

Review

# The Influence of E-Commerce Platforms on Sustainable Agriculture Practices among Smallholder Farmers in Sub-Saharan Africa

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**Abstract:** Sustainable agriculture is vital for food security and environmental conservation in Sub-Saharan Africa (SSA), where smallholder farmers encounter challenges like limited resources and market access. E-commerce platforms offer potential solutions by enhancing connectivity and sustainable practices. This review assesses the impact of such platforms on smallholder agriculture in the region, analysing the literature, reports, and case studies from 2010 to 2024 sourced from databases like Google Scholar and Scopus. Inclusion criteria focused on market access, economic outcomes, and sustainability. Findings indicate that e-commerce platforms notably improve market access, leading to better prices and reduced post-harvest losses. They also facilitate information flow, encouraging sustainable practices. However, challenges such as digital literacy and infrastructure deficits persist. E-commerce platforms positively influence sustainable agriculture in SSA by improving market access and supporting sustainable practices. Overcoming barriers through policy interventions and capacity-building is crucial for maximising these benefits. Further research is needed to explore long-term impacts and scalable models.

**Keywords:** e-commerce; sustainable agriculture; smallholder farmers; SSA



**Citation:** Morepje, M.T.; Sithole, M.Z.; Msweli, N.S.; Agholor, A.I. The Influence of E-Commerce Platforms on Sustainable Agriculture Practices among Smallholder Farmers in Sub-Saharan Africa. *Sustainability* **2024**, *16*, 6496. <https://doi.org/10.3390/su16156496>

Academic Editor: Hossein Azadi

Received: 28 June 2024

Revised: 24 July 2024

Accepted: 27 July 2024

Published: 30 July 2024



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## 1. Introduction

In Sub-Saharan Africa (SSA), technology plays a critical role in promoting sustainable agriculture. Electrotonic commerce (e-commerce) is relatively a new concept that is used in the contemporary business environment to delineate any trading in products and services using the internet. It is dependent on technologies of various dimensions such as electronic funds transfer, supply chain management, internet marketing, online transaction processing, electronic data exchange, and all mobile electronic appliances to engage people and industries. As a result, e-commerce platforms have become important forces behind the worldwide economic revolution of several industries, including agriculture [1,2]. These platforms provide a special chance to encourage smallholder farmers in SSA, where agriculture is a major contributor to the economy of many nations [3]. The long-term survival of agriculture in this region depends on sustainable agriculture, which prioritises social fairness, economic profitability, and environmental health [4].

Many obstacles, including restricted market access, expensive transaction fees, and a lack of information on sustainable farming methods, are faced by smallholder farmers in SSA [5]. These obstacles frequently keep smallholder farmers from using sustainable agricultural practices, which are crucial for improving resilience to climate and food insecurity [6]. Through the provision of timely access to essential information, the ability to link farmers to larger markets, and the reduction of transaction costs, e-commerce platforms have options to mitigate these difficulties.

The development of mobile technology has made it easier for e-commerce platforms to flourish throughout SSA. Examples of platforms that show how technology may close

the gap between smallholder farmers and prospective markets include M-Farm in Kenya and Farm-crowdy in Nigeria [7,8]. With the help of these platforms, farmers may sell their goods directly to customers or bigger market channels, frequently for a higher price than what local intermediaries would charge. By giving sustainably generated food a consistent market, this direct market access boosts smallholder farmers' earnings and encourages the adoption of sustainable methods [9].

Additionally, e-commerce platforms are essential for spreading knowledge about sustainable agricultural marketing. Digital platforms, for example, may provide real-time guidance from agricultural specialists, best practice recommendations, and training modules. Through these tools, smallholder farmers may learn about crop rotation, organic farming, and water conservation techniques, which are all essential for sustainable agriculture [10]. Smallholder farmers benefit from this sharing of information by creating a community of practice that enhances learning and creativity among the stakeholders.

Furthermore, smallholder farmers now have the financial resources to engage in sustainable agriculture because of the integration of e-commerce platforms with financial services like mobile banking and microloans. This is demonstrated in Kenya via the M-Pesa mobile money transfer service, which is related to Kilimail and Jumia e-commerce platforms, so that users may make purchases using their M-Pesa accounts [11]. Credit availability enables smallholder farmers to invest in expensive products like organic fertilisers, effective irrigation systems, and premium seeds that are frequently beyond of their price range [12]. E-commerce platforms enable farmers to implement and sustain sustainable practices by removing financial barriers.

#### *Problem Statement*

In SSA, smallholder farmers are essential to both the region's economic stability and food security. Despite their significance and contribution to economic growth, these farmers encounter several obstacles that make it difficult for them to use sustainable farming methods. These obstacles undermine the region's agriculture's long-term sustainability by causing poor production, environmental degradation, and climate change vulnerability.

An essential problem is market access; many smallholder farmers depend on local market channels, where prices are frequently low because middlemen pocket a large portion of the proceeds. According to a World Bank study [13], Sub-Saharan Africa (SSA) smallholder farmers faced several obstacles to entering the market, such as inadequate infrastructure, restricted access to financing, and expensive transaction fees. Farmers are unable to generate enough revenue to invest in sustainable practices due to inadequate market linkage [12]. Furthermore, there is frequently little information released on sustainable agriculture. Most of the time, traditional extension agencies lack the resources necessary to reach all farmers, especially those who live in distant locations. Farmers who lack access to contemporary agricultural information persist in employing techniques that might have negative effects on both the environment and their own production [10].

It is challenging for smallholder farmers to invest in the technology and inputs that are required to support sustainability as they frequently do not have access to credit or other financial services. About 60% of people in SSA work in agriculture, according to the Food and Agriculture Organisation of the United Nations (FAO), yet just 4% of them have access to formal credit [14]. The substantial risk involved in agricultural investments deters banking institutions from lending to smallholders, exacerbating their financial marginalisation [9]. Thus, there is still a lack of research and use of the potential e-commerce platforms to address these complex issues and to promote sustainable agriculture among smallholder farmers.

Therefore, the purpose of the study is to find out how e-commerce platforms affect smallholder farmers in SSA. To promote sustainable agricultural practices, furthermore, this research also seeks to explore how e-commerce platforms improve market access through the distribution of information and offers support for sustainable agricultural growth.

## 2. Research Methodology

### 2.1. Research Design

To thoroughly review the impact of e-commerce platforms on sustainable agriculture practices among smallholder farmers in Sub-Saharan Africa (SSA), this study used a systematic review technique. It was appropriate to use a systematic review to summarise the literature and find trends, gaps, and new information from several literature sources. This strategy made sure that the level of knowledge on the subject was thoroughly and objectively analysed. In the systematic review process, the following steps were taken: (i) framing the research questions, (ii) identifying relevant work related to the review, (iii) assessing the quality of studies through appraisal guides, (iv) summarising the evidence through data synthesis, and (v) interpreting the findings to ensure quality summary and recommendations [15].

### 2.2. Data Collection Methods

Literature from significant academic databases, including Scopus, Web of Science, JSTOR, Google Scholar, and AGRIS, was included in the review. Furthermore, reports from agencies like the Food and Agriculture Organisation (FAO), International Fund for Agricultural Development (IFAD), World Bank, and other regional organisations in charge of socioeconomic and agricultural development in SSA nations were consulted for pertinent grey literature.

A wide range of search phrases were employed, such as market access, agricultural practices, digital agriculture, smallholder farming, sustainable agriculture, SSA, and e-commerce platforms. To guarantee a comprehensive and inclusive search, these phrases were combined in several ways. The research focused predominantly on studies conducted between 2010 and 2024, studies conducted in English, research on Sub-Saharan Africa (SSA), and research on the effects of e-commerce on agriculture, and peer-reviewed papers, reports, and theses were all reviewed. Finally, research concentrating on areas outside of SSA, non-English publications, and studies unrelated to the impact of e-commerce on agriculture were excluded.

### 2.3. Data Extraction

The first search found publications that could be of interest by focusing on the titles and abstracts. These articles were subjected to independent eligibility screening by two reviewers. A third reviewer or a conversation were used to settle disagreements. Key information from each selected study was gathered using a standardised data extraction form. This information included the author(s) and the year of publication; the study location; the research objectives; the methodology; the sample size and characteristics; the key findings regarding market access, income, and sustainable practices; and the barriers and facilitators that were identified.

### 2.4. Data Analysis Method

Key themes from all included papers were found and compiled using thematic analysis. The retrieved data were coded to find recurrent themes and group them into more general groups.

## 3. E-Commerce Platform Adoption Effects on Sustainable Agricultural Practices

### 3.1. A Synopsis of E-Commerce and E-Commerce Platforms

The definition of electronic commerce, or e-commerce, varies according to one's profession, viewpoint, product, and technology employed [16]. It is also frequently misunderstood as e-commerce is supported by more than thirty technologies, yet it is more than simply technology. To accomplish commercial goals, e-commerce incorporates the integrated use of information and communication technologies (ICT) from the beginning to the end of the value chain [17]. This covers electronic procedures for business-to-business (B2B), business-to-consumer (B2C), and consumer-to-business transactions that may be

partial or full. As a result, e-commerce describes a company strategy that offers a platform and an environment for the selling and purchase of goods online. Within the agricultural industry, this refers to the buying and selling of agricultural products including bananas, macadamia nuts, and avocados, to name a few.

B2B transactions are a sort of commerce that take place between enterprises in the private sector [18]. Here, “private sector” refers to non-government e-commerce operators who are legally registered and want to conduct business with each other. B2C transaction refers to some sort of commerce transaction where enterprises in the public or private sectors transact with one another. In this context, the private sector is defined as non-government e-commerce operators who are registered as individuals or legal entities and aim to transact business with each other. Consumer–consumer refers to a kind of business transaction that takes place between private individuals. Business-to-government (B2G) transactions can be classified into two categories: e-market and e-bidding. These transactions take place between the public and commercial sectors [18].

A study by Gopinath [19] states that e-commerce is the term for the purchase, sale, and marketing of goods and services to consumers using communications technology, mostly the internet. National economies that are isolated from one another by obstacles to international trade and investment; by distance, time zones, and language barriers; and by national differences in laws, customs, and business practices have undergone a fundamental shift because of the internet [20]. E-commerce provides a level equal opportunity for small- and medium-sized enterprises (SMEs) and large businesses to operate in the global market; additionally, it allows regional businesses and communities to seamlessly participate in social, economic, and cultural networks across international boundaries [21].

According to StatsSA [22], the e-commerce process involves three key stages: placing the order, making a payment, and receiving the goods or services. This definition encompasses the entire e-commerce transaction cycle, from ordering to delivery, and highlights the digital nature of the process. E-commerce adoption is the enablement of farmers to participate in online trade, including both selling and buying [23].

The rise of e-commerce, made possible by the internet, is a groundbreaking scientific achievement that has revolutionised the business world. It has broken down barriers of time and space; transformed trade patterns; and improved the flow of goods, capital, and information. This has given businesses a competitive edge by reducing production costs. E-commerce has enabled traditional businesses to achieve greater efficiency, speed, and economic results. Its impact will extend beyond business to affect various aspects of society, including production, employment, government, talent development, legal systems, education, industries, logistics, finance, media, and even agriculture. As e-commerce continues to evolve, its influence will only grow, driving a digital and internet-based economic revolution that will have a profound impact on human society, surpassing the Industrial Revolution in its scope and depth. It will not only boost productivity and efficiency but also shape people’s lifestyles, worldview, and methodology, making it a transformative force in human history.

The use of digital technologies and online platforms in agriculture, also known as e-commerce in agriculture, enables farmers to sell their products and services to consumers and businesses more efficiently. This approach, which includes online marketplaces and digital channels, aims to improve agricultural supply chain management; expand farmers’ customer base; and provide consumers with easy access to fresh, locally sourced agricultural products.

Social media, the agricultural e-marketplace, e-retailers, and the e-fresh market are the four e-commerce platforms. Farm products are often sold via collectors or middlemen and then marketed via supermarkets and fresh markets [16]. Fresh markets and supermarkets are important channels for the delivery of agricultural goods. In the digital age, farmers and end consumers are now connected through new digital channels. Supermarkets and fresh markets must therefore implement innovative services such as chat boxes, deliv-

ery, and application-based ordering and provide several channels for both online and offline business.

### 3.2. *The Implementation of E-Commerce among Smallholder Farmers*

Electronic commerce has the potential to have a big impact on farmers and their companies today as it is a quick way to move the globe toward an information society. Businesses have shown that the internet and online commerce are essential for conducting business for both small and large organisations globally. Web-based business innovation indicates the possibility for corporate growth and expansion. Due to several adoption challenges, small-scale farmers are not embracing e-commerce at the same rate as their bigger counterparts [24]. More about small producers, they create various items, employ various e-commerce techniques, and require various forms of support and training [25].

A study on e-commerce, problems, and prospects in Nigeria stated that even while e-commerce is becoming more and more popular worldwide, developing nations like Nigeria appear to be falling behind [26]. Nigeria is a developing nation where ICT is slowly expanding, and it was reported in 2006 that only 16.1% of the population used the internet [27]. In 2009, there was significant increase in the population that used services in the late 2000s [28]. Hence, e-commerce is reportedly growing more and more common among Nigerians as more people become computer proficient and receptive to using ICT. However, prior research has indicated that the nation has not fully embraced e-commerce. According to Folorunso and Momoh [29], only 32% of respondents who participated in the study and responded to the poll had ever used e-commerce, even though 70% had heard of it. Furthermore, approximately 22% of the sample polled really used e-commerce, which is consistent with the findings of most studies on the adoption of e-commerce in Nigeria [30].

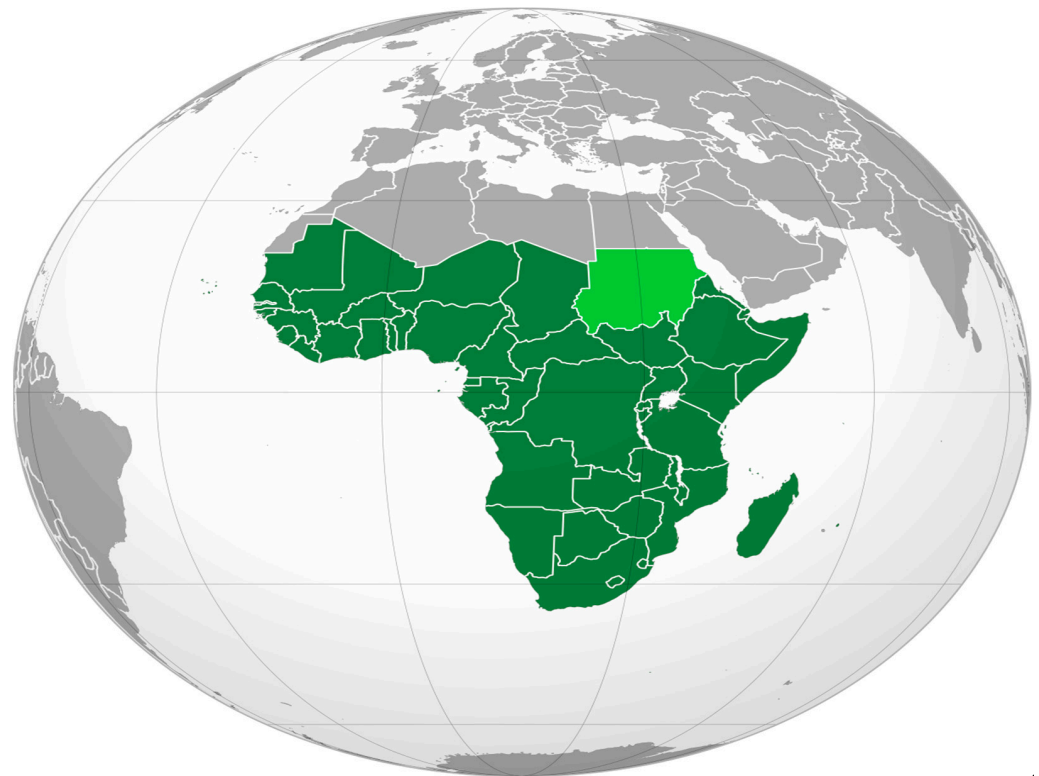
In contrast to other sectors, the rate of e-commerce adoption in the agricultural sector among Thai farmers and SMEs is relatively low, even with the implementation of multiple agricultural support programs. Thai agricultural cooperatives were sluggish to adopt e-commerce and rarely employed information technology for business transactions, as demonstrated by Hendricks and Mwapwele [31]. Most Thai farmers continued to favour traditional channels over internet ones, even though selling agricultural products online allows farmers to cut out middlemen and yields additional benefits [32]. Digital gap, digital literacy and skills, lack of incentive to use, and preference for comfort zone are some of the obstacles preventing farmers from adopting e-commerce [33]. Due to their restricted access to information technology, farmers in rural areas are unable to fully appreciate the advantages of using technology [33]. On the other hand, e-commerce related to agriculture has been growing quickly in large cities' suburbs, particularly in the provinces of Chiang Mai and Bangkok. A few SMEs and smallholder farmers have applied to use internet channels, particularly young, astute farmers, and farmers of niche products (i.e., natural, pesticide-free, organic). The e-Community Supported Agriculture (eCSA) system was developed by Wicha et al. [34] to promote organic agricultural products grown locally in the province of Chiang Rai. As a result, a long-term strategic strategy to transition from traditional agriculture to e-agriculture was necessary for the adoption of agricultural e-commerce [16].

For rural farmers, e-commerce has created new opportunities that have improved their financial results and allowed direct communication between producers and consumers [35]. The ability to market their goods at competitive pricing has increased rural producers' income levels. E-commerce, which minimises waste and synchronises supply with demand, has also helped to stabilise food markets and prices. Producers and consumers alike gain from the supply chain's enhanced efficiency in maintaining price stability. But there are obstacles to using e-commerce to promote rural development [35].

### 3.3. *The Current Economic and Social Outlook on SSA*

From a geographical perspective, the region of the African continent located south of the Sahara Desert is known as SSA [36]. It is made up of 48 nations, as seen in Figure 1

below: the island state of Seychelles is the only high-income economy, with the others being 23 low-income, 18 lower-middle-income, and 6 upper-middle-income countries [37]. There are large differences in the region's economic development and performance due to its diversity. In general, the area struggles with issues including poverty, a lack of industry, and a dependency on agriculture [36]. Nonetheless, a few nations have seen swift economic expansion, propelled by industries like mining, oil, and telecommunications [38].



**Figure 1.** Sub-Saharan African region shaded in green. The file is licensed under the Creative Commons Attribution-ShareAlike 3.0 Unported license (CC BY-SA 3.0) and was created by Bitton [39]; it was published on 18 January 2023.

SSA's population grew from 665 million between the year 2000 and 2017 to reach 1.050 billion [40]. The estimate is that by 2043, the region's population will have increased by an additional 77.38% to 1.962 billion [36]. The five most populous countries in the region were Nigeria (203.8 million), Ethiopia (112.1 million), the Democratic Republic of the Congo (DR Congo) (86.9 million), South Africa (58.3 million), and Tanzania (58.1 million) [37]. The region's age distribution is youthful, with 43% of the cohort under 15 years and 28% of the cohort under 30 years of age. As a result of declining fertility rates and improved medical care, SSA's median age is expected to reach 22.82 years in 2043 [37].

Thirteen of the forty-eight countries in SSA have average urbanisation rates of less than 44% in 2019, with more than half of the population living in rural regions and dependent on agriculture. By 2043, just 22 SSA nations will be mostly rural; 50.5% of the region's population is anticipated to reside in urban regions. A total of 998 million people will be residing in cities by that time, which is more than twice as many as there were in 2019 (449 million) [37].

Though there are still large differences in education between genders and between urban and rural regions, SSA's average level of education has been rising. UNESCO [41] reports that the adult literacy rate is 64.3%, with males having higher rates than females, while the juvenile literacy rate is 77.5%. Enrolment rates in primary schools have gone up, but because of financial and physical limitations, enrolment in secondary and post-secondary education is still low. Economic diversification is becoming more and more

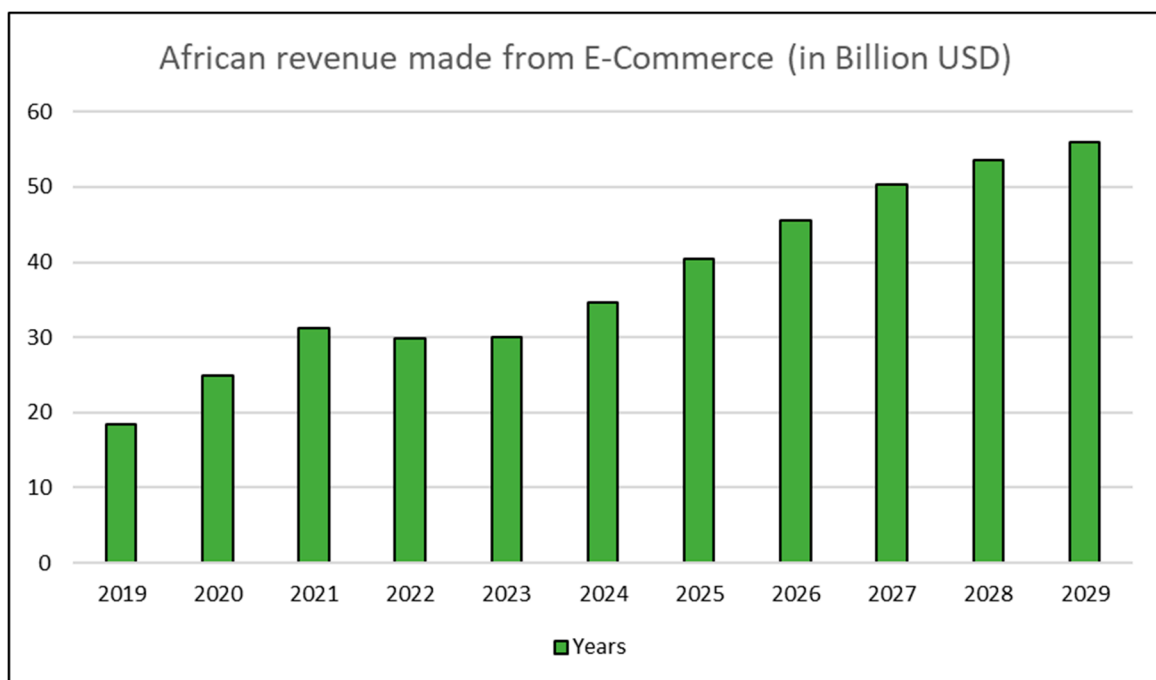
important to lessen dependency on extractive industries and agriculture. There is a rise in investment in manufacturing, services, and technology [41].

### 3.4. The Benefits of E-Commerce for Smallholder Farmers in SSA

For smallholder farmers, e-commerce has an excess advantages and prospects, especially when it comes to advancing sustainable farming methods. These advantages fall under four categories: greater supply chain efficiency, higher profitability, improved market access, and the encouragement of sustainable behaviours.

#### 3.4.1. Enhanced Market Access

Access to markets can be improved by removing conventional entry obstacles, and e-commerce greatly improves smallholder farmers' access to markets [42]. Africa's e-commerce revenue is expected to increase from USD 18.45 billion in 2019 to USD 56.03 billion in 2029, according to Statista [43] (see Figure 2). The anticipated expansion of e-commerce indicates that smallholder farmers stand to gain over time from this sector. Additionally, according to the GSM Association [44], the number of mobile internet users in SSA will increase from 300 million in 2019 to over 475 million by the end of 2025. As a result, the data from Statista [43] on an expected growth in the e-commerce market and revenue over time is supported by the mobile internet access numbers.



**Figure 2.** African revenue generated from the e-commerce industry (adapted from Statista [43]).

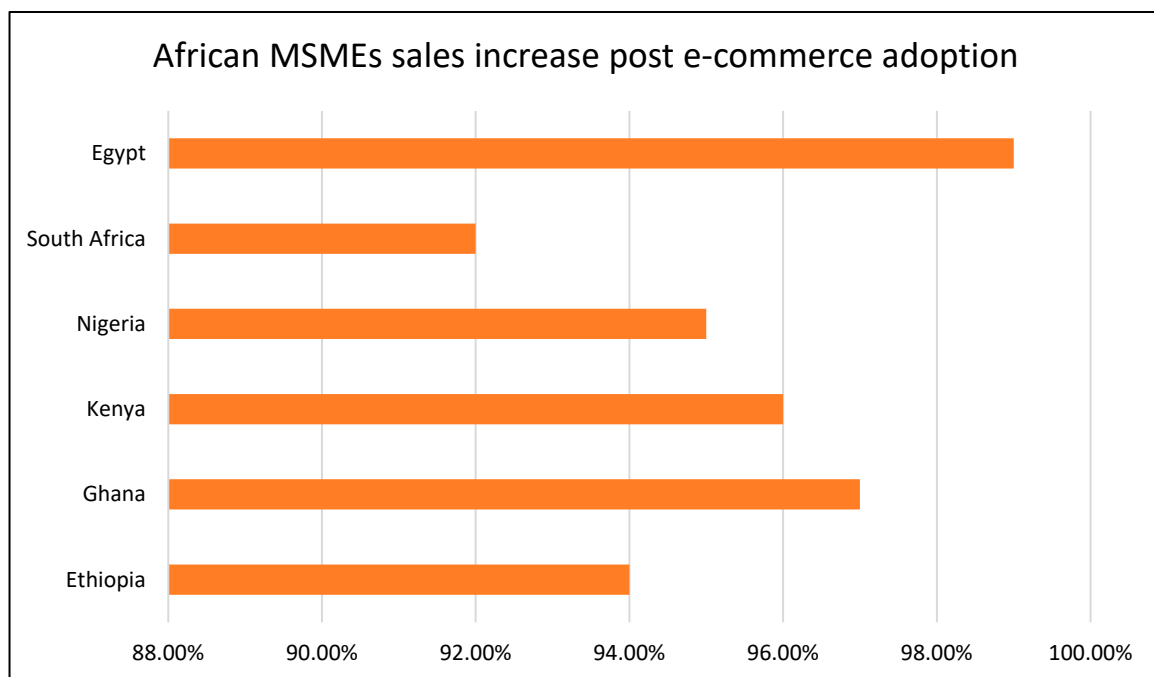
Smallholder farmers frequently encounter geographic limitations in conventional marketplaces that restrict their ability to reach far-off consumers. These restrictions are removed by e-commerce platforms, which allow farmers to sell their goods online and reach a considerably larger consumer base. Smallholder farmers can market their goods to metropolitan customers, where demand is usually higher and buyers are ready to pay premium rates for fresh, high-quality items, thanks to this direct relationship with consumers [45]. Furthermore, internet marketplaces frequently offer tools that assist farmers in reaching foreign markets, so increasing their reach and giving them the chance to take advantage of chances to meet the demand for specialty or organic goods worldwide.

E-commerce platforms also give smallholder farmers the resources they need to sell their goods successfully [16]. By utilising tools like online catalogues, thorough product descriptions and customer testimonials, farmers can showcase their food in an expert way

and draw in more customers. To boost exposure and revenue even more, many platforms also provide marketing services like social media integration and customised advertising [46]. Smallholder farmers may compete more widely and overcome the constraints of their local markets by employing these digital technologies, which will boost their revenue and stability [47]. As a result, smallholder farmers in SSA can invest their profits in sustainable agricultural practices, leading to improved farm viability, enhanced position to negotiate better prices and terms, and overall investment in quality enhancement and product differentiation.

### 3.4.2. Increased Profitability

For smallholder farmers, e-commerce has a significant potential to boost profits. Several intermediaries, each getting a cut of the profit, are frequently involved in traditional market setups [48]. By selling directly to customers and avoiding these intermediaries, farmers can keep a higher percentage of the sales money [16]. Farmers now earn more money through this direct-to-consumer strategy, which also gives them more price control. Farmers are protected against price manipulation by middlemen by having the ability to determine prices based on current market data and receiving appropriate recompense for their goods. Figure 3, which is extracted from the GSM Association [44] report, illustrates how e-commerce use by micro, small, and medium enterprises (MSMEs) increased sales in the majority of SSA countries (apart from Egypt). For the majority of MSMEs in the area and around the continent, the growth in sales is largely within the 90% range, which is good for smallholder farmers looking to boost their earnings.



**Figure 3.** MSMEs increase in sales post e-commerce adoption (adapted from GSM Association [44]).

E-commerce also lowers transaction costs related to conventional marketing methods [49]. It is possible to reduce or completely remove expenses like travel to far-off markets, middleman fees, and time spent in actual marketplaces. Farmers benefit immediately from this decrease in overhead expenses in the form of increased profitability. Furthermore, digital platforms frequently provide farmers with analytics tools that aid in their understanding of customer preferences and market trends, allowing them to enhance their product offers and pricing strategies. Farmers can increase their profitability by using this information to make better decisions and use resources more effectively [9].



### 3.4.3. Improved Supply Chain Efficiencies

Smallholder farmers can benefit greatly from e-commerce's ability to streamline logistics and lower post-harvest losses in their supply chains [50]. Conventional supply chains frequently suffer from inefficiencies, including poor storage facilities, untimely delivery, and a lack of coordination between parties. The integrated logistics solutions provided by e-commerce platforms guarantee the prompt and dependable delivery of agricultural products. These technologies may work with logistics companies to optimise delivery routes, track shipments in real time, and manage inventories [51]. Consequently, farmers may enhance the overall productivity and profitability of their operations by decreasing post-harvest losses, which are sometimes substantial as a result of mishandling and delays.

E-commerce platforms can also help with improved production scheduling and demand forecasts [52]. Farmers may more precisely meet market demand by modifying their production plans based on the analysis of sales data and customer patterns. This predictive capacity aids in avoiding underproduction, which may result in lost sales opportunities, and overproduction, which may cause waste. Furthermore, by placing farmers in direct contact with customers or merchants, e-commerce can facilitate the creation of shorter supply chains by cutting down on the number of middlemen and the intricacy of the logistical network [50,51]. This efficient method lowers expenses while also enhancing the quality and freshness of product that is supplied to customers [53].

### 3.4.4. Promotion of Sustainable Practices, Knowledge Sharing, and Capacity Building

E-commerce platforms may be extremely important in encouraging smallholder farmers to use sustainable farming methods. These platforms frequently give users access to a multitude of knowledge on environmentally friendly farming practices, including integrated pest control, organic farming, and precision agriculture [54]. To learn about practices that lessen their impact on the environment and increase production over the long term, farmers may attend webinars, take part in virtual training sessions, and access online resources. For example, farmers are more likely to embrace precision agricultural techniques—which use technology to maximise field-level management of crop farming—when they have access to reliable data and professional advice via e-commerce platforms [55,56].

To add, e-commerce platforms can also make it easier to obtain sustainable inputs [54]. Environmentally friendly items, such as biopesticides, organic fertilisers, and energy-efficient machinery, are readily available for farmers to buy. These inputs are made available online, which promotes the adoption of environmentally friendly techniques that also increase the output and quality of agricultural products. E-commerce platforms assist farmers in lessening their ecological impact, improving soil health, and securing the viability of their farming enterprises for future generations by endorsing sustainable inputs and practices [55].

Moreover, e-commerce platforms frequently incorporate functionalities that facilitate the development of smallholder farmers' capacity and knowledge exchange [57]. These platforms have the capacity to house a wide range of instructional materials, including as articles, films, and interactive modules, that give farmers important knowledge on contemporary agricultural methods, pest control, soil health, and other topics. Farmers are better able to implement creative techniques that can raise agricultural yields and promote sustainability thanks to this informational access. A culture of continual learning and development may be fostered by introducing farmers to new technology and processes through webinars and online training sessions given by agricultural professionals [58].

E-commerce platforms also help with community development and peer-to-peer learning. To ask questions, discuss best practices, and trade experiences, farmers may interact with one another through social media groups and online forums. This cooperative setting aids in the dissemination of useful information that may be used right away in the field. E-commerce platforms help farmers solve issues and innovate, which results in more resilient and sustainable farming practices by building a feeling of community and mutual

assistance. When it comes to solving shared problems and promoting agricultural growth, a farming community's collective knowledge may be a very useful instrument [58].

#### 3.4.5. Financial Inclusion

E-commerce platforms that integrate with digital payment systems help smallholder farmers become more financially inclusive [59]. By eliminating the need for potentially dangerous and ineffective cash transactions, this integration gives farmers safe and effective ways to receive payments. Maintaining confidence and dependability in the marketplace depends on fast and transparent transactions, which are ensured by digital payments [60]. Moreover, digital payment histories produce a financial record that farmers may use to establish their credit profiles, which will make it easier for them to get loans and other financial services [59]. Farmers must be able to invest in cutting-edge equipment and environmentally friendly techniques to increase their revenue and output [61].

E-commerce platforms can also provide financial solutions that are specifically designed to meet the demands of smallholder farmers. These items, which are obtainable straight through the site, can contain savings accounts, crop insurance, and microloans [62]. E-commerce platforms assist farmers in making long-term investments in their operations and help reduce the risks associated with farming, such as crop failures and price volatility, by offering these financial services. This financial stability encourages overall agricultural sustainability and resilience by enabling farmers to use sustainable practices and technology that may otherwise be unaffordable [62].

### 3.5. Country-Specific E-Commerce Platforms for Smallholder Farmers

#### 3.5.1. Kenya

Kenya has a well-developed e-commerce agricultural scene, with many platforms designed specifically for smallholder farmers. Through SMS (Short Message System), M-Farm (Mobile Farm), a cutting-edge platform, gives farmers access to real-time market pricing, weather reports, and agricultural advice. This increases farmers' profit margins by enabling them to make well-informed decisions and decreasing their dependency on intermediaries. Furthermore, M-Farm facilitates direct communication between farmers and customers, fostering openness and fair-trade principles [63].

DigiFarm (Digital Farm) is another noteworthy platform that was introduced by Safaricom (a mobile service provider in Kenya). By using mobile technology, DigiFarm provides farmers with training, finance, and input access. Additionally, it makes connections across markets easier by enabling farmers to sell their goods directly to consumers, expanding their market and increasing their profits. This all-inclusive digital ecosystem helps environmentally conscious agricultural methods by offering tools and customised guidance to increase output and environmental care [64].

#### 3.5.2. Nigeria

Nigeria's agricultural industry has seen a change thanks to e-commerce sites like ThriveAgric (the name was conceptualised by combining the words "thrive" and "agriculture") and Farm-crowdy (conceptualised by merging the words "farming" and "crowdy", probably derived from the word crowdfunding). Through a crowdfunding concept, Farm-crowdy links smallholder farmers with investors, giving them access to the funds they need for expansion and input purchases. Through its backing of environmentally conscious enterprises, this platform not only increases financial inclusion but also advances sustainable agriculture practices [8].

On the other side, ThriveAgric manages the agricultural value chain using a digital platform. It gives farmers access to market connections, training, and inputs. ThriveAgric increases the sustainability of farming operations by lowering post-harvest losses and ensuring effective supply chain management via the use of technology. To guarantee farmers are receiving fair pricing for their goods, the site also makes direct sales easier [65].

### 3.5.3. Tanzania

E-commerce platforms like AgriSoko, which links farmers to marketplaces and offers useful agricultural information, are beneficial to Tanzania's agriculture industry. By listing their goods online with AgriSoko, producers may access a larger market and become less reliant on local purchasers. Through the provision of tools and instruction on environmentally friendly agricultural methods, this platform promotes sustainable practices [66].

Another essential platform in Tanzania is Kilimo Fresh. Its main objective is to gather produce from small-scale farmers and sell it to institutional and metropolitan consumers. Kilimo Fresh leverages technology to streamline supply chain management and logistics, reducing food waste and guaranteeing fresh product is effectively delivered to customers. By minimising its negative effects on the environment, this strategy not only increases farmers' earnings but also advances sustainable agriculture [67,68].

### 3.5.4. Uganda

Platforms such as Bringo Fresh and EzyAgric are making great progress in Uganda. A wide range of services, such as market connections, input access, and farm management tools, are provided by EzyAgric. It offers data-driven insights to farmers so they may increase agricultural yields and sustainability. Additionally, the platform facilitates direct communication between farmers and buyers, guaranteeing higher pricing and a decrease in post-harvest losses [69].

Produce from smallholder farmers is gathered by Bringo Fresh, an online marketplace, and delivered to urban consumers. Bringo Fresh guarantees that farmers are compensated and that consumers obtain fresh, premium fruit by optimising the supply chain. This paradigm encourages the effective use of resources and lessens food waste, which helps sustainable agriculture [70].

### 3.5.5. Ghana

Esoko and Farmerline are two examples of platforms that help Ghana's agriculture industry. Esoko helps farmers make educated decisions and maximise their practices by sending them SMS with market pricing, weather forecasts, and agricultural advice. Additionally, the platform enables direct market connections, which lessens dependency on intermediaries and boosts revenue [71].

Another significant company, Farmerline, provides farmers with financial products and extension services via mobile technology. It encourages the use of sustainable agricultural methods by giving access to financing, resources, and training. Farmers may obtain timely information and resources thanks to Farmerline's digital platform, which boosts sustainability and production [72].

### 3.5.6. South Africa

Platforms like Khula and HelloChoice are beneficial to the agriculture industry in South Africa. Through direct connections between farmers and buyers via HelloChoice, an online marketplace, market access is improved, and transaction costs are decreased. By providing information and instruction on effective agricultural methods, the platform promotes sustainable practices [73].

Khula offers a range of digital solutions for managing farms, such as financial services, market access, and input procurement. Khula assists farmers in adopting sustainable practices and streamlining their operations through the integration of various services. The platform's emphasis on technologically advanced solutions guarantees smallholder farmers to enhance their environmental stewardship and production [74].

## 3.6. Challenges Faced by Farmers Using E-Commerce

### 3.6.1. Digital Literacy and Technological Barriers

Digital literacy is one of the main obstacles smallholder farmers face while using e-commerce. It is challenging for many farmers in SSA to use digital technologies and the

internet efficiently because of their lack of knowledge. Their capacity to fully benefit from e-commerce prospects, from selling their items online to handling digital transactions, may be hampered by this lack of proficiency in digital skills [9,75]. To close this gap, training programs are crucial, but they need time and money that many farmers do not have.

Furthermore, there is sometimes insufficient technology infrastructure in rural locations. Farmers' access to smartphones and computers is restricted, and this limits their capacity to interact with e-commerce platforms. Even in situations where connection is offered, it may not be dependable or be too costly for everyday usage. The potential advantages of e-commerce for smallholder farmers are greatly diminished by these technological obstacles, which also make it more difficult to adopt sustainable farming methods that depend on digital tools and data [9].

### 3.6.2. Financial Constraints and Access to Capital

One other major obstacle still facing smallholder farmers that want to use e-commerce is access to capital. Buying digital gadgets, paying for internet services, and making the necessary infrastructure investments might come with prohibitive upfront prices. Without outside assistance, many farmers would not have the financial flexibility to invest in these technologies because they already operate on narrow margins [61]. Furthermore, smallholder farmers are frequently excluded from the official banking system because they lack collateral or a credit history, even if e-commerce platforms might make it easier for them to obtain financing.

While they have shown potential, innovative finance mechanisms like crowdsourcing and microloans are not yet widely used or available to all farmers. Due to their incapacity to invest in the resources or technology needed to increase productivity and environmental sustainability, farmers are limited in their potential to use e-commerce for sustainable practices [61].

### 3.6.3. Trust and Security Issues

When it comes to smallholder farmers using e-commerce, trust is a major factor. Due to worries about fraud, payment security, and the dependability of online customers and sellers, many farmers are doubtful of conducting business online [76]. Despite the possible advantages, farmers may be discouraged from fully utilising e-commerce due to a lack of confidence in digital platforms [64]. Gaining the trust of farmers requires ensuring safe and open transactions [77]. This entails giving buyers and sellers clear information regarding payment procedures, setting up trustworthy methods for verification, and making sure that strong data protection procedures are in place.

Moreover, smallholder farmers might not know how to safeguard their digital information, which leaves them open to fraud and cyberattacks. To reduce these dangers and provide a reliable environment for e-commerce, platforms need to make significant investments in robust security measures and offer instruction on safe online habits [64].

### 3.6.4. Logistics and Supply Chain Challenges

For e-commerce in agriculture to be successful, supply chain management and logistical efficiency are essential. However, a lot of smallholder farmers deal with logistical issues including expensive transportation and poor infrastructure. The advantages of selling goods online may be undermined by these difficulties, which may cause delays and higher post-harvest losses [53]. These problems are made worse by the absence of cold storage facilities and effective distribution systems, especially for perishable commodities that need to be delivered on time to preserve quality and cut down on waste.

E-commerce platforms must provide strong logistical solutions to meet these difficulties. This might entail investing in infrastructure upgrades, forming alliances with logistics companies, and leveraging technology to streamline supply chain processes. To guarantee that e-commerce can promote sustainable agricultural practices by cutting waste

and boosting the effectiveness of the agricultural value chain, these logistical obstacles must be removed [53].

### 3.6.5. Market Access and Competition

E-commerce platforms provide smallholder farmers more access to markets, but they also put them in a more competitive environment. In addition to local producers, farmers also must contend with foreign vendors who can have superior resources and more sophisticated technology. Smallholder farmers may find this increased competition intimidating since they lack the economies of scale to compete on volume or price [47].

Furthermore, the fees and commissions charged by e-commerce platforms might cut into farmers' profit margins. Although these fees are essential to the platforms' viability, farmers may find them burdensome, particularly those who are already working on a tight budget. Farmers must carefully weigh the advantages of increased market access against the expenses and competition that come with e-commerce [47].

### 3.6.6. Adaptation to Market Demand and Trends

It can be difficult for smallholder farmers to adjust to shifting customer preferences and market needs without sufficient knowledge and assistance. E-commerce platforms can offer insightful information about the market, but many farmers may lack the business acumen necessary to understand and act upon these data. To comprehend market trends, enhance their product offers, and modify their agricultural operations correspondingly, farmers require ongoing education and assistance [58].

Furthermore, farmers may need to modify their production techniques significantly and embrace new practices in response to the growing demand in various markets for sustainable and organic products. Although e-commerce platforms might help with this shift by giving farmers access to sustainable inputs and training, the early phase of adaptation can be difficult and expensive for them [58].

## 3.7. The Implications of E-Commerce for Sustainable Agriculture

Electronic commerce is a multifaceted business strategy, and its impact across sectors is evident in terms of influencing business market access, management of food wastes, improving stakeholder engagement and traceability, purchases and sales that are acute and real-time data driven, and access to reliable business funding [78]. Now, in the context of the agricultural sector, the implications of e-commerce centres around the processes of market access and expansions, food waste management, real-time-data-driven purchases and sales, small-scale producers' empowerment, innovation acceptance and utility, clientele education and empowerment, and infrastructure development [78,79].

The influence of e-commerce on the practice of sustainable agriculture practice is further evident with the ability of the customers to trace the agricultural products to see where it was produced, how it was produced, and how the producer followed the necessary market specifications in the production of the kind of produce the market demands [80]. The application of e-commerce and its principles and tools in the agricultural sector aids the producers in reducing their production costs while raising their income. This is mostly due to the implementation of conservation agriculture and organic agriculture, as well as the reduction of marketing costs and activities simultaneously. Therefore, farmers, in the production of any agricultural product, obtain specifications from their clientele, who will later have access to the information of how these products were produced (transparency and traceability). Moreover, the use of e-commerce improves agricultural value chain stakeholder engagement, bridging the gap between producers, buyers, and the production input suppliers. Therefore, e-commerce not only favours the producers over the buyers by reducing the stress, time constraints, and budget tensions, but it also helps in the protection of our environment so that production would not compromise the future generations of their potential and abilities to produce their own food.

## 4. Measures Aimed at Improving E-Commerce Adoption among Smallholder Farmers

### 4.1. Improving Digital Literacy among Smallholder Farmers in SSA

#### 4.1.1. Education and Training Programs

For smallholder farmers to gain critical skills in addition to agricultural knowledge, agricultural education curriculum must incorporate digital literacy [81]. Owing to this connectivity, farmers may access markets, manage their farms, and obtain climatic data by using digital tools. Distributing in-depth instruction that combines conventional agricultural methods with contemporary digital tools is mostly dependent on agricultural institutions such as extension agencies [82].

Considering that many smallholder farmers might not have had much formal education [83], adult education initiatives ought to concentrate on teaching fundamental digital skills like utilising cell phones for financial transactions, market research, and weather predictions [84]. These programs enable farmers to efficiently use technology in both their farming techniques and commercial operations. Also, programs tailored for workforce training provide advanced digital skills to community facilitators and agricultural extension agents [85]. These include teaching other farmers how to use digital technologies, obtaining online agricultural information, and utilising data analytics for precision farming. Extension services can help farmers in implementing digital solutions that are adapted to their agricultural needs, owing to workshops and on-the-job training sessions.

#### 4.1.2. Community Engagement

The creation of digital literacy hubs in rural areas gives smallholder farmers access to training materials and gadgets that can be connected to the internet [86]. These hubs act as gathering places for training on digital technologies related to agriculture, such as online marketplaces or pest control applications for smartphones. Through peer support networks and shared learning experiences, farmers from a variety of backgrounds are certain to benefit from community involvement projects [82].

Intensive public awareness initiatives educate smallholder farmers about the advantages of digital literacy for increasing agricultural output and revenue [81]. These initiatives highlight the valuable benefits of digital tools in regular farming operations and are carried out through community gatherings, farmer field schools, and local radio broadcasts. Campaigns urge farmers to accept digital advancements as essential to their livelihoods by presenting information that is both accessible and culturally appropriate [87].

Smallholder farmers with inadequate literacy in their respective country's official languages benefit from having access to digital training materials and resources in their native tongues, which improves their understanding and adoption [88]. Equitable access to information and technology is ensured by translating online lessons, mobile app interfaces, and agricultural manuals into local languages [88]. Training methods that take language sensitivities into account encourage diverse participation and give farmers the confidence to use digital platforms.

#### 4.1.3. Public–Private Partnerships (PPP)

Corporate sponsorship of agribusinesses and technology companies promotes the creation and adoption of farmer-centric digital solutions [89]. Sponsorship programs include funding for the development of mobile applications for agriculture, the distribution of inexpensive smartphones and tablets, and digital literacy activities. Smallholder farmers' ability to embrace digital technology sustainably is strengthened locally through cooperative efforts between agricultural cooperatives and partners in the corporate sector [90].

Initiatives for partnership-driven skill development provide tailored information in cutting-edge digital tools and platforms that are suited for agricultural situations. These programs, which encourage technology innovation and entrepreneurship among farmers, include hackathons, innovation challenges, and mentorship programs [91]. Initiatives for skill development provide farmers with market-relevant skills necessary for the digital revolution of agriculture by fusing local knowledge with industrial experience.

#### 4.1.4. Mobile and Online Learning

Access to agricultural information and services is facilitated by the creation of user-friendly mobile apps designed specifically for smallholder farmers [92]. These applications include features including market pricing, agronomic guidance, weather predictions, and financial management tools. The ability to operate offline and consume less data makes the software more accessible in isolated locations with spotty internet access, enabling farmers to increase production and make well-informed decisions [93].

Digital-agriculture-related online courses are made available by collaborating with e-learning platforms [94]. Topics covered in the courses include digital marketing tactics, IoT (Internet of Things) integration in agriculture, and sustainable agricultural techniques. Farmers' schedules and learning preferences can be catered to through flexible learning formats, which allow for ongoing skill improvement and acquisition of digital literacy expertise.

### 4.2. Enhancing Infrastructure Development in Smallholder Farming Communities

#### 4.2.1. Expansion of Internet Connection to Rural Smallholder Farming Communities

Expanding broadband infrastructure into rural regions improves smallholder farmers' access to the internet [95]. Investing in mobile broadband solutions, satellite technologies, and fibreoptic networks enhances the availability of digital marketplaces and online agricultural resources. To provide real-time data transfer, remote sensing applications, and virtual training sessions that are essential for precision agriculture and climate-smart agricultural practices, dependable internet access is required [92].

Improving the infrastructure for mobile internet access makes digital services more accessible to farmers who use smartphones exclusively. Network coverage, data pricing, and network reliability improvements provide for easy access to online markets, e-extension services, and agricultural apps [96]. Farmers with mobile internet connectivity may acquire agricultural knowledge, participate in virtual agricultural extension programs, and engage in digital commerce [94].

#### 4.2.2. Digitisation of Farmer Support Services through Mobile Applications

Service delivery to smallholder farmers is improved by implementing digital platforms for government programs and agricultural extension services [96]. Access to essential agricultural resources is streamlined by online platforms for weather predictions, market information, and agricultural subsidies. E-government programs encourage farmers to participate digitally and advance accountability, efficiency, and openness in agricultural governance [97].

Creating mobile applications for smallholder farmers in the agriculture industry increases their productivity, market access, and climate variability resistance. Features such as digital payment systems for agricultural transactions, pest and disease diagnostics, and crop management tools are all offered by these applications [98]. Farmers are better equipped to successfully adopt digital advances due to user-centric design and simple interfaces that assure accessibility across a range of literacy levels and technological proficiencies.

### 4.3. Policies Employed across Sub-Saharan Africa to Enhance E-Commerce Adoption

#### 4.3.1. Kenya

- National Broadband Strategy (2018–2023)

Introduced in 2013 and revised for 2018 to 2023, Kenya's National Broadband Strategy intends to improve internet availability and affordability, especially in rural regions, by expanding broadband infrastructure throughout the nation [99,100]. To facilitate access to digital banking services, e-commerce platforms, and market intelligence systems that are essential for trade and business development, the plan aims to increase digital inclusion, particularly for the previously excluded such as smallholder farmers.

- National ICT Policy (2006, revised 2019)

Kenya's National ICT Policy, which was updated in 2019 after being initially created in 2006, offers a thorough framework for the growth of ICT in several industries, including agriculture [101]. The strategy places a strong emphasis on using ICTs to promote social inclusion, innovation, and economic prosperity. The policy's initiatives are designed to increase smallholder farmers' and rural communities' digital literacy so they can use digital technologies, access online marketplaces, and increase agricultural production and market access.

- E-money Regulation (2013)

A regulatory framework for mobile financial services is provided by Kenya's e-money regulation, which were implemented in 2013 under the National Payment Systems regulations and the Central Bank of Kenya Act [102]. For rural communities, particularly smallholder farmers, the laws guarantee the security, interoperability, and consumer protection aspects of mobile money systems, enabling safe online transactions, savings, and credit availability. These rules encourage financial inclusion and make it possible for farmers to engage in e-commerce more successfully by endorsing mobile money services.

- Kenya National E-Commerce Strategy (2023)

A legislative foundation for digital signatures, electronic contracts, and electronic transactions was established in 2023 by the Kenya national e-commerce strategy [103]. With the goal of protecting the interests of all parties involved, particularly smallholder farmers involved in e-commerce, the act seeks to increase trust and confidence in internet transactions. In agricultural markets, innovation, investment, and sustainable growth are encouraged by stable and favourable e-commerce environments that are facilitated by the act's clear and enforced laws.

- National Agriculture Policy (2021)

Kenya's National Agriculture Policy contains measures to support modernisation of agriculture and improve smallholder farmers' access to markets. The policy backs programs aimed at enhancing market information systems, facilitating access to e-commerce platforms, and integrating ICTs into agriculture [104]. Kenya seeks to improve farmers' income-generating prospects, market efficiency, and productivity through digital transformation by coordinating agricultural policy with digital initiatives.

#### 4.3.2. Nigeria

- National Broadband Plan (2020–2025)

Expanding broadband infrastructure throughout Nigeria is the goal of the National Broadband Plan (2020–2025), which focuses on enhancing affordability and internet access, especially in underdeveloped rural regions [105]. The strategy, introduced in 2020, aims to improve digital inclusion by providing smallholder farmers access to digital banking services, e-commerce platforms, and market intelligence systems vital for agricultural trade and company development.

- National Digital Economy Policy and Strategy (2020–2030)

Nigeria offers a thorough framework for digital transformation in several industries, including agriculture, with the announcement of its National Digital Economy Policy and Strategy in 2020 [106]. The strategy places a strong emphasis on using ICTs to promote social inclusion, innovation, and economic prosperity. The strategy's specific efforts are designed to increase smallholder farmers' and rural communities' digital literacy so they can use digital technologies, access online marketplaces, and increase agricultural productivity and market access.

- Mobile Money Regulations (2021)

The Central Bank of Nigeria announced the Mobile Money Regulations in 2021, which establish the legal foundation for mobile financial services [107]. For rural communities,



particularly smallholder farmers, the laws guarantee the security, interoperability, and consumer protection elements of mobile money systems, enabling safe online transactions, savings, and credit availability. These rules encourage financial inclusion and make it possible for farmers to engage in e-commerce more successfully by endorsing mobile money services.

- Nigeria Data Protection Regulation (2019)

The Nigeria Data Protection Regulation (NDPR), which came into effect in 2019, sets rules for privacy and data protection in e-commerce and electronic transactions [108]. The aim of the regulation is to protect the interests of all parties involved, particularly smallholder farmers involved in e-commerce, while enhancing consumer trust and confidence in online transactions. A stable and favourable e-commerce environment advances innovation, investment, and sustained growth in agriculture markets through the implementation of clear regulatory standards under the NDPR.

#### 4.3.3. South Africa

- Digital Society South Africa, South Africa's E-Strategy (2017)

The South African National e-Strategy, which was introduced in 2002 and revised in 2017, offers a comprehensive framework for digital transformation in a number of industries, including agriculture [109]. The main objective of the plan is to employ ICTs to advance inclusion, innovation, and economic prosperity. The e-Strategy's specific activities are designed to increase smallholder farmers' and rural communities' digital literacy so they can use digital technologies, access online marketplaces, and increase agricultural production and market access.

- Electronic Communications Act (2005)

The legislative foundation for electronic communications, including the creation of broadband infrastructure and the supply of digital services, was established in 2005 by the Electronic Communications Act of South Africa [110]. To improve broadband connection and digital access for rural communities, especially smallholder farmers, the act encourages competition, investment, and universal service duties in the telecoms industry.

- National Payment System Act (1998)

South Africa's National Payment System Act, which was passed in 1998 and later updated, governs the nation's electronic payment systems and transactions [111]. Laws on digital financial services and mobile money platforms guarantee the security, effectiveness, and integrity of payment systems. The act promotes financial inclusion and makes it easier for smallholder farmers to participate in e-commerce by facilitating safe and dependable digital payments.

- Consumer Protection Act (2008)

Consumer rights are protected in electronic transactions and e-commerce by the 2008 Consumer Protection Act of South Africa [112]. The laws protect the interests of all parties involved, especially smallholder farmers involved in e-commerce, by ensuring fair business practices, transparency, and consumer rights in online transactions. Agricultural markets are supported by sustainable growth and innovation when clear regulatory standards under the act foster trust and confidence in digital trading.

#### 4.4. Measures to Address Cultural and Social Differences among Smallholder Farmers

When it comes to dealing with cultural and social differences in smallholder farming communities, a variety of strategies, including information-sharing programs, cultivating relationships and trust among smallholder farmers, may be used to effectively increase e-commerce adoption [113]. It is also crucial to offer tailored training programs that address the unique needs and capabilities of smallholder farmers [114]. These programs ought to emphasise enhancing digital literacy, summarising the advantages of e-commerce

and clearing up any misunderstandings or anxieties about doing business online. These educational initiatives can be more successful in breaking down cultural barriers when they are adapted to fit local languages, cultures, and learning preferences.

Another essential strategy for bridging social and cultural divides among smallholder farmers is to cultivate trust and relationships [115]. In their economic activities, smallholder farmers frequently give priority to personal connections and networks built on trust. As a result, for these smallholder farmers, establishing trustworthy e-commerce platforms that ensure safe transactions, equitable pricing, and prompt delivery of commodities is crucial [76]. Thus, adding customer service, feedback, and dispute resolution processes helps to reassure smallholder farmers who are reluctant to use e-commerce platforms [116].

In conclusion, overcoming the cultural and societal barriers that prevent smallholder farmers from adopting e-commerce needs a multipronged approach that includes relationship-building, education, and trust-building. Thus, by understanding and showing consideration for the unique circumstances and difficulties encountered by smallholder farmers, stakeholders can enable these farmers to capitalise on the advantages of e-commerce platforms to enhance sustainable agricultural practices, market accessibility, productivity, and livelihoods.

## 5. Conclusions and Recommendations

The agricultural sector has never been the same since the introduction of e-commerce. This has allowed robust but timely and effective engagements between all the agricultural stakeholders such as the producers (farmers), the buyers (market), the industry partners (production input suppliers), and research and innovation institutions such as institutions of higher education and research councils or commissions. This paper reviewed literature on the influence of e-commerce platforms towards the practice of sustainable agriculture, especially among smallholder farmers in the SSA region. The paper discusses the implications of e-commerce on the sustainable farming practices, which involves crop rotation, mulching, the use of integrated pest and weeds management, production of both livestock and crops (mixed farming), and the use of cover and intercropping systems. These practices are influenced by the market (clients) who in one way or the other dictates what must be produced and how it must be produced.

The policy implications of e-commerce come as a result of the increasing use of e-commerce in the industry and the agricultural sector. This is necessitated by the call for the integration of precision and digital agriculture with e-commerce to improve efficiency and productivity. The market demands, with the set standards on how to produce agricultural products, calls for policy development and implementation that details the use of e-commerce ethically. The enactment and implementation of policies guiding the ethical use of e-commerce, digital agriculture, precision agriculture, and artificial intelligence (AI) for business transactions in the agricultural sector is of the essence. These will further guide marketing of agricultural products to raise awareness in a socially acceptable manner and at the same time guide government interventions in aiding smallholder farming in the SSA region.

The impact of electronic commerce is enormous and aids the agricultural sector in increasing production and contributing to employment creation, especially in terms of technical skills instead of only semi-skilled labour for the sector. Policy will further guide the recruitment and appointment of e-commerce agents, not only for the purchases and sales at a local scale but also the international level. Rapid rural development (RRD), especially through smallholder farming, would be achieved, leading to poverty alleviation and food security among rural people. Therefore, it is recommended that policymakers urgently attend to the call of policy development for guiding online transactions in all possible ways, especially considering the acceptability of e-commerce among smallholder farmers in SSA.

Social and cultural factors influencing uptake of technology advancements needs to be factored in when drafting such policies. Moreso, it is recommended that government

agents should consequently put together activities and programs for raising awareness and promoting the uptake of e-commerce and related technologies. The business environment must be made to be conducive for smallholder farmers to thrive and advance in SSA. In the quest to uncover how to break many of the barriers to the uptake of e-commerce, future research studies can focus on how social and cultural factors influence farmers in their adoption of e-commerce as well as how extension youth projects can harness the implementation of e-commerce and lead SSA to a wealth of activities to transform the region, especially through smallholder farmers.

## 6. Limitations

The review may be subject to publication bias, as studies with positive results are more likely to be published. Limiting the review to English-language publications and studies conducted from 2010 to date may have excluded relevant research published before 2010. Moreover, the review study mostly reviewed literature on SSA as a geographical region rather than placing too much emphasis on all the individual 48 countries constituting the region. Therefore, literature from other countries within the SSA region on e-commerce use by smallholder farmers might have been overlooked.

**Author Contributions:** M.T.M. masterminded the paper and came up with some areas to be covered in the paper. N.S.M. was very instrumental in the writing of the results and discussion part of the paper. M.Z.S. participated in drawing up policy implications of e-commerce in the context of SSA countries. A.I.A. served as the reviewer and technical editor. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** This is a review paper; no data are available for this purpose.

**Acknowledgments:** The authors wish to acknowledge the University of Mpumalanga for paying the Article Processing Fees for the purpose of publishing this paper.

**Conflicts of Interest:** The authors declare no conflicts of interest.

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