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Effect of digitizing food systems from agriculture on youth employment in Africa countries

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ABSTRACT

Using the Sub-Saharan region of Africa as a case study, this paper offers a thorough analysis of the impact of digitizing food systems from agriculture on youth employment in African nations. Africa is confronted with the urgent problem of high rates of young unemployment, even if the agricultural sector continues to play a significant role in the nation's employment and economic conditions. The transformational influence of digital technology on the agri-food business as it pertains to youth employment is investigated through a review of relevant literature and an analysis of secondary data that is readily available. Furthermore, the study looks at the opportunities and challenges for young people to get involved in the digital agriculture environment, taking into account factors like digital literacy, technological accessibility, and policies that encourage it. This report provides evidence-based tactics for leveraging the potential of digitalization to support youth employment for governments, development organizations, and business sector partners. The suggested tactics seek to overcome obstacles, close the current gaps in digital knowledge and access, and create a supportive atmosphere for youth-led agri-food involvement. This research contributes to our understanding of how digital technologies may be used to promote food security, empower youth, and foster sustainable economic growth in Sub-Saharan Africa. Increasing youth participation and digitizing agri-food systems can transform Africa into a more affluent and inclusive continent.

Keywords: Digitizing; Food systems; Agriculture; Youth employment; Africa

1. INTRODUCTION

The importance of the agriculture and food sectors in ensuring food security, fostering economic growth, and reducing poverty may not be overstated. The sector's contribution to GDP and employment creation at the local, national, regional, and global levels Loizou et al., (2019), Alston and Pardey, (2014) is indicative of this. Reports that this industry is well-known for offering a wide range of employment opportunities, especially in developing nations like Ethiopia and Nigeria where agriculture is the main driver of the economies and employs over 70% of the labour

force 52% in Ghana, and 54.8% in Zambia (Odetola and Etumnu, 2013). According to agriculture accounts for 20% of GDP in Zambia and 17% in Ghana.

Moreover, these emerging nations account for more than 4% of the global GDP (World Bank, 2023). Nevertheless, despite its importance, the agricultural industry confronts several difficulties, such as an ageing farming population, a lack of enthusiasm from the younger generation, and problems with productivity brought on by traditional farming methods. Family farming, which is mostly done on small farms, is unrestricted and unhindered in SSA as it is still very important in the field of food production (FAO, 2018). Notably, labour on these family-run farms is increasingly taken on by the older generation, which may make it difficult for them to adopt new agricultural technology.

As a result of all of these variables working together, food prices have increased, which has increased the rate of hunger and crises among the people in Sub-Saharan Africa (SSA). Shocks related to COVID-19, unfavourable weather, drought brought on by climate change, and geopolitical upheavals like Russia's invasion of Ukraine have all made these problems worse. Therefore, encouraging the next generation to choose a career in agriculture becomes crucial. According to, young people's disinterest in agriculture is mostly caused by their perception that the formal wage sector is the answer to their problem of youth unemployment. Consequently, there is a huge demand for a relatively small number of white-collar professions.

However, it is evident that despite the agriculture sector's significant potential to create "green jobs", youth involvement in farming is still declining in Sub-Saharan Africa (SSA) due to the risks involved, the profitability ratios, and the continued lack of physical demand. The current worldwide shift towards a more environmentally conscious lifestyle offers promising job opportunities, particularly for young people. By 2030, investments in green transitions might generate 20.5 million new employments, according to the UNEP and ILO. Furthermore, according to ILO projections, the implementation of digital and green policies might result in the creation of approximately 60 million extra employment for youth by 2030. Irungu et al., (2015) have listed digital, financial, climate-smart, and precision agricultural tools as examples of contemporary technology advances that have the potential to serve as catalysts for young engagement in the agri-food industry and spur innovation.

These developments have raised productivity and efficiency, which has resulted in the production of more food that is both abundant and sustainable. They are also assisting in addressing the issue of youth migration by encouraging young people to return to agriculture. For instance, the IFAD has recognized the potential and implemented several programs to encourage youth involvement and the use of technology in agriculture. There is a critical research gap as the specific impact of these programs has not yet been determined. This project aims to investigate how digitalization in the agri-food industry might act as a spur for creating job possibilities for young people in Sub-Saharan Africa. This research aims to improve our understanding of how digital innovations can be effectively harnessed in the agri-food domain to address youth unemployment and stimulate economic growth in the region by thoroughly analyzing the status, impact, prospects, and challenges of digitization initiatives.

This research seeks to add to the body of knowledge by providing fresh perspectives and useful recommendations to stakeholders and policymakers regarding how best to leverage digitization to maximize the benefits of creating jobs for youth in SSA's agriculture industry. Even though agriculture has a bright future thanks to technology, several obstacles are preventing young people from entering this field, such as low financing, poor education, and expensive infrastructure (IFAD, 2018). Previous studies have focused on how youth participation in agriculture is influenced by assets such as land, finance, skills, and non-financial items (Mulema et al., 2021). On the other hand, little is known about how digital technology may boost youth entrepreneurship and involvement in a way that opens up employment prospects in the agri-food industries.

By providing novel and important insights on the application of digital technology in agriculture to engage youth in the agri-food sector in Sub-Saharan Africa, this research seeks to fill a gap in the body of current work. To encourage more young people to participate in the agriculture and food industries, it also looks at how IFAD and other development organizations are promoting the wider adoption of digital technology. The results of this study may have an impact on future policies and actions in this field (Leavy and Hossain, 2014). The specific goals are to look into how digital technologies can improve youth involvement in the agri-food sector, assess how IFAD projects can help youth get more involved in the agricultural sector, and assess the opportunities and challenges of digitizing the agri-food sector and how that will affect youth engagement in Sub-Saharan Africa.

2. LITERATURE REVIEW

Agriculture in Sub-Saharan Africa

The agri-food business, to put it simply, encompasses everything from farm production to food consumption (IFAD, 2019a). As the main source of income for 60% of the continent's population and a contributor to 23% of its GDP, it remains Africa's most important economic sector. It is essential to both global trade and regional economic growth because it provides the majority of the raw materials needed by nearby businesses. Africa makes up over 25% of the world's arable land, but because traditional agricultural practices are so prevalent, 60% of the continent's arable land is left uncultivated.

Even though the UN established the Sustainable Development Goals (SDG) in 2015 to eradicate hunger, reducing poverty, and promoting peace and equality by 2030, over 250 million people in Africa remain hungry. This is primarily because of population growth, which suggests that SSA will continue to experience rapid growth, which will have a significant impact on the region's food demand. It is predicted that by the middle of the century, there will be an unprecedented 9 billion people on the planet (IFAD, 2019). Over time, Sub-Saharan African smallholder farmers have relied more and more on manual labour and basic farming inputs as a result of the continent's rapidly growing population and rising food demands.

Moreover, their reliance on natural ecosystem processes for farming is substantial, making them more susceptible to the effects of climate change (IPCC, 2014). Due to these circumstances, efforts to move from traditional to modern systems in the agri-food sectors in line with the structural transformation of national economies in SSA have made it possible to promote and implement sustainable agriculture through digitization, an inclusive approach to transitioning from the conventional farming system to a digitized one while advancing and safeguarding sustainable development goals.

Digitization in the agri-food sector

Adeniran et al., (2024a) noted that to create a digital representation that can be electronically processed or stored, an analogue signal must first be captured and then converted into digital form, this is a process that is referred to as digitization. Adeniran et al., (2024) noted that information and communication are now accessible to everyone, wherever, at any time, through any device, and any kind of access due to of digitization. A growing amount of recorded information has gone digital due to the increased usage of computer technology. Digitalization in the agri-food industry refers to the use of digital instruments, which include things like radios, cellphones, neural networks, cloud computing, the World Wide Web, and big data. The goal of this digitization was to increase output and boost food production efficiency.

Agriculture 4.0, often known as digital farming or precision farming, is the result of this. The future of industrial agriculture is known as "agriculture 4.0", and it entails revolutionizing production, processing, distribution, and marketing as well as using digital tools, data analytics, networking, and automation. Digitalization services range from straightforward advice via mobile devices to cutting-edge drone and satellite systems for accurate soil and nutrient management (Tsan et al., 2019). Throughout history, farming has seen several notable breakthroughs, and the present revolution in digital farming has the potential to meet the demand for food that the world will need in the future (Trendov et al., 2019). Digital technologies such as automation based on drones, machine learning, and related advancements are enabling progress in agriculture.

Digital farming optimizes the management and distribution of agricultural products by utilizing instantaneous access to data and a highly interconnected infrastructure (Trendov et al., 2019). Digitalization for agriculture (D4Ag), a method that involves implementing technological advancements throughout the value chain for agriculture chains, is being utilized to address barriers facing the agricultural industry (Tsan et al., 2019). D4Ag advocates for better environmental outcomes, a greater role for women and young people, protection against hunger and malnutrition, and higher profits for small-scale farmers. By increasing the flow of data to participants in the agricultural value chains, including extension professionals, agric-input retailers, agricultural companies, financiers, and policymakers, D4Ag helps bring about a fundamental shift in the agri-food industry. This is achieved through the use of online resources and pathways.

Over the past three years, there has been a notable growth in the number of digital agricultural services firms entering the African market. Approximately 60% of these companies, or 227 out of 390 options, currently serve the continent (Tsan et al., 2019). Goedde et al., (2021) state that these digital agricultural businesses provide solutions that generally consist of five essential services: Data and advice offerings. Digital farming is growing quickly and earning up to €144 million a year, with 13% of small-scale farmers in Africa

utilizing digital solutions. There's growing evidence that the industry helps small-scale farmers. The recent rebirth in digital agriculture is good news for Sub-Saharan Africa because it tackles some of the key difficulties the region is now facing. In the field of agriculture, digitalization has been hailed as a revolutionary development.

However, the majority of research focuses on how e-commerce technologies affect the supply chain, sometimes failing to consider how this affects adolescent involvement. Furthermore, even though Glaros et al., (2023) highlight the participants in food systems and place a greater emphasis on small-scale farmers, the literature does not break down to account for youth in his research. Nonetheless, there is now much discussion on how technology in SSA affects young people's participation in the agri-food industry.

Understanding how technology is influencing the youth, who are among the population with the highest levels of engagement, is essential. Their involvement in this area is especially noteworthy because the region mainly depends on agriculture for living and economic prosperity (IFAD, 2018). SSA has the youngest population in the world, with about 60% of its citizens under 25. However, it has been observed that to fully realize their potential, innovative solutions are desperately needed due to the alarmingly high rates of young unemployment.

Overview of the youth engagement in agriculture in SSA

The shift from reliance to independence characterizes the developmental stage of youth (IFAD, 2019a). Depending on reliable sources, there are differences in the precise age range that constitutes youth. The standard age range for defining youth in Sub-Saharan Africa is 15 to 35 years old, as per the Africa Youth Charter (AYC), which has the backing of the African Development Bank. Nonetheless, there is a difference in this definition between the United Nations, which defines young people as those between the ages of 15 and 24, and the ILO, which views youth as those between the ages of 15 and 29. This variety represents various viewpoints about the classification of young people.

As projected by the International Labour Organization, which made it clear that the youth population in Sub-Saharan Africa will continue to rise until 2050, people in the age range of 15 to 24 are expected to make up 16% of the global population by 2020, according to the World Youth Report. According to additional forecasts, there will be around 1.3 billion young people living in the world by the year 2050. This young population will live in poor countries for the vast majority of the time which is roughly 85% of them with 17% of them being in Africa. Notably, the Youth Division of the Africa Union Commission reports that about 65% of the continent's population is under 35. Youths under 25 make up over 60% of the population of Africa, which is characterized by a high young presence in the continent's demographic landscape.

By 2030, it is anticipated that there will be an astounding 400 million young people on the continent. In addition, it is predicted that 60% of the global labour force will reside in Africa by 2050. Notwithstanding this demographic benefit, there are alarming employment figures. Of the nearly 400 million youth in Africa, more than 140 million are jobless, another 140 million work in unstable jobs, and just around 70 million have steady, well-paying jobs. These numbers demonstrate the opportunities and challenges associated with youth employment in the area. The rate of youth NEETs (not in education, employment, or training) is rising throughout Africa; in 2021, it was 20.8%, with a 10% higher rate for women. Youths account for 60% of the jobless labour force in Sub-Saharan Africa.

According to, youth in SSA comprise 23.5% of the 38.1% overall impoverished labour force. This means that, given the number of young people joining the labour market each year, more than 20 million jobs must be created year until 2035. In the past, agriculture has historically given the younger generation many opportunities by contributing significantly to employment in SSA. As immediate chances for formal wage job development may be limited, countries that predominantly rely on agriculture are projected to continue benefiting from employment growth potential inside the agricultural sector in the medium to long term, according to. Furthermore, highlights that the rising demand for agricultural items both domestically and internationally encourages young individuals to work in agriculture and gives them the chance to make a life doing so.

However, despite agriculture's ability to produce jobs for the growing young population, there is a noticeable lack of excitement for it among the youth, especially those living in urban areas (Yeboah et al., 2020). Backs up his claim that young people are becoming less interested in agriculture due to danger, physical demands, and low-profit margins. While there has been a recent reduction in young engagement in agriculture, it is easy to generalize about adolescent perceptions and aspirations in the agri-food systems without taking the local context into account. If youth are accustomed to commercialized agriculture and believe they can take advantage of good economic opportunities to increase their income and standard of living, they may view agri-food systems as a platform of opportunities; however, they may be intimidated by the antiquated, traditional, and methodical farming practices.

While the design of such should take into account their local context, it has been demonstrated that promoting young engagement in agriculture through skills and training is essential and successful in increasing paid income, self-employment, and entrepreneurship for youth in agribusiness. Researchers like have emphasized the need for technology uptake, particularly about ICT-based extension, which will also help women become highly involved in the agri-food system. Efforts are being made to achieve the desired gender balance.

3. METHODOLOGY

The study often employs a secondary methodology, deriving findings from data and research that has already been published, including case studies from development programs and IFAD-funded initiatives. To accomplish this study, a structured (narrative) study is used to examine the relationship between youth employment and digitalization in the farm and food sector. To enable flexible analysis of current information and the provision of rapid solutions to problems about youth development and job prospects in SSA, a semi-systematic literature review technique was used.

A semi-systematic review adopts a more flexible approach to assessing the literature on developing subjects than a systematic literature review, which seeks to gather all empirical evidence satisfying predetermined criteria to address a particular research question. While there are benefits to both methods, a semi-systematic review can offer a more comprehensive viewpoint and insights into a rapidly evolving field of research. Due to budget restrictions, it is not feasible to conduct research on every facet of youth agriculture engagement in Sub-Saharan Africa before suggesting a policy or intervention solution. This means that the analysis in this study is based on studies that were conducted in a variety of environments.

Research design

Developing research objectives and questions to guide the analysis and evaluation process was the first stage. It was simpler to compile and assess relevant studies since these study aims and questions guided the choice of materials and search phrases in the literature. In the second phase, a comprehensive search of the corpus of earlier research relevant to the study themes was conducted on Science Direct and Google Scholar. Conducting thorough research requires the effective integration of pertinent terminology and texts about youth development and digitization in the agri-food business. This variety of materials will probably help you do a thorough investigation of the topic for your paper.

Data collection

The IFAD, FAO, CTA, Science Direct, and Google Scholar databases provided the publications for this study. Recent research on the impact of digitization on promoting youth employment in agri-food systems was examined using methods for finding, collecting, and organizing material.

Choosing keywords

A comprehensive keyword strategy was constructed using relevant phrases and concepts related to the study subject. Terms utilized for literature searches included digitization, youth employment, agri-food systems, agricultural technology, youth participation, rural youth, e-agriculture, and agricpreneurship, both separately and in combination. A search term string was created by using Boolean operators like "AND" to combine distinct keywords and "OR" to account for synonyms. This string was used to get data from databases in addition to screening all publications according to their titles and abstracts.

Standards for inclusion and exclusion criteria

The following criteria were applied when selecting which publications to include in the systematic review to evaluate their quality and relevance: Regarding the Inclusion Standards:

- Articles that concentrate on teaching young people about agri-food systems;
- Articles published in journals with peer review;
- Articles published within the past ten years;
- Articles focusing on Sub-Saharan Africa;

Pieces written by English authors.

If a document met these criteria, it was read in its entirety. The references in the articles that were read were also examined to find other papers that could have been missed in the previous search. About 4000 articles made it past the first screening, and only those that met all assessment criteria were included. Additional literature, including reports from organizations and policy papers, supported the study's findings. We looked over these articles to find information or main points that we may include in the review. Creating research questions was the initial stage to guide the process of analysis and review.

Exclusion Criteria

Studies that were not in English were disqualified because of resource limits that will take language difficulties into account. Theses, dissertations, and conference abstracts which all non-peer-reviewed research which was not included in the review. Excluded from consideration were studies that did not specifically examine how youth employment in agri-food systems is affected by digitalization. After downloading, reading, and synthesizing the pertinent publications, extensive discoveries and insights for the dissertation were obtained.

Data analysis

The examination of the data was thematic. Finding, analyzing, and interpreting patterns or "themes" in the data we have collected are all part of this process. This approach gives qualitative data structure and order, making it useful for managing large datasets.

4. RESULTS AND DISCUSSION

How digital technology fosters youth engagement in agriculture in SSA

Youth in Africa may now actively participate in the agri-food business because of digital technologies (FAO, 2020). It provides access to resources that were previously limited or unavailable, including essential information. Young farmers may overcome conventional hurdles and increase their production with the use of internet access, smartphone applications, remote sensing, and precision agriculture. Businesses such as One Acre Fund, which collaborates with M-PESA, employ digital technology to assist farmers with loan repayment. Similarly, companies like Aerobotics utilize artificial intelligence and drones to provide farmers with early alerts regarding pest and disease outbreaks on their farms.

These developments bolster the FAO's position, which projects that the African agribusiness sector will be valued at \$1 trillion by 2030, with a significant role played by agritech. Youth participation in agriculture has been impacted by the rise of smartphone applications and internet platforms (Meirmanova, 2019). Thanks to digital solutions created by entrepreneurs, young farmers now have access to essential information including market pricing, weather forecasts, financing, and agricultural best practices. For example, organizations such as WeFarm, Thrive Agric, and Farmcrowdy provide young Africans with access to a global farming community and possibilities to provide services to farmers in exchange for financial compensation.

Furthermore, the use of digital technology to close knowledge gaps for aspiring farmers is another important benefit. Real-time access to market pricing, pest and disease control strategies, weather predictions, and best agricultural practices is made possible by mobile applications and internet platforms. Youth are better able to manage crops, make educated decisions, and reduce hazards thanks to this timely information. Digital technology also makes it possible for young farmers to interact with consumers and marketplaces, removing geographical obstacles and the need for middlemen. Digital marketplaces, mobile money apps, and e-commerce sites allow for direct transactions, giving young people access to a larger consumer base and reasonable rates for their goods (Dillon et al., 2020).

Furthermore, youth may now access loans, savings, and insurance products thanks to digital financial services, which improves financial inclusion and lowers the risks involved in agricultural production. Young people's entrepreneurship in the agri-food sector is encouraged by digital technologies. Young farmers can reach a larger audience by marketing value-added products, including processed foods or handcrafted crafts, through online platforms. Young entrepreneurs may build their brands, boost profitability, and generate jobs in their communities by utilizing social media platforms, e-commerce, and digital marketing techniques. Thanks to modern technology, youth in agriculture may develop their talents and skills more quickly.

Thanks to online training programs, webinars, and e-learning platforms, young farmers have easily accessible and reasonably priced opportunities to acquire new skills, learn about modern farming techniques, and stay up to date with the newest trends. Digital platforms also facilitate peer learning and information exchange, connecting youth from diverse locations and promoting collaboration and creativity. While there are many benefits to digital technology, there are also issues and restrictions that need to be resolved. Youth in rural regions continue to face obstacles related to limited access to reasonably priced cell phones, internet connectivity, and digital literacy abilities. Furthermore, poor infrastructure and unstable power supplies make it difficult to use digital technologies effectively, particularly in isolated and off-grid areas.

Gender and socioeconomic disparities need to be considered when young people in the agri-food industry adopt and use digital technologies. Among the additional difficulties that women and other disadvantaged groups commonly face include cultural norms, a lack of control over resources, uneven access to technology, and limited opportunities for training. The full benefits of digital technology for all young people engaged in agriculture depend on inclusiveness and the encouragement of gender-responsive digital activities. In conclusion, robust institutional frameworks, financial commitments, and legal frameworks are necessary for the agri-food industry to successfully incorporate digital technology. To help teenagers utilize digital technologies effectively, governments, development organizations, and commercial partners must collaborate to provide the necessary infrastructure, provide training and capacity-building programs, and foster a positive environment.

A thorough study has shown that adolescents' engagement in agriculture in Sub-Saharan Africa is significantly and complexly impacted by technology. Thanks to technological advancements like digital platforms, precise farming, and other instruments that help overcome difficulties obtain information and learn new farming practices, youths are growing more self-sufficient. To capitalize on the enthusiasm and fervour of the younger generation and advance agricultural development in the region, it is imperative to explore and understand the potential of technology as it advances (Onyeneke et al., 2023).

Digital tools that support Youth engagement in the Agri-food sector

According to earlier studies, digitization might lead to more young people being employed in the agri-food industry. Current ICT equipment and applications, such as mobile phones, drones, SMS, TV, GIS, and video tools, have a substantial influence on the cost-effective distribution of knowledge and information to subsistence farmers in Sub-Saharan Africa, according to a recent study. State that additional state-of-the-art innovations such as blockchain technology for traceability, artificial intelligence tools like robots and drones for precision agriculture, and remote sensing technology that uses satellites to provide climate data are helpful for sustainable development in the agri-food sector with significant effects on youth engagement in the sector.

Given that the total addressable market in 2018 was over 2.3 billion euros and covered important sub-sectors like market linkages, digital advisory services, and financial access using tools like artificial intelligence (AI), big data, blockchain, sensors, and remote sensing, it is believed that digitalization of agri-food systems will create a wide net of opportunities in Africa. In addition to the substantial market base, research indicates that combining sub-sector services can enhance young farmers' income by 57% and productivity by 168%. Results from earlier studies, such as the CTA study "Digitalization of African Agriculture", which reported on a mixed-method study using a database of 390 D4Ag, show the number of use cases. The agri-food sector can draw investment thanks to digitization. The survey also reveals that young people make up the majority of D4Ag solution users, with over 70% of registered users being between the ages of 15 and 35.

This has led to projections that D4Ag will create net jobs, particularly via facilitating the agency network that will connect farmers in SSA to markets, financing, inputs, information, and other resources. These days, young people are involved in digital farming, which uses IOT systems and wireless sensor networks to gather data on agricultural and animal operations. Drones and other technologies are used to reduce costs and increase field efficiency (Marwa, 2020). Many software programs have been developed for precision agriculture, including iCow, which uses SMS to communicate with farmers on a package of practices to manage their livestock, including notices of disease outbreaks and when cows are on heat, and Hello Tractor, which allows farmers to text tractor booking agents to obtain a tagged tractor that they can use for planting, harrowing, ploughing, and ridging (ibid.).

The social enterprise is providing affordable tractor services to resource-poor farmers, especially young individuals facing labour shortages, by employing state-of-the-art technology (Accelerator, 2020). Using IoT-powered software, Hello Tractor transforms ordinary tractors into smart tractors by linking them to a data cloud so that farmers can view the tractors' whereabouts and availability. Since its founding in 2014, the company has generated over 2 million direct and indirect jobs in 16 SSA countries. Its operational base is

in Kenya and Nigeria, and over 3000 tractors equipped with its IOT technology have enabled over 500,000 farmers to access affordable tractor services, generating over \$5 million in revenue annually (Accelerator, 2020). It hires young people and trains them to utilize its software platform.

The young commission-based booking agents assist farmers in scheduling the necessary tractors and also link idle tractors with nearby farms. These young agents' wages have increased as a consequence, improving their standard of living. According to, the younger generation believes that the platform-based tractor leasing service is beneficial to farmers and simple for them to reserve on their behalf. Others, such as Acquahmeyer in Ghana, provide farmers with drone services for comprehensive farm surveillance to guarantee effective crop management. Research by Aker and Ksoll, (2016) also shows that mobile money can help young people and women have more access to financing. The author concludes that there is a larger penetration of mobile money, including mobile credits and savings services, in less changed nations after comparing them with highly transformed ones.

The use of mobile money by SHF in Kenya and other SSA countries, according to indicates that digital technology is a crucial entry point for young involvement in the agri-food industry. With e-extension advice, more farmers may affordably obtain the most latest information, in contrast to traditional extension approaches (Davis, 2008). Furthermore, according to Arouna et al., (2020), digital technology enables farmers to obtain more affordable and customized extension services. According to farmers in rural Tanzania used more ecologically friendly techniques and had a better comprehension of many aspects of agriculture when information was distributed through text messaging and radio. The study found that combining SMS assistance with radio commercials boosted awareness and acceptability.

Heifer also conducted a study in which 299 SGF, 110 Agribusiness companies, and 29,954 youths representing 11 different countries (Zimbabwe, Ghana, Uganda, Kenya, Malawi, Rwanda, Nigeria, Tanzania, Senegal, Zambia, Ethiopia) participated in a virtual focused group study and an e-survey to learn more about the use of technology in agriculture. According to the poll, youth's involvement in agriculture is significantly impacted by technology use, as evidenced by the fact that over 39% of kids in the survey became active in agriculture as a result of technological innovation. The CTA manual on digitization states that ICT may help to advance agricultural businesses and that there is a big chance to address the young unemployment crisis in Sub-Saharan Africa by combining digital technology with agriculture.

This is because young people are spearheading the use of ICT and digital tools that will address the productivity problems that have led to food insecurity in Sub-Saharan Africa (SSA) in the face of an expected 2.4 billion people by the year 2050. Additionally, money transactions have improved the efficiency of cash transfers, increased the percentage of non-farm freelance work (from 3.4% to 6.4%), and reduced the number of severely malnourished families (from 62.9% to 47.2%) in areas lacking easy access to traditional banking services.

Prospects and obstacles for youth engagement in agri-food system in SSA leveraging digital technology

For young people in Africa, this part offers a thorough overview of the difficulties posed by digital technology in agricultural and agri-food systems.

Enabling value chain links and access to market information

The expansion of agriculture is behind in SSA (World Bank, 2013). In several of the region's nations, such as Ethiopia, Malawi, and Burundi, exports of agricultural products account for around 75% of total exports. However, due to a lack of real data on pricing and marketing, young farmers in SSA have a tough time making timely decisions about selling their goods. Digital innovations that provide farmers more access to price and marketing data might help them bargain more effectively and reduce the danger of selling at absurd prices (Malabo, 2019). For example, the widespread usage of mobile phones in rural Niger has made it more inexpensive to acquire agricultural information, particularly price information (Aker, 2010). Recently, there has been an effort to solve some of the issues facing the agri-food sector by integrating young, small-scale farmers into global value chains (GVCs) (Ruben, 2017).

However, due to some factors, including challenges in the output market, inaccessibility to inputs and technologies, inadequate infrastructure, a lack of funding, a shortage of skilled labour, and other barriers, small-scale farmers in Sub-Saharan Africa, particularly women and youth, are underrepresented in agriculture value chains (World Bank, 2013). But there's a growing recognition that more effective and well-regulated agri-food systems in Sub-Saharan Africa rely heavily on better digital connection. Global value chains may

be better managed and tracked with the use of data gathered by digitalizing value chains. Small-scale farmers are connected to inputs through technology-enabled solutions, which address challenges in the agri-food systems.

Twiga Foods, an agricultural company founded in 2014 to bridge the gap between vegetable and fruit growers in Kenyan communities and SME sellers in towns, benefited more than 17,000 farmers in the country in 2019. This project demonstrates how such initiatives may benefit some agri-food supply chain elements, such as markets, equipment and services used in production and post-harvest, and final consumers (Malabo, 2019). Because there is no longer a need for physical travel between stakeholders in the value chain, advances in information and communication technology (ICT) have improved information flows and strengthened ties between organizations (Foster and Heeks, 2013).

According to the, the spread of digital technology and online markets has the potential to drastically alter how SMEs engage with their suppliers and consumers. The growing number of Kenya's small-scale horticultural producers who own mobile phones has facilitated the development of digital markets, improved growers' awareness, and provided them with more means of communicating with other chain choices, among other advantages.

Agricultural productivity and livelihood improvement

Sub-Saharan Africa (SSA) is often seen as a crucial area for economic growth, the reduction of hunger, and the upkeep of a food-secure region, according to. The area has a large quantity of undeveloped arable land, an abundance of underutilized water resources, and the potential to boost agricultural output via the use of better inputs. Thus, it is believed that Africa's agricultural sector has to grow to meet the world's growing need for food. Nonetheless, SSA's farm production is still poor in comparison to other areas for some reasons. These difficulties are caused by a variety of elements, such as low land ownership, limited investment, inadequate infrastructure, poor pricing tactics, and the existence of weak organizations. Moreover, according to the research conducted by Bjornlund et al., (2020), other elements are contributing to this situation. Among these include the climate, the state of the land, slavery, and illnesses.

Furthermore, the agricultural productivity of the area has not kept pace with the population growth of the area (Tittonell and Giller, 2013). In comparison to other worldwide regions, this is mostly caused by lower rates of employment and agricultural productivity (Tittonell and Giller, 2013). Enhancing input accessibility, implementing supportive regulations, and putting in place as efficient of a value chain as feasible are all required to get beyond this barrier. The ever-growing population and its ever-increasing need for food will not be met by simply expanding the quantity of land that can be cultivated. Asfawa et al., (2012) state that the creation and use of technology that raises crop yields is necessary to enhance agricultural productivity in Sub-Saharan Africa.

Information inequality has historically served as a barrier to subsistence farmers' access to markets and creative inventions that have the potential to boost productivity, claim (Ochieng et al., 2013). Extension specialists have been crucial in filling up the knowledge gaps and offering SHF in SSA advisory services, according to (Davis, 2008). However, low infrastructure, inadequate incentives and duties, and lower extension agent-to-farmer ratios may make it more difficult for them to deliver information that is both relevant and current (Aker, 2011). In certain parts of sub-Saharan Africa, precise knowledge about the ideal rates of fertilizer application has not been translated into attainable production improvements, according to a study by (Arouna et al., 2020).

To adapt to changing circumstances, farmers require constant education and continuous access to knowledge about environmentally friendly yield-increase technologies. This has led to a growing focus on providing knowledge that is easily accessible and customized to meet their specific needs, which emphasizes the necessity of efficient information transmission techniques while utilizing technology. ICT platforms have the power to completely transform conventional extension services by providing farmers with timely and information-rich resources, claim.

Research by Quandt et al., (2020), and Ochieng et al., (2013) in Kenya, in Nigeria, in Tanzania's Iringa village have all demonstrated the benefits of ICT-based interventions on farmers' adoption of better practices and increased productivity. These studies showed that smallholder farmers increased their productivity and profitability by using ICT-based market information services, customized mobile advising applications, and SMS reminders. They also improved the way they used seed and fertilizer, increased labour and land efficiency, and increased seed and fertilizer consumption.

Financial services and inclusion

Only a little more than 25% of the general population has access to formal financial services, according to the 2017 After Access study carried out in ten Sub-Saharan African countries (Gillwald and Mothobi, 2019). For instance, the adoption rate of mobile financial services is significantly lower in Nigeria and South Africa, at 4%, compared to 85% in Kenya, 55% in Ghana, and 45% in Tanzania. Notwithstanding these differences, mobile money services have contributed significantly to increasing SSA's access to financial services. McIntosh and Mansini, (2018) contend that without access to financial services, farmers' contributions to economic growth and the reduction of poverty are minimal. Agriculture accounts for one-fourth of the GDP in Sub-Saharan Africa (SSA), making it a vital sector for the region's economy, efforts to combat poverty, and food security.

According to reports from the World Bank Group, (2020) and the Malabo, (2019), a sizable portion of smallholder farmers in Sub-Saharan Africa still do not have access to official financial institutions or basic financial products like loans and insurance. Digital financial services (DFS) have a promising opportunity to lessen these disparities by decreasing entry barriers for banking, savings, and transaction services (Martin and Harihareswara, 2016; Malabo, 2019). The term "Digital Financial Services" (DFS) encompasses a wide range of financial support programs (Martin and Harihareswara, 2016). By 2020, digitization is expected to contribute to higher agricultural productivity and savings rates, according to the World Bank Group.

Additionally, it can ensure trustworthy and secure financial transactions. For example, mobile money services facilitate the sending and receiving of money in rural parts of Northern Uganda. A similar study carried out in Malawi discovered that because mobile banking services are so convenient, families with more mobile phones were more likely to have access to finance. M-PESA, or mobile money, encouraged families, particularly those where women handled financial decisions, to save more money and take on more financially responsible behaviours, according to different research by (Jack and Suri, 2014).

Social comfort and risk sharing

According to digital payments can enhance the welfare of consumers through direct and indirect means. M-PESA is credited for assisting 194,000 Kenyan families to escape poverty by increasing the average amount of money spent per person (Suri and Jack, 2016). For women who have moved from agriculture to business, it has also created new job prospects (Suri and Jack, 2016). According to Martin and Harihareswara, (2016), DFS can benefit farmers in some ways, including risk management, reduced transaction costs, and increased access to credit and savings.

Research conducted in Kenya indicates that M-PESA contributed to families' ability to recover from shocks by making gifts and loans easier to acquire through social networks, strengthening the informal risk-sharing ecosystem (Jack and Suri, 2014). Consequently, M-PESA users were more likely to get bigger rewards from distant locations and wider networks in the event of unanticipated negative shocks. In contrast, households that did not utilize M-PESA were unable to sustain their spending levels in the face of income fluctuations brought on by events such as illness or drought (Jack and Suri, 2014).

5. CONCLUSION

The impact of digital technology on encouraging youth participation in agri-food systems has been examined in this study. The findings suggest that digital technologies have the potential to significantly contribute to the recruitment and retention of youth in the agricultural sector. This can be accomplished by providing access to up-to-date information and knowledge, creative approaches to learning and employment, and new channels for young people to engage with the agri-food community and each other. The research also discovered that digital technologies can give young people new avenues for learning about agriculture, including social media platforms, online courses, and virtual reality simulations. These technologies can also give young people access to information and knowledge about agriculture, such as crop production techniques, market prices, and weather forecasts.

Young people will be exposed to new opportunities to market their goods and services, such as through online farmer's markets and e-commerce platforms, and they will be able to connect with other young people and seasoned farmers through social media groups, online forums, and agricultural apprenticeship programs enabled by digital technologies. In addition, to fully utilize digital technology in encouraging young engagement in agri-food systems, the following obstacles need to be addressed. Among these difficulties is the digital divide, which denotes the difference between people who have access to digital technology and those who do not. The lack of internet literacy among young people is another issue. Lastly, some inadequate policies and initiatives can encourage

the use of digital technologies in the agriculture sector, as well as a dearth of accessible and reasonably priced digital technology in rural communities.

Therefore, it is advised that governments fund initiatives that help young people develop their digital literacy. For agriculture, businesses should provide more accessible and reasonably priced digital technology. Even though this study has shed more light on the role that digital technology plays in encouraging young people to participate in agriculture in Sub-Saharan Africa, there are still some areas that might be explored in future research to further our understanding and close knowledge gaps. It is critical to look at the ways that institutional support and policy frameworks could motivate young people in SSA's agriculture sector to use digital technologies. Analyzing the barriers and enablers in the policy environment may provide helpful recommendations for creating an environment that encourages digital innovation.

Informed consent

Not applicable.

Conflicts of interests

The authors declare that there are no conflicts of interests.

Ethical approval

Not applicable.

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Data and materials availability

All data associated with this study are present in the paper.

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