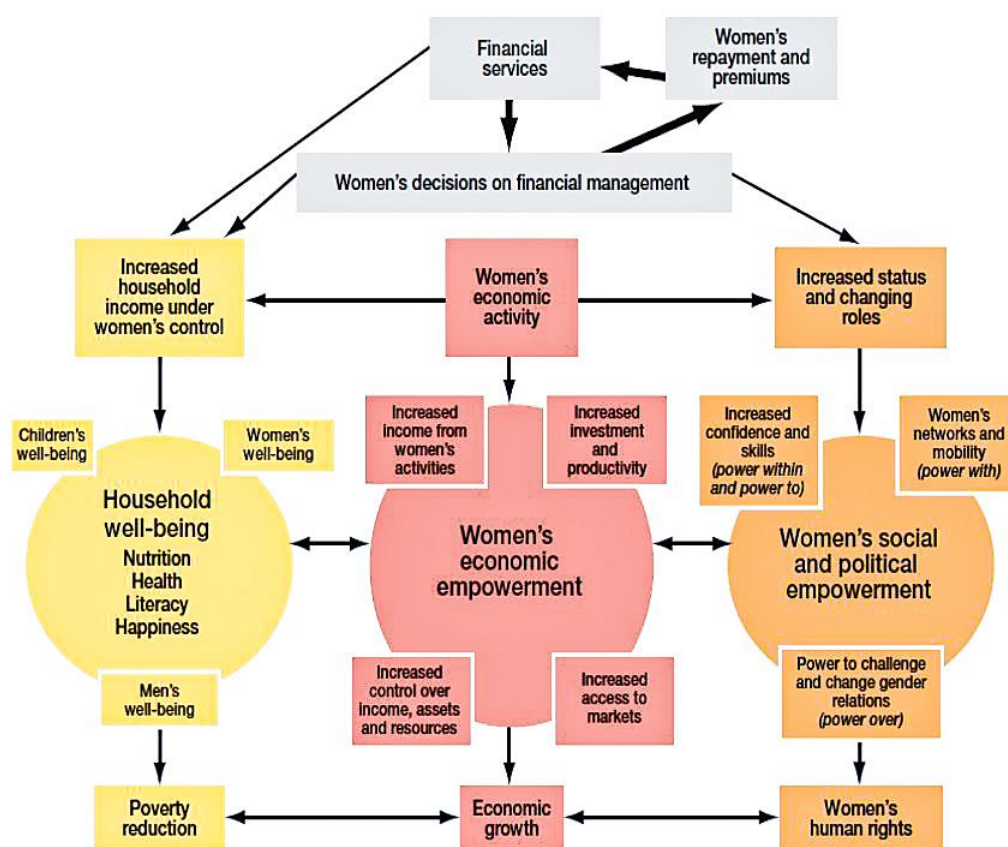
Gender equality and growth, resilience, poverty reduction, stability, and social cohesion are all closely related. Women and girls, in all their variety, have the key to solving our shared problems when they reach their full potential. To achieve that goal, we don't need to change women; instead, we need to change the institutions and structures that are now impeding advancement and roll back the regressive societal norms that are restricting women's rights and prohibiting their full and meaningful involvement. To overcome these significant obstacles, it will need widespread political will, commitment from the public and commercial sectors, and expedited action in important areas, including the use of

cutting-edge tools and special initiatives as well as better data, finance, and legal frameworks. In order to make the change we want, we must make certain that women as well as girls are adequately prepared and effectively represented in all areas of life and decision-making (Bahous, 2023).

To ensure that new technologies, like artificial intelligence, are fair, secure, inclusive, and easily available from the outset, it is essential to include women and girls at all stages of their development. With the goal to make certain that women and girls are fully qualified for leadership roles in all spheres of life in a world that is becoming increasingly digital, we must make audacious new investments in their education in the digital, scientific, and technological fields. In addition, as women now hold just one in three roles in the sector, we must redistribute power throughout the tech and innovation industries and protect their jobs and leadership positions there (Bahous, 2023).

The SDGs could help to promote gender equality if more of the 2 billion unbanked people in the world, the majority of whom are impoverished women, opened bank accounts. In order to promote gender equality, financial services are essential in assisting women in asserting their economic power. Women in Kenya who owned savings accounts increased their business investments by 45% and were less inclined to liquidate assets in the event of a medical emergency. Being able to access financial services may also lead to increased spending on basic necessities like healthcare (see *Figure 19*) (Wattoo *et al.*, 2015; Klapper *et al.*, 2016).

Figure 19. Financial Services and Women's Empowerment



Source: Wattoo, Z. A., Ayuub, S., Shabbir, M. S., Baloch, U., & Nasar, H. (2015). *Strategies for Empowering Women and Gender Equality through Micro Finance in Pakistan. Int. J. Acad. Res. Account. Financ. Manag. Sci*, 5, 171-178.

Digital financial services also assist women-owned enterprises by cutting administrative and disbursement expenses and lowering theft risks. Utilizing digital platforms like mobile phones may provide users with access to marketplaces and information, including statistics on costs, inputs, and rivals. These services could also provide opportunities for women to work from their own homes or communities remotely and present chances for them to transition from free to paid jobs. When registering a business means making several, expensive journeys to a government agency, many women hesitate to do so. Digitizing licensing fee payments and registration processes might promote company formalization and aid in closing the gender ownership gap (Malhotra *et al.*, 2012; Klapper *et al.*, 2016).

Several development goals outside of SDG 5 are supported by women's financial inclusion. When money is managed by women, it is more likely to go toward basic needs like food and water along with child welfare costs like health care and school tuition. Several field studies also demonstrate how female farmers now produce more while handling food shortages and shocks more skillfully thanks to insurance. According to Food and Agriculture Organization (2011), women might increase agricultural productivity by 20% to 30% if they had the same access to financial services and other productive resources as

men, they could enhance farm output by 20% to 30% (FAO, 2011; Duflo, 2012; Manfre & Nordehn, 2013; Delavallade *et al.*, 2015; Klapper *et al.*, 2016).

The fast growth of FinTech, which has a significant influence on China's pay distribution, is accelerated by information and communication technology. Guo *et al.* (2021) used data from the Chinese General Social Survey and the Index of Digital Financial Inclusion to examine the impact of FinTech on the gender wage gap. They discovered that FinTech:

- reduces gender wage;
- decreases operational costs and capital restrictions to encourage female entrepreneurship, increase the number of women working, and provide women more negotiating power in the home and higher salaries;
- positively affects the salaries of women (and men) with less affluent families and assists women (but not men) in reducing the risk of pay loss brought on by pregnancy and caring obligations resulting from the two-child policy (Guo *et al.*, 2021).

Their findings have significant policy ramifications and show how women's better economic circumstances have resulted in the gender pay gap shrinking (Guo *et al.*, 2021).

The majority of research discovered that FinTech might reduce income inequality by fostering financial inclusion and helping to open up new employment and income-generating options for the underprivileged. Regarding cross-country research, Asongu and Nwachukwu (2018) came to the conclusion that only upper-middle income nations see a substantial and negative correlation between the usage of mobile phones for bill payment and money transfers. In a more recent study, Chinoda *et al.* (2021), who examined how monetary technology, financial inclusion, along with income disparity interacted in a group of twenty-five African nations between the years of 2011, 2014, and 2017, came across a realization that financial inclusion impacts the relationship between financial technology and income disparity, playing an essential part in lowering income inequality in Africa. Last but not least, Demir *et al.* (2022) revealed that whereas FinTech significantly reduces inequality at all quantiles across the disparity distribution, these benefits are primarily associated to higher-income countries (Asongu & Nwachukwu, 2018; Chinoda & Mashamba, 2021; Demir *et al.*, 2022; Loko & Yang, 2022).

The advantages of FinTech could be more significant when viewed through the prism of gender. Populations that have experienced being disproportionately excluded from the traditional banking system can gain from FinTech by leveraging digital financial instruments to broaden access to and consumption of financial services. Over a billion women still not make use of or have access to the financial system, according to the World Bank Group's recently released Global Findex study, and more than 70% of small and medium-sized enterprises owned and operated by women have little or no exposure to

financial services and products. The growth of FinTech services provides the potential to improve convenience for the formerly unbanked or economically disadvantaged female population, privacy, and security (Demirguc-Kunt *et al.*, 2018; Sahay *et al.*, 2020; Loko & Yang, 2022).

Access to funding may be made easier by FinTech, particularly for homes and companies run by women. There is an estimated \$300 billion financing gap for formal, female-owned smaller businesses worldwide. Without this access, women find it difficult to earn money, save money, move their families out of poverty, and grow their own businesses. Many "big data, small credit" FinTech-based platforms can encourage women to start their own businesses and achieve financial independence by concentrating on small and medium-sized enterprises, lowering loan rates, and relaxing collateral requirements (Sahay *et al.*, 2015; IFC, 2022; Loko & Yang, 2022).

FinTech can help determine someone's creditworthiness more precisely, especially for people who might have been previously neglected by the traditional financial system due to an absence of or a very little credit history. FinTech assists loan providers in making lending choices without using credit reports or scores using supplemental information, for instance data provided by and about customers on digital platforms. These novel methods to evaluate credit risk as well as model creditworthiness might be advantageous to numerous of the female borrowers, who frequently lack credit records and scores (Loko & Yang, 2022).

The major goal of Loko & Yang's study from 2022 was to determine whether FinTech had an a comparable beneficial impact on gender disparity as assessed by female employment. They used a fixed-effects identification approach and a multiple country FinTech database that involves 114 nations to provide an answer to this issue. They demonstrated how the growth of FinTech significantly enhances the wellbeing of women. It not only boosts the number of female workers in the workplace, but also increases the proportion of female as opposed to male employees. According to their first findings, FinTech might increase female employment and lessen gender disparity. More precisely, a 1% rise in FinTech adoption is associated with a 1.4 percentage point rise in female employment plus an increase of 0.4% in the ratio of female employees to all workers in the investigated firms. Given that the average ratio of female employees in the sample is just 32%, the economic relevance is significant. Their research also illuminates the underlying economic dynamics, showing that FinTech makes it simpler for businesses with little resources, particularly those run by women, small businesses, and businesses in service industries, to obtain capital. Finally, they discovered that the beneficial effects of FinTech are diminished by weak institutions. In nations with excellent institutional quality, laws, and regulations, FinTech may significantly increase women's employment, but its advantages are less clear in countries with a level of institutional quality which falls below the average globally. These findings show that the percentage of female workers is positively impacted by

FinTech in developed and rising markets, while in low-income nations, the impact is negligible or even negative. The impact of FinTech is beneficial at the regional level in Sub-Saharan African, Pacific and Asian, and European nations, negligible in the Caribbean and Latin American sample, and adverse in Middle Eastern and North African nations (Loko & Yang, 2022).

4.4. Affordable and clean energy, Climate action and FinTech

The relevance of sustainable finance, and particularly at the business, political, and international levels, climate-related money has increased recently. Nevertheless, for the Paris Agreement to be successfully implemented and the Sustainable Development Goals (SDGs) to be achieved, enormous expenditures of at least \$3 trillion annually—of which \$1.4 trillion would go to developing countries—are required. Making such large investments would help to achieve the Paris Agreement's main objective of keeping global average temperature increases to 2°C (Schmidt-Traub & Shah, 2015; Puschmann *et al.*, 2022).

The phrase "green finance" refers to financial activity that prioritizes protecting the environment. It is sometimes referred to as "environmental finance" or "sustainable finance". It establishes a link between the financial sector and environmental preservation. As an innovative form of finance that addresses the demand for environmental preservation, green finance refers to financial instruments made for fostering, encouraging, and bolstering productive and long-lasting activities that have environmental impacts. It is dedicated to promoting a coordinated economic society and finding solutions to issues like environmental degradation and the greenhouse effect. For banks, the term "green finance" describes financial products and services that evaluate environmental factors before making a loan decision, as well as during post-monitoring and management of risks. It promotes environmentally friendly investment and jumpstarts low-carbon technology, projects, businesses, and enterprises (Salazar, 1998; Cen & He, 2018).

FinTech not only advances green funding and sustainable development but also redefines financial services and pricing methods. FinTech promotes sustainable development and protects the environment, at least in some of the following ways: by ensuring green finance, reducing costs and informational inequities, promoting efficiency, appreciating the value of nature's assets, and promoting realistic sustainable lifestyles (Cen & He, 2018).

The United Nations Task Force on Digital Financing of the Sustainable Development Goals along with numerous startups specializing in fields like robo-advisors for environmentally friendly expenditures, payment tokens to be used for peer-to-peer power associations, and blockchain technologies for environmentally conscious supply chains are just a few of the organizations and initiatives that are developing at the crossroads of FinTech and environmental issues. These so-called "green FinTech" products are a growing industry that strive to lessen the risks posed by climate change. Policymakers,

particularly those in underdeveloped and emerging countries, should consider these products as they work to carry out the Paris Agreement and promote the achievement of the SDGs. All key players in the value chain, such as customers, financial institutions, insurance providers, alternatives to banks (new businesses, large tech firms), (technology) suppliers, legislators, etc., are connected via green FinTech. Therefore, green FinTech is focused on emerging trends in the FinTech field that are associated with protecting the environment and impacts of climate change. Green FinTech solutions have impact on Affordable and Clean Energy (SDG 7), Sustainable Cities and Communities (SDG 11), Responsible Consumption and Production (SDG 12), Climate Action (SDG 13), Life Below Water (SDG 14), Life on Land (SDG 15), and Partnerships for the Goals (SDG 17) (Puschmann *et al.*, 2022).

According to Nassiry (2019), there are three main areas where FinTech might be used in green finance:

- Blockchain applications which support environmentally friendly development;
- Blockchain applications for sustainable energy, a decentralized power marketplace, carbon offsets and financing to combat global warming;
- Blockchain financial inventiveness, including green bonds (Nassiry, 2019).

Bayram *et al.* (2022) concluded that innovative technologies that include Big Data, Artificial Intelligence, as well as blockchain can collect information on the consequences of climate change from a variety of sources and combine it with the most recent data in Turkey's FinTech system, such as insurance databases, to assist in risk assessment and management for loans for environmentally friendly projects and lay the groundwork for a national emissions trading system. By complying with impending international laws like the carbon border adjustment mechanism, such solutions might assist the banking system advance its efforts to increase loans for sustainable energy and other projects (Bayram *et al.*, 2022).

According to Castilla-Rubio *et al.* (2016), to be able to achieve climate objectives, the worldwide financial system must be reset, with FinTechs serving as the primary disruptor. Green investing options are becoming more widely available to the general public thanks to financial technologies like crowdfunding, robo-advisors, and blockchain. To put it briefly, removing barriers to the mobilization of green money may be possible with the help of robo-advisors, crowdfunding, and blockchain technology. They make it easier to access new financial resources, particularly those provided by private investors. The mobilization of resources is additionally facilitated through providing distributed systems, avoiding conventional intermediaries like banks or other financial organizations, thereby reducing costs and inefficiencies. Additionally, effective monitoring, reporting, and validation are made possible by blockchain technology (Castilla-Rubio *et al.*, 2016; Dorfleitner & Braun, 2019).

Livingston *et al.* (2018) have discussed a variety of possible blockchain uses for electricity supply systems, which includes peer-to-peer as well as grid transactions, energy finance, sustainability attribution, electrical cars, and a number of other applications like smart appliances. Carbon credits, climate financing, peer-to-peer energy operations and decentralized energy systems are a few examples of blockchain uses that support sustainable energy (Livingston *et al.*, 2018; Nassiry, 2019).

The effectiveness of carbon trading systems might be increased in a number of ways, according to Marke's (2018) research, including by demonstrating improved methods for transferring or trading carbon credits along with suggesting a global network of carbon markets utilizing blockchain technology, in addition to speeding up global climate financing transfers and improving peer-to-peer renewable energy transactions (Marke, 2018).

5. FINTECH IN BOSNIA AND HERZEGOVINA

Although the finance technology (FinTech) sector in Bosnia and Herzegovina is still growing, there are multiple FinTech tools that could be helpful in achieving the Sustainable Development Goals (SDGs).

A large number of FinTech tools that are available on the world market are also available in Bosnia and Herzegovina. The intensity of their use is increasing every day. In addition to world-famous tools that are also used on the domestic market, start-up companies that develop their own FinTech solutions are also appearing in Bosnia and Herzegovina. One of such companies is RokPay with headquarters in Zenica. RokPay offers solutions for online shopping with deferred payment (RokPay, 2023). It is important to note that this company cooperates with domestic brands. RokPay and similar start-ups promote sustainable and fair business of domestic brands, which promote the significance of women's participation in business, use raw materials from sustainable sources and integrate Sustainable Development Goals into their business.

The promotion of financial inclusion, that falls in accordance with several SDGs, may be aided by FinTech technologies like mobile banking applications and digital payment systems. FinTech solutions make it possible for underserved people, especially those living in rural regions, to access banking services, electronic wallets, and internet-based lending platforms (Klapper *et al.*, 2016). In Bosnia and Herzegovina, several banks have created their own applications for mobile banking. Customers may use these applications to carry out a variety of banking tasks on their mobile devices, including monitoring account balances, transferring money, paying bills, and accessing transaction history. In Bosnia and Herzegovina, there are a variety of digital payment options that allow customers to send money online, make payments in-person, and carry out peer-to-peer transactions. Some

examples include applications like Intesa Sanpaolo's online banking platform, m-plati, as well as kviko a mobile payment solution offered by ASA bank. Digital wallets are slowly gaining popularity in our country, enabling users to save and manage their bank cards and credit cards, and perform contactless payments via their smartphones. Service providers such as mWallet and Addiko Mobile Wallet allow practical and safe payment options for users.

The following SDGs, SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-Being), SDG 4 (Quality Education), and SDG 13 (Climate Action), may all be supported through the usage of crowdfunding platforms. Individuals and groups can collect money for sustainable agriculture, healthcare initiatives, educational programs, or environmental projects using FinTech-enabled crowdfunding. In Bosnia and Herzegovina, crowdfunding websites have also developed, giving people and organizations an opportunity to raise money for their initiatives. Campaigns for crowdfunding are facilitated by platforms like GoGetFunding, GoFundMe, and Pomozi.ba.

6. DISCUSSION

FinTech, or financial technology, stands for the application of technology to the provision of novel financial options and products. There are multiple essential FinTech tools that have increased in prominence in the past few years, each of which has benefits as well as drawbacks.

The phrase "FinTech regulatives" describes the rules and regulations that govern how FinTech companies and services are run. Regulations for the financial technology (FinTech) industry can vary by country and jurisdiction. These policies have been implemented by governmental organizations and regulatory agencies to protect consumers, preserve financial stability, stimulate creative thinking, prevent illicit financing and fraud, and reduce risks in the FinTech business.

For legal operation, FinTech businesses may be obligated to secure particular licenses or registrations. These licenses may differ based on the kind of financial services offered, for instance payment services, online banking, or investment advising. The licensing process is overseen by regulatory agencies, who also establish criteria for licensing, including capital requirements, compliance protocols, and appropriate tests for essential employees. Regulations concerning payment services intend to ensure the safety and effectiveness of payment processes. FinTech companies that provide payment services must abide by laws in various nations, including the Payment Services Directive (PSD2) in the European Union. Regulations for cross-border operations are necessary since FinTech businesses frequently operate across borders. In order to assure compliance and reduce the risks related to conducting business internationally, these rules may involve licensing requirements, safeguarding data, cross-border data flows, and collaboration between

regulatory bodies across jurisdictions (Donnelly, 2016; Romānova *et al.*, 2018; Stamegna & Karakas, 2019).

FinTech regulations prioritize protecting the interests of consumers. They could demand transparency in the costs, conditions, and terms of financial goods and services. Regulations also address data privacy and security in order to safeguard both financial and personal data. Regulations may also provide procedures for managing consumer complaints as well as procedures for resolving disputes. FinTech businesses deal with private and sensitive financial data. As a result, they must abide by legislation regulating the security and confidentiality of data, among them the General Data Protection Regulation (GDPR) of the European Union. FinTech rules frequently contain cybersecurity standards to guard against cyber attacks and data breaches as a result of their dependence on digital technology. To reduce risks and guarantee the integrity and confidentiality of consumer data, FinTech businesses may be obliged to establish robust security measures, carry out regular audits, and have incident response plans (Stamegna & Karakas, 2019; Pathak *et al.*, 2022).

FinTech regulations often require organizations to establish rigorous Anti-Money Laundering (AML) processes to prevent money laundering, terrorist funding, and other illegal actions. These regulations could require customer due diligence, oversight of transactions, and the reporting of suspicious behaviors to the relevant authorities (Faccia *et al.*, 2020).

A brief representation of FinTech Regulatives in EU can be seen in *Table 4*.

Table 3. FinTech Regulatives in EU

REGULATIVE	BRIEF DESCRIPTION	SOURCE
Payment Services Directive II (PSD II)	Payment Services Directive II went into effect in response to the payments sector's technological advancements. It provides a practical method for controlling online payments.	Payment Services Directive II Donnelly, 2016 Romānova <i>et al.</i> , 2018 Stamegna & Karakas, 2019
General Data Protection Regulation (GDPR)	The General Data Protection Regulation addresses how to secure people's privacy when processing their personal data and moving that data freely.	General Data Protection Regulation Stamegna & Karakas (2019) Pathak <i>et al.</i> (2022)
Anti-Money Laundering Directive	Anti-Money Laundering Directive governs efforts to stop both the laundering of money and the financing of terrorism.	Anti-Money Laundering Directive Faccia <i>et al.</i> (2020)

Markets in Financial Instruments Directive II (MiFID II)	Markets in Financial Instruments Directive II regulates algorithmic trades, best execution, client categorization reviews, top management duties, extraterritorial regulations governing the influence of other countries, and trading requirements for derivative investments and securities, transparency, as well as transaction reporting.	Markets in Financial Instruments Directive II Sheridan (2017)
Electronic Money Directive (Directive 2009/110/EC)	Directive 2009/110/EC serves as a regulatory structure that governs the use of digital currency in the EU member states.	Electronic Money Directive (Directive 2009/110/EC)

Source: Author's creation

Protecting financial stability and lowering systematic risks is one of the key objectives of FinTech legislation. Regulatory bodies may monitor the impact of FinTech operations on the overall financial system and impose specific prudential requirements, which include capital adequacy ratios, stress testing, and risk management frameworks, especially for FinTech companies that engage in lending, investment management, or online banking. To preserve financial stability and reduce risks, some FinTech companies, especially those engaged in lending or investing operations, can be subject to capital requirements. Regulators can monitor FinTech businesses as they test their cutting-edge goods and services in controlled environments known as regulatory sandboxes, which have been established in several jurisdictions. This enables experimentation while minimizing dangers (Chen, 2020; Everhart, 2020; Sanction Scanner, 2020; Kunhibava & Muneeza, 2021; Schilirò, 2021).

It is crucial to remember that FinTech legislation might differ greatly between nations and regions. Each jurisdiction may employ a distinct regulatory strategy, with some establishing FinTech-friendly regulatory sandboxes or innovation centers to promote innovation as well as regulatory compliance for startups and emerging technologies. FinTech businesses should collaborate closely with law and compliance specialists in order to understand the regulatory environment and ensure that they comply with applicable rules in the regions where they operate.

In order to perform quick and safe transactions using their cellphones, customers may utilize mobile payment applications like PayPal, Venmo, and Apple Pay. These services are straightforward and simple to use. They frequently interact with other financial services, including budgeting applications, and offer features like dividing expenses and sending/receiving money among friends and family. Although mobile payment applications have many advantages and make everyday life easier, there are also

disadvantages that must be acknowledged. Not all shops will accept all mobile payment applications, and some might charge fees for certain purchases. Additionally, compatibility problems across various operating systems or platforms may be experienced by customers. In the event that the user's device is compromised, there may also be security issues (Chiu, 2017; Agarwal & Zhang, 2020).

P2P lending platforms, such as LendingClub and Prosper, link lenders and borrowers directly, cutting out traditional intermediaries. They could reward borrowers with reduced interest rates and lenders with larger profits. P2P lending can be an option for people or enterprises that have limited access to conventional loans and can streamline the application procedure and accelerate the access to funds. Despite the all advantages provided by P2P lending platforms, it is essential to comprehend the possible risks that they carry with them. P2P lending is riskier than traditional lending since there is less regulatory control than with traditional lending institutions, and borrowers may be less creditworthy. Defaults and investment losses are also possible. Furthermore, different jurisdictions may have different P2P lending laws and regulations. It's crucial to explain both the advantages and disadvantages of crowdfunding when talking about P2P lending services. Crowdfunding offers an alternative to conventional financing options that include bank loans as well as venture capital. It enables people and organizations to raise money from a wide range of supporters, possibly reaching a broader audience. Launching a crowdfunding initiative may be useful as a market verification tool. If an initiative gains substantial backing and funding, it demonstrates that there is interest for the good or idea, that can be attractive to investors as well as potential partners. Along with supporters, this may also draw media interest and potential economic prospects. However, even with a carefully designed campaign, there is always a risk of failing to meet the funding goal. It is worth noting that crowdfunding initiatives depend on the collective desire of many people rather than on the investment value of the project. In such circumstances, it's possible that the project won't receive sufficient financing, and the invested time and effort may be lost. It is important to emphasize that during the crowdfunding campaign, disclosing specifics about the idea puts it at risk of intellectual property infringement or theft (Chen *et al.*, 2019; An *et al.*, 2021; Boeddu *et al.*, 2021).

Blockchain technology delivers a decentralized and safe ledger used for money transfers, decreasing the need for middlemen. Cryptocurrencies like Ethereum and the digital currency Bitcoin are only two examples that may enable quicker, less expensive, and borderless transactions. They can also be used as assets for investments. Cryptocurrencies based on blockchain are used for portfolio diversification. However it's crucial to be informed of the drawbacks of blockchain technology. Cryptocurrencies do, in reality, face market volatility, regulatory uncertainty, and security threats including hacking and frauds. Furthermore, there may be issues with the energy efficiency and scalability of blockchain networks (Nakamoto, 2008; Nasir *et al.*, 2021; Khalid *et al.*, 2023).

Robo-advisors, including Betterment and Vanguard Digital Advisor, employ algorithms as well as user preferences to offer automated financial guidance and portfolio management. In contrast to conventional financial advisers, they provide cheaper fees, allow access to lesser investment amounts, and do automatic rebalancing. Even though robo-advisory is gradually taking the place of the traditional retail customer counseling process, robot advisers lack the individualized attention of their human counterparts. They might not be able to take into account complicated financial situations or individual aspirations, and relying too much on algorithms might result in poor investing choices under particular market conditions. Robo-advisors' capacity to adjust to major market fluctuations or unforeseen occurrences is limited. Given that Robo-Advisors automatically rebalance investment portfolios, the question arises whether they behave with the most beneficial interest of the client all the time. It is important to emphasize that numerous legal issues and worries rise when talking about robo-advising. Due to the character of the relationship between the user and the machine and it is still uncertain how regulators ought to handle this field (Sironi, 2016; Jung *et al.*, 2019; Maume, 2019).

Artificial intelligence (AI) and Internet of Things (IoT) have an ability to automate procedures, swiftly analyze massive amounts of data, and carry out operations with accuracy, improving operational efficiency for financial organizations. By lowering the quantity of data required, they can expedite and enhance the precision of monetary transactions and services, manual labor required, streamlining workflows, and eliminating human error. From analyzing to funding to production, artificial intelligence (AI) must be viewed as enhanced intelligence that supports all of us in making better financial decisions. The data analyst's tools are replacing the actuary's conventional ones because they can gather real time data on a person's health, routines, exercise, preferences, nutrition, drug use, genetics, and other factors in a matter of minutes. This provides a picture that is much more detailed and precise than even the most experienced actuary could have predicted. AI systems may identify trends, abnormalities, and probable fraud in real-time, improving risk assessment as well as fraud detection techniques. This makes it possible for financial institutions to identify and reduce risks, protecting the assets of their clients and enhancing general security. AI algorithms depend extensively on the precision and quality of the data they analyze. Incomplete, biased or poor-quality input data can result in inaccurate forecasts, poor judgment, and negative effects on financial services. To ensure the reliability of AI and IoT applications, high-quality data must be retained. To guarantee ethical and responsible application of AI as well as IoT in the finance industry, laws and regulations must keep up with technical breakthroughs. Despite the fact that IoT and AI have many advantages, relying too much on them might have disadvantages. Service outages or money losses may result from technical issues, system malfunctions, or connection issues. Financial institutions must keep solid backup plans and emergency preparations in place to handle any potential technological issues (Schulte & Liu, 2017; Bhat *et al.*, 2023).

It's crucial to remember that while FinTech products have many advantages, they also have downsides and hazards. Before implementing these technologies, users should weigh their advantages and downsides depending on their unique requirements and circumstances. We need to be aware that FinTech offers useful tools and it is up to us to utilize them properly to accomplish our objectives, and it is the responsibility of us to integrate Sustainable Development Goals into our lives and business operations. FinTech tools are capable of playing a crucial part in achieving the Sustainable Development Goals (SDGs) of the United Nations by using creative approaches to deal with a variety of social and environmental challenges.

FinTech makes it possible for underserved groups, including those who are unbanked and underbanked, to receive financial services. Financial services like savings accounts, loans, and insurance can also be made accessible through online payment platforms, mobile banking, as well as microfinance apps, promoting financial empowerment and lowering poverty and inequality, which has an impact on the following SDGs, SDG 1, SDG 8 and SDG 10. The costs and inefficiencies related to money transfers and cross-border transactions can be decreased by using FinTech technologies like digital wallets and blockchain-based platforms. FinTech promotes financial inclusion, poverty reduction, and the growth of the economy in emerging nations by simplifying procedures and eliminating traditional intermediaries (Agur *et al.*, 2020; Demir *et al.*, 2022).

FinTech technologies like robo-advisors and crowdfunding platforms may encourage sustainable investing by providing chances to invest in green initiatives, renewable energy, and socially conscious companies. This can help raise money for sustainable development while addressing infrastructure limitations and climate change. By establishing connections between investors and green projects and allowing carbon trading and offset procedures, FinTech platforms may help finance climate action. Blockchain technology may provide openness and traceability in climate finance, supporting responsibility and sustainable behaviors. FinTech tools have ability to enhance sustainable investments and aid in the accomplishment of SDGs 7, 9, 12, and 13. FinTech innovations can increase access to reasonably priced insurance products, especially in disadvantaged areas. By utilizing technology like blockchain and artificial intelligence, insurance operations can potentially be made more cost-effective while improving risk management for people and organizations affected by natural catastrophes or health crises, which has impact on SDG 3 and SDG 13 (Klapper *et al.*, 2016; Bayram *et al.*, 2022; Puschmann *et al.*, 2022; Bhat *et al.*, 2023).

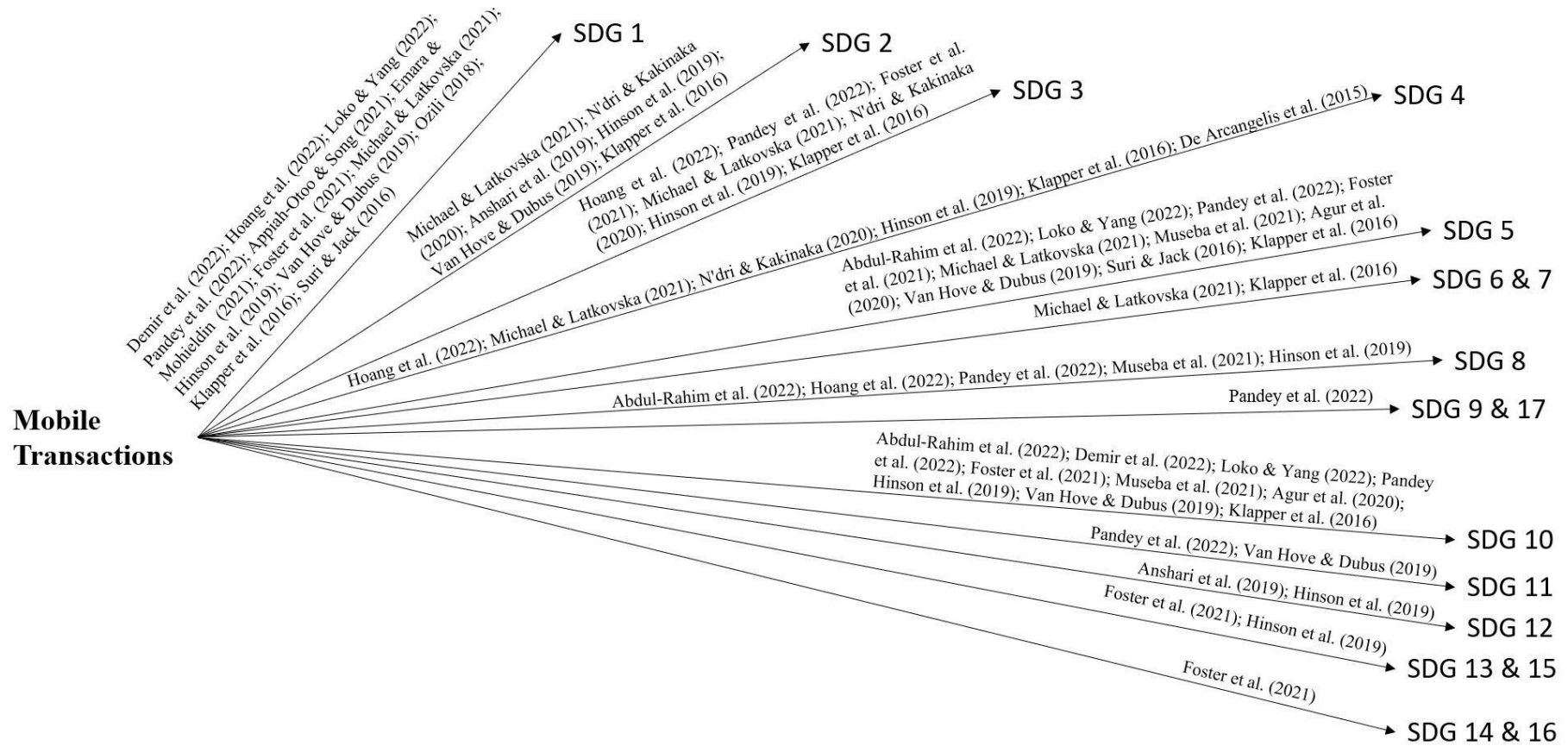
FinTech embraces big data along with sophisticated algorithms in order to deliver data on trends in society and the economy. FinTech technologies may provide policymakers and organizations with information by examining financial transactions, consumer behavior, and market dynamics, enabling decision-making based on evidence and effective distribution of resources for sustainable development. The broad utilization of big data

technologies should serve as the new paradigm for eradicating poverty and boosting its effectiveness. The challenges of faulty data and inaccurate data in the current work on poverty alleviation may be successfully handled by big data focused on poverty elimination cloud system, which may additionally effectively raise the effectiveness of targeted poverty alleviation activities (Gaye *et al.*, 2021; Gao *et al.*, 2022).

In order to promote equality between the sexes (SDG 5), monetary services are essential in assisting women in claiming their financial independence. Digital financial services also assist women-owned enterprises by cutting administrative and disbursement expenses and lowering theft risks. FinTech platforms may support microfinance, enabling small-scale businesses and individuals to acquire loans and funding for their business ventures or personal needs. FinTech can help determine someone's creditworthiness more precisely, especially for people who might have been previously neglected by the traditional financial system due to a lack of or a very little credit history. By offering alternative sources of money, crowdfunding platforms may help strengthen marginalized groups which include women and young people (Malhotra *et al.*, 2012; Wattoo *et al.*, 2015; Klapper *et al.*, 2016; Loko & Yang, 2022).

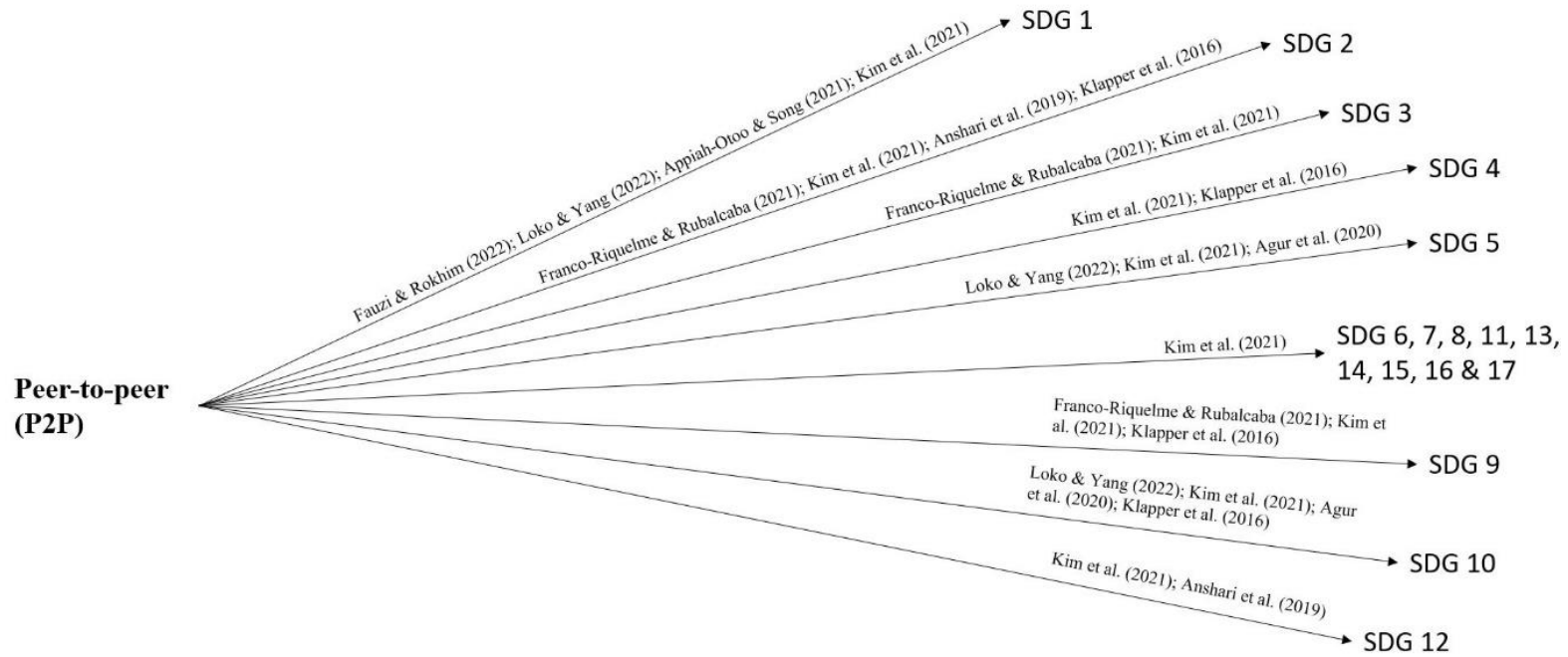
An overview of the significance of FinTech tools for accomplishing the SDGs is given in *Figures 20 to 24* and *Table 4* along with the references of the analyzed scientific works.

Figure 20. Mobile transactions in achieving SDGs



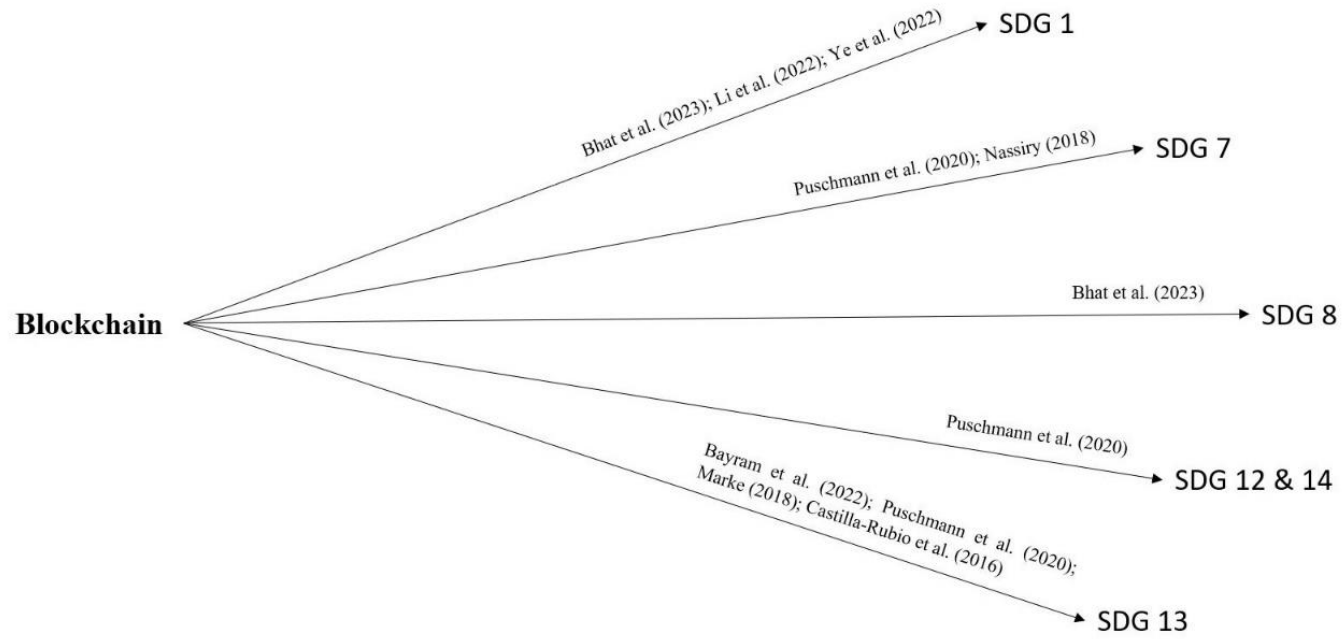
Source: Author's creation

Figure 21. Peer-to-peer (P2P) in achieving SDGs



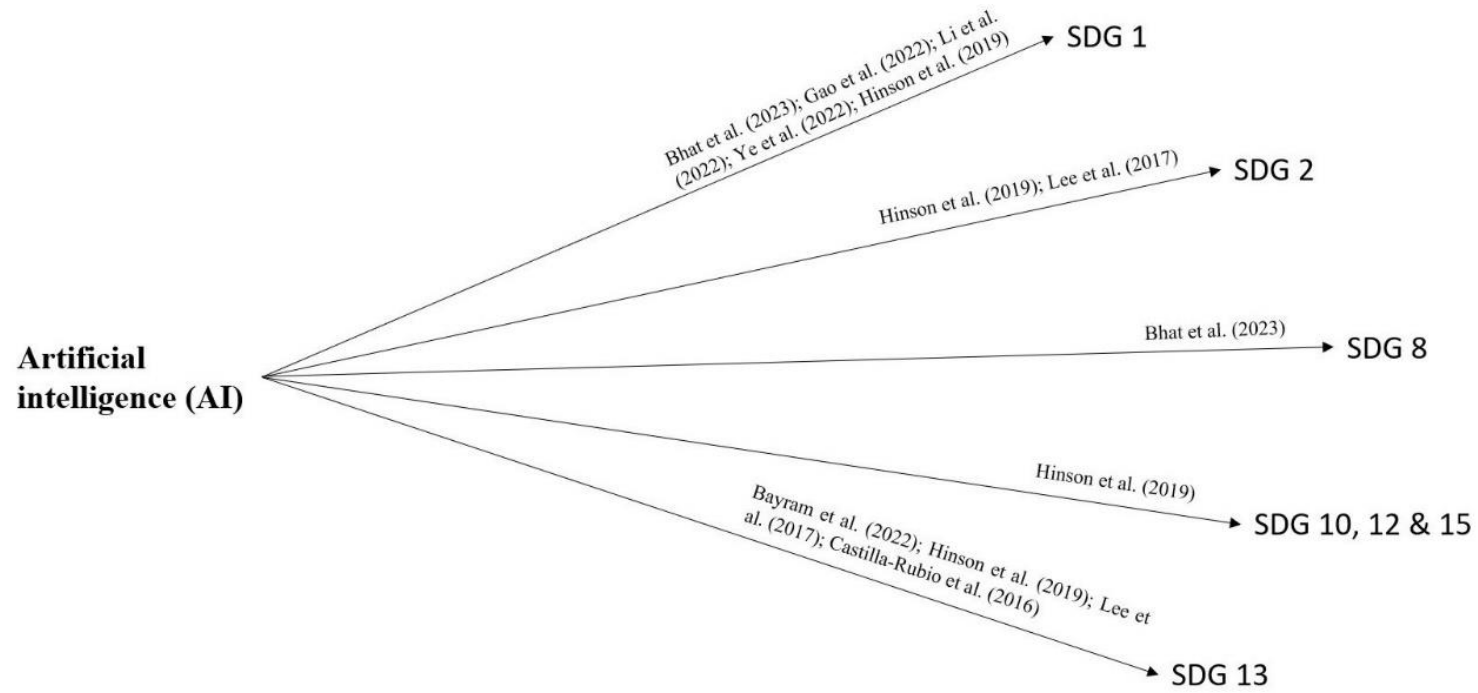
Source: Author's creation

Figure 22. Blockchain in achieving SDGs



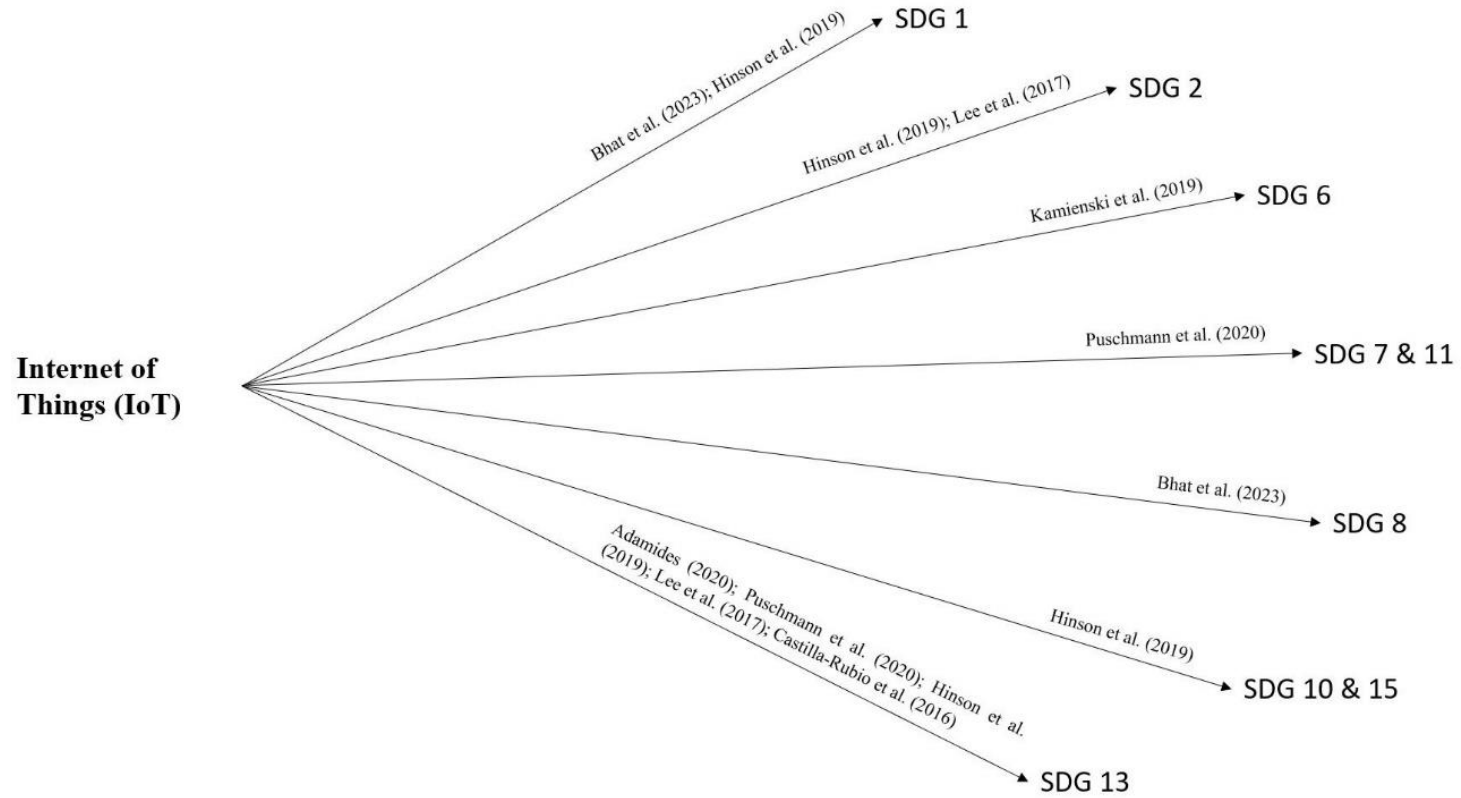
Source: Author's creation

Figure 23. Artificial intelligence (AI) in achieving SDGs



Source: Author's creation

Figure 24. Internet of Things (IoT) in achieving SDGs



Source: Author's creation

Table 4. FinTech tools in achieving SDGs

SDG 1		SDG 2		SDG 3	
Mobile Transactions	Peer-to-peer (P2P)	Mobile Transactions		Mobile Transactions	
Demir et al. (2022)	Fauzi & Rokhim (2022)	Michael & Latkovska (2021)		Hoang et al. (2022)	
Hoang et al. (2022)	Loko & Yang (2022)	N'dri & Kakinaka (2020)		Pandey et al. (2022)	
Loko & Yang (2022)	Appiah-Otoo & Song (2021)	Anshari et al. (2019)		Foster et al. (2021)	
Pandey et al. (2022)	Kim et al. (2021)	Hinson et al. (2019)		Michael & Latkovska (2021)	
Appiah-Otoo & Song (2021)	Blockchain	Van Hove & Dubus (2019)		N'dri & Kakinaka (2020)	
Emara & Mohieldin (2021)	Bhat et al. (2023)	Klapper et al. (2016)		Hinson et al. (2019)	
Foster et al. (2021)	Li et al. (2022)	Peer-to-peer (P2P)		Klapper et al. (2016)	
Michael & Latkovska (2021)	Ye et al. (2022)	Franco-Riquelme & Rubalcaba (2021)		Peer-to-peer (P2P)	
Hinson et al. (2019)	Artificial intelligence (AI)	Kim et al. (2021)		Franco-Riquelme & Rubalcaba (2021)	
Van Hove & Dubus (2019)	Bhat et al. (2023)	Anshari et al. (2019)		Kim et al. (2021)	
Ozili (2018)	Gao et al. (2022)	Klapper et al. (2016)			
Klapper et al. (2016)	Li et al. (2022)	Artificial intelligence (AI)			
Suri & Jack (2016)	Ye et al. (2022)	Hinson et al. (2019)			
	Hinson et al. (2019)	Lee et al. (2017)			
	Internet of Things (IoT)	Internet of Things (IoT)			
	Bhat et al. (2023)	Hinson et al. (2019)			
	Hinson et al. (2019)	Lee et al. (2017)			

Source: Author's creation

Continuation of Table 4

SDG 4	SDG 5	SDG 6	SDG 7
Mobile Transactions	Mobile Transactions	Mobile Transactions	Mobile Transactions
Hoang et al. (2022)	Abdul-Rahim et al. (2022)	Michael & Latkovska (2021)	Michael & Latkovska (2021)
Michael & Latkovska (2021)	Loko & Yang (2022)	Klapper et al. (2016)	Klapper et al. (2016)
N'dri & Kakinaka (2020)	Pandey et al. (2022)	Peer-to-peer (P2P)	Peer-to-peer (P2P)
Hinson et al. (2019)	Foster et al. (2021)	Kim et al. (2021)	Kim et al. (2021)
Klapper et al. (2016)	Michael & Latkovska (2021)	Internet of Things (IoT)	Blockchain
De Arcangelis et al. (2015)	Museba et al. (2021)	Kamienski et al. (2019)	Puschmann et al. (2020)
Peer-to-peer (P2P)	Agur et al. (2020)		Nassiry (2018)
Kim et al. (2021)	Van Hove & Dubus (2019)		Internet of Things (IoT)
Klapper et al. (2016)	Suri & Jack (2016)		Puschmann et al. (2020)
	Klapper et al. (2016)		
	Peer-to-peer (P2P)		
	Loko & Yang (2022)		
	Kim et al. (2021)		
	Agur et al. (2020)		

Source: Author's creation

Continuation of Table 4

SDG 8	SDG 9	SDG 10	SDG 11
Mobile Transactions	Mobile Transactions	Mobile Transactions	Mobile Transactions
Abdul-Rahim et al. (2022)	Pandey et al. (2022)	Abdul-Rahim et al. (2022)	Pandey et al. (2022)
Hoang et al. (2022)	Peer-to-peer (P2P)	Demir et al. (2022)	Van Hove & Dubus (2019)
Pandey et al. (2022)	Franco-Riquelme & Rubalcaba (2021)	Loko & Yang (2022)	Peer-to-peer (P2P)
Museba et al. (2021)	Kim et al. (2021)	Pandey et al. (2022)	Kim et al. (2021)
Hinson et al. (2019)	Klapper et al. (2016)	Foster et al. (2021)	Internet of Things (IoT)
Peer-to-peer (P2P)		Museba et al. (2021)	Puschmann et al. (2020)
Kim et al. (2021)		Agur et al. (2020)	
Blockchain		Hinson et al. (2019)	
Bhat et al. (2023)		Van Hove & Dubus (2019)	
Artificial intelligence (AI)		Klapper et al. (2016)	
Bhat et al. (2023)		Peer-to-peer (P2P)	
Internet of Things (IoT)		Loko & Yang (2022)	
Bhat et al. (2023)		Kim et al. (2021)	
		Agur et al. (2020)	
		Klapper et al. (2016)	
		Artificial intelligence (AI)	
		Hinson et al. (2019)	
		Internet of Things (IoT)	
		Hinson et al. (2019)	

Source: Author's creation

Continuation of Table 4

SDG 12	SDG 13	
Mobile Transactions	Mobile Transactions	Internet of Things (IoT)
Anshari et al. (2019)	Foster et al. (2021)	Adamides (2020)
Hinson et al. (2019)	Hinson et al. (2019)	Puschmann et al. (2020)
Peer-to-peer (P2P)	Peer-to-peer (P2P)	Hinson et al. (2019)
Kim et al. (2021)	Kim et al. (2021)	Lee et al. (2017)
Anshari et al. (2019)	Blockchain	Castilla-Rubio et al. (2016)
Blockchain	Bayram et al. (2022)	
Puschmann et al. (2020)	Puschmann et al. (2020)	
Artificial intelligence (AI)	Marke (2018)	
Hinson et al. (2019)	Castilla-Rubio et al. (2016)	
Internet of Things (IoT)	Artificial intelligence (AI)	
Hinson et al. (2019)	Bayram et al. (2022)	
Kamienski et al. (2019)	Hinson et al. (2019)	
	Lee et al. (2017)	
	Castilla-Rubio et al. (2016)	

Source: Author's creation

Continuation of Table 4

SDG 14	SDG 15	SDG 16	SDG 17
Mobile Transactions	Mobile Transactions	Mobile Transactions	Mobile Transactions
Foster et al. (2021)	Foster et al. (2021)	Foster et al. (2021)	Pandey et al. (2022)
Peer-to-peer (P2P)	Hinson et al. (2019)	Peer-to-peer (P2P)	Peer-to-peer (P2P)
Kim et al. (2021)	Peer-to-peer (P2P)	Kim et al. (2021)	Kim et al. (2021)
Blockchain	Kim et al. (2021)		
Puschmann et al. (2020)	Artificial intelligence (AI)		
	Hinson et al. (2019)		
	Internet of Things (IoT)		
	Hinson et al. (2019)		

Source: Author's creation

While Financial Technology (FinTech) has the ability to significantly contribute to the Sustainable Development Goals' (SDGs) accomplishment through innovative financial solutions, it also encounters certain limitations that need to be mentioned.

FinTech solutions rely heavily on internet access and infrastructure. One of the potential risks that FinTech brings with it is putting additional pressure on the poor due to the digital divide and the inability to access the services that FinTech offers. The advantages of FinTech may not reach vulnerable groups in areas with poor internet connection or restricted access to technology, escalating already-existing disparities. FinTech still has difficulties providing universal access, despite its potential to increase financial inclusion by addressing underserved and unbanked communities. Vulnerable groups, such as those in distant locations or with poor socioeconomic status, may not be able to fully benefit from FinTech solutions as a result of limited access to technology, the internet connectivity, and digital literacy. This could worsen current disparities and impede steps toward inclusive development. FinTech might, unfortunately, make current disparities worse. People who have inadequate access to technology, especially those who live in rural areas or low-income communities, might encounter obstacles in benefiting from FinTech services. This can widen the digital gap, further marginalize vulnerable groups, and obstruct the achievement of SDGs (Emara & Mohieldin, 2021; Bahous, 2023).

Concerns about data privacy and security have grown in response to the greater utilization of technology in financial transactions and data management. Risks include unlawful access to personal and financial information, identity theft, data breaches, and cybersecurity concerns. These problems might undermine the general trust in FinTech solutions and discourage adoption if they are not resolved adequately. Trust in FinTech solutions can be weakened by worries about data safety, privacy breaches, and fraudulent activity, particularly in places with weak cybersecurity laws and regulations. For FinTech to flourish sustainably, it is crucial to implement strong cybersecurity safeguards and protect sensitive user data (Ng & Kwok, 2017; Stamegna & Karakas, 2019; Kaur *et al.*, 2021; Pathak *et al.*, 2022).

FinTech acts in a challenging regulatory environment, and laws and regulations may struggle to keep pace with innovations in technology. This may lead to uncertainty and barriers that hinder the implementation and expansion of FinTech solutions, especially in areas related to digital identity authentication, international transactions, as well as data privacy. Additionally, laws intended to safeguard consumers and maintain financial stability could not always keep up with how the FinTech sector is developing so quickly, possibly exposing users to dangers and vulnerabilities. The FinTech regulatory environment is constantly changing and can be difficult to navigate because of its fragmentation and complexity across multiple jurisdictions. Coordinating innovation along with protecting customers and maintaining financial stability is still difficult. The growth of FinTech and its ability to contribute to the SDGs may be compromised by insufficient

laws or unduly strict policies (Butenko & Larouche, 2015; Treleaven, 2015; Jagtiani & John, 2018; Bittini *et al.*, 2022).

Digital and financial literacy are essential for using FinTech products effectively. Users may find it difficult to understand and cope with the complexity of numerous FinTech goods and services without sufficient financial knowledge. Financial literacy is often lacking in developing countries, resulting in difficulties for underrepresented groups and those with low incomes to embrace and use FinTech products (Emara & Mohieldin, 2021; Ye *et al.*, 2022; Bahous, 2023).

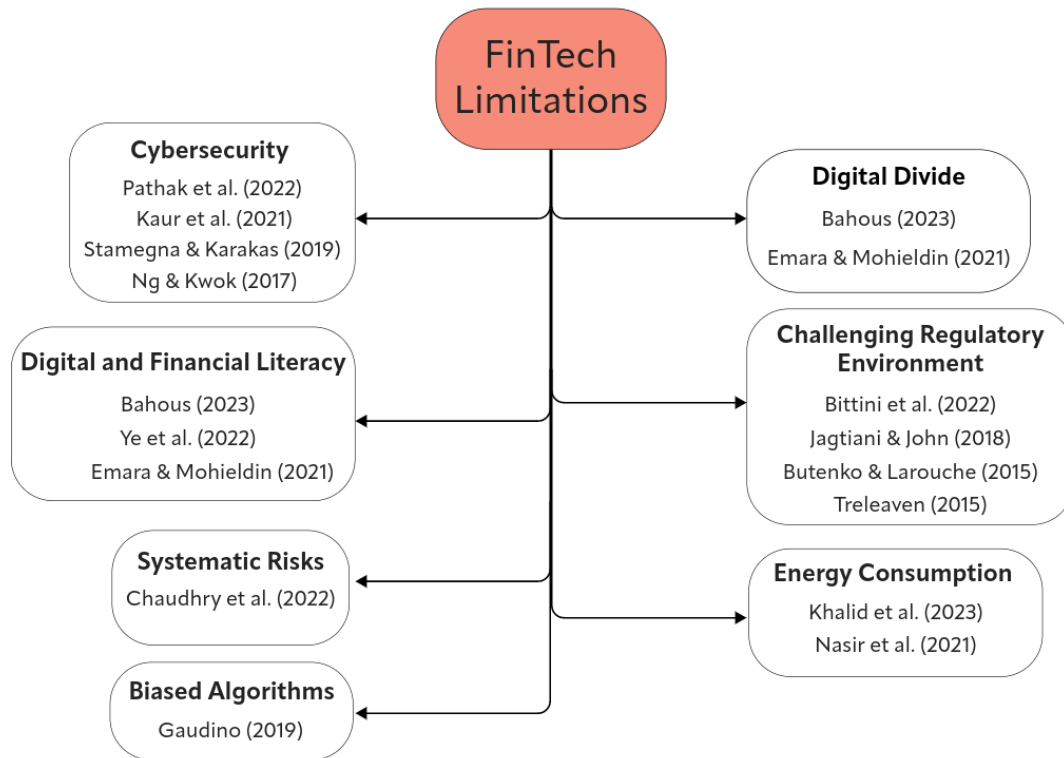
FinTech innovations have the potential to disrupt established financial institutions, but they also bring with them additional risks. Systematic risks could arise as a result of rapid adoption of emerging innovations without proper risk management procedures. Financial stability may be affected in a variety of ways by interruptions or failures in FinTech platforms or services. To reduce possible systematic risks, appropriate risk management practices and collaboration with regulatory agencies are required (Chaudhry *et al.*, 2022).

FinTech should be developed and used in a way that is consistent with moral standards. Concerns exist, nevertheless, regarding the possibility of biased algorithms, unfair lending practices, and the effects of automated decision-making on groups that are already at risk. Finding the ideal balance between innovation and moral issues is still difficult. It is important to make sure that ethical issues, human rights, and social effect are taken into account while designing and implementing FinTech solutions (Gaudino, 2019).

The swift development of FinTech, primarily blockchain, may additionally lead to higher energy consumption as well as carbon emissions, especially when it comes to data centers and digital infrastructure. The environmental footprint of FinTech needs to be carefully managed to be consistent with the SDG targets related to environmental sustainability (Nasir *et al.*, 2021; Khalid *et al.*, 2023).

Figure 25 comprehends all previously mentioned FinTech limitations including references of the analyzed scientific papers.

Figure 25. FinTech Limitations



Source: Author's creation

Addressing these obstacles calls for a comprehensive approach which includes cooperation between governments, regulators, the financial technology sector, and civil society organizations. In order to ensure that FinTech successfully contributes to the achievement of the SDGs, it is critical to put emphasis on digital infrastructure development, improve financial literacy campaigns, build suitable regulatory frameworks, and encourage inclusion.

7. CONCLUSION

The most common definition of FinTech has been given by Patrick Schueffel (2016) and he defines FinTech as “a new financial industry that applies technology to improve financial activities” (p. 45). FinTech offers several major benefits, including lower costs and the opportunity to facilitate and monitor all actions in real-time, owing to the usage of digital technology and big data. Financial technologies strive to increase clients' access to, productivity with, and accessibility of financial services. They also aim to improve how conventional services are provided.

A comprehensive taxonomy of FinTech with seven areas has been developed by Chen *et al.* (2019): cybersecurity, mobile transactions, data analytics, blockchain, peer-to-peer (P2P), robo-advising, and Internet of Things (IoT). The term "cybersecurity" corresponds

to the preparation, creation, and execution of equipment, processes, and practices to safeguard intellectual property, customer data and organizational assets from deliberate or unintentional breaches by unauthorized individuals. Digital payments are transactions that are not made with cash and that are carried out via digital technology. Due to its connections to both traditional financial institutions and a digital payment infrastructure built on IT technology, FinTech payment services provide a far simpler and more adaptable payment alternative than traditional payment services. Massive volumes of data are analyzed using computer systems in data analytics, which helps in decision-making. Data analytics, foundation technology advancements, big data, and mobile device technological ameliorations enable FinTech companies to compete directly with established financial institutions by offering distinctive, specialized, and individualized services. Nakamoto (2008) explained the way a network of users might perform safe peer-to-peer financial operations, doing away with the need for middlemen and lowering the cost of sending money abroad. Arrival of the Bitcoin, a decentralized cryptocurrency for internet use, is inextricably connected to the development of the technology known as blockchain. Any tools, platforms, or systems that allow customer-to-customer monetary transactions, as offered by technologies like crowdsourcing, peer-to-peer lending, and customer-to-customer payments, are considered peer-to-peer. Peer-to-peer payment models might be argued to be essential for offering current payment systems genuinely disruptive competition. Without assistance, most people on their own find it challenging to take financial risks. Robo-advisors are artificially intelligent solutions for investing that engage individuals through digital tools that provide a sophisticated customer experience, assisting them in internal assessment and leading their investing choices toward fundamental goal-based choices, effectively backed up by portfolio rebalancing methods through algorithms for trading that utilize passive asset allocation and diversification strategies. The term "Internet of Things" typically describes scenarios where internet connectivity and computing power are extended to objects, sensors, and common household objects which aren't usually conceived of as computers, allowing these gadgets to generate, share, and use information with minimal or no human intervention.

The term "FinTech regulatives" refers to the legal frameworks and standards that control how FinTech businesses and services are managed. Regulations in the domain of financial technology (FinTech) can vary by country and jurisdiction. The efficiency of the financial services sector could be increased, systemic risk could be decreased, and economic benefits could result from harmonizing financial legislation across numerous jurisdictions and developing innovative automated analytics and reporting standards.

The UN General Assembly endorsed the Agenda, that sets SDGs, after it was signed on September 25th, 2015, by the 193 United Nations Members' states. The Sustainable Development Goals, widely known as SDGs, are 17 Sustainable development objectives that are small components of an action plan with 169 related initiatives that must be accomplished in the social, environmental, institutional, and economic domains by 2030.

FinTech and digital finance can significantly contribute to the accomplishment of the Sustainable Development Goals. One method they do this is by increasing the distribution of the financial resources already available to support sustainable development. This is accomplished through business approaches, incentives, rules, and regulations that reroute financial assets locally and worldwide to provide cash for the SDGs. FinTech solutions, including internet banking, mobile wallets and online money transaction platforms, have become extremely popular among developing countries due to the inability of conventional financial institutions to offer financial services to the most underprivileged sections of society. FinTech is widely recognized as a crucial facilitator of financial inclusion, with digital financial services sticking out as the FinTech category most capable of bringing the unbanked into the traditional banking environment. Participating in the financial system and investing in one's company or education can help people transcend poverty. Thanks to tools like Mobile Payments, Digital Lending, Crowdfunding and Peer-To-Peer Lending, it is possible to collect funds needed for education or take a student loan more simply and with better conditions than with traditional financial institutions. FinTech solutions allow more women to access financial services and provide them with greater financial autonomy, increasing their bargaining power at home and positively affecting family well-being, and thus help promote gender equality. Banks, governments, and FinTech companies all play significant roles in reducing poverty and promoting financial inclusion. Financial inclusion has been viewed as a key component of prosperity and the eradication of poverty. It is essential to have access to secure, convenient, inexpensive financing, savings, coverage, along with other financial services in order to reduce risk, act as a cushion against economic shocks, offer social security, foster financial and social inclusion, and spur economic progress. FinTech advancements may lead to new financial services and products, lower transaction costs and higher transactional effectiveness. FinTech is anticipated to benefit a growing number of people, including small and medium-sized businesses. Thanks to FinTech, small and medium-sized enterprises (SMEs) have a better chance of getting loans with cheap interest rates. Additionally, FinTech speeds up the credit application procedure, enabling customers to get loans more rapidly, perhaps increasing the capacity of SMEs to utilize money on the scheduled date. FinTech similarly reduces the cost of helping SMEs with their investment management. FinTech not only advances green funding and sustainable development but also redefines financial services and pricing methods. FinTech is eco-friendly and supports sustainable development, preferably in the following ways: by ensuring green funding, reducing costs and informational inequities, fostering efficiency, appreciating nature's assets, and supporting realistic sustainable lifestyles.

In conclusion, FinTech has enormous potential for accelerating the SDGs' development. FinTech can advance financial inclusion, sustainable finance, and sustainable investment while harnessing innovations in technology and financial services to help accomplish the SDGs. Governments, legislators, financial institutions, and tech firms must work together

to establish a supportive climate that takes advantage of the revolutionary potential of FinTech while assuring that it is used responsibly. FinTech represents a modern technology that has the capability to significantly contribute to sustainable development. By doing this it has a capacity to foster a more inclusive, more equitable society.

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