CHAPTER-25

EVIDENCE-BASED LITERATURE REVIEW AND RESEARCH SYNTHESIS

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Abstract

Digital technologies are transforming agriculture globally, and youth are the first to take up these technologies and the most important demographic group for the future of agriculture. This chapter draws on the results of 20 systematic searches from peer-reviewed literature to explore how young people interact with digital agriculture, the barriers to this interaction and the interventions that effectively span the chasm between the possibilities of technology and actual adoption. Based on studies in Africa, South and Southeast Asia, Europe and the Pacific, this chapter examines the status and applications of digital tools, ranging from smart phones to social media, through to the Internet of Things (IoT), drones, artificial intelligence and block-chain, and their impact on youth engagement in agricultural value chains. The key findings highlight that access to ICTs could help drive up youth employment in agriculture by around 21% (Aliu, 2024; Kote et al., 2024), community-based peer learning networks are as critical as access to ICTs, and social identity issues, such as the stigma attached to a low status career in farming, continue to be a significant obstacle. The chapter ends with a comprehensive policy and practice blueprint based on the Sustainable Development Goals to promote digital agricultural transformation with inclusiveness and youth leadership.

1. Introduction

There is an imminent generational crisis in agriculture. In most developing areas, the average farmer is more than 45 years old, and young people are moving to the cities to find higher status and better-paying jobs. But this age shift comes at the same time as an extraordinary technological revolution – smart phones, broadband, sensing technology, artificial intelligence and digital marketplaces are all booming at an exponential rate. A young, digital-generation and agricultural sector that is undergoing a radical transformation represent an alarming danger and an unprecedented opportunity.

What does evidence about youth engagement with digital agriculture teach us, what factors promote or deter youth engagement, and what can be done by policy makers, educators and practitioners to engage youth in the transformation of food systems? To answer these questions, we searched systematically in the Consensus academic search engine with 20 specific queries to retrieve peer-reviewed scientific articles from various fields of research, such as development economics, agricultural extension, information and communication technology, and rural sociology.

The chapter follows 7 themes.

1. the global context of youth and agriculture;

2. digital tools and platforms that are relevant to young farmers.
3. enablers and barriers for digital adoption.
4. the importance of social networking and peer learning.
5. gender dimensions.
6. entrepreneurship and Agri-tech.
7. policy and governance frameworks.

It ends with recommendations that are based on the Sustainable Development Goals and an agenda for future research.

The analytical approach adopted here (SPIDER: Sample, Phenomenon of Interest, Design, Evaluation, and Research Type) is appropriate for this social science enquiry which emphasizes lived experiences, aspirations, and adoption behavior, as opposed to a controlled clinical intervention. This framework is mapped to the topic in Table 1.

Table 1: SPIDER Framework Applied to Youth Engagement in Digital Agriculture

Component	Mapping to Topic	Sub-area Explored	Key Insight
Sample (S)	Rural/ peri-urban youth, Agri-students, young farmers aged 15–35	Demographic profiles, gender, migration patterns	Youth form a heterogeneous group with divergent aspirations
Phenomenon (PI)	Digital technology engagement in farming	Mobile phones, IOT, drones, AI, social media, e-commerce	Smartphones are the dominant entry point for digital agriculture
Design (D)	Mixed methods, surveys, case studies, scoping reviews	Policy & program interventions, community networks	Community-based approaches outperform top-down programmes
Evaluation (E)	Employment, income, productivity, attitudes, aspirations	Outcomes of digital agriculture on youth livelihoods	ICT adoption can increase youth agricultural employment by ~21%
Research Type (R)	Empirical, qualitative, quantitative, bibliometric	Barriers & enablers: digital divide, literacy, infrastructure	Digital literacy and connectivity are the top systemic barriers

2. the Global Context: Youth, Agriculture, and the Generational Crisis.

The need to involve youth in agriculture is not a new concept and has been well established in literature (Ayim et al., 2022). A scoping review of youth involvement in agriculture in Africa concluded that youth must be offered economic opportunities to ensure the future of the sector and reduce poverty, unemployment and inequality (Geza et al., 2021). However, the same analysis found that current agricultural interventions are mostly production-oriented, generate low-income returns and do not offer sufficient social protection, a factor that is not particularly appealing to young people.

A complementary global bibliometric analysis found that factors such as restricted access to land, financial considerations (Pathma et al., 2025), institutional support and negative perceptions of agriculture all play a role in decreasing the interest of youth in agriculture. These results reflect a South African study, which in a survey of 573 young people's narratives, concluded that about a third of the youth were clear about their passion for farming, yet this positive aspiration was

continually dampened by social stigma and poor quality of employment opportunities within a growingly corporatized food system (Metelerkamp et al., 2019).

In Indonesia, the NFSS data indicates that the odds of youth leaving for urbanization are much greater than for older age groups, and that manufacturing and services are more attractive to young people than farming. The pattern is repeated across Indonesia, Japan, India and much of Sub-Saharan Africa, making what researchers have deemed an ‘aging farmer problem' with far-reaching long-term implications for food security in the nation (Ngadi et al., 2023).

However, it is not a consistent picture. According to the study carried out in Pakistan, majority (68.3%) of the farmers surveyed were interested in agriculture as their occupation while 73.3% of them were adopting modern farming practices (Iftikhar et al., 2025). In Cambodia, it was found that the involvement in the educational farming activities changed the students' career orientation due to the enhancement of their relatedness to the local environment. The findings indicate structural, social and communicative barriers to youth involvement, not intrinsic ones, and that these barriers are not insurmountable.

Digital technology keeps reappearing in the literature as a possible game changer in this equation (Hasan et al., 2022; Glover & Sumberg, 2020): not only as a productivity instrument, but also to re-invent and re-brand agriculture as a modern, innovative and viable career for the next generation (Addison et al., 2024)**.**

3.Digital Tools and Platforms in Agricultural contexts 3.1. The Smartphone as an agricultural gateway

In literature, smartphone is consistently the sole salient digital tool for young people's engagement in agriculture. The mixed methods study of the Indian Digital Agriculture Mission revealed that the smartphone could revolutionize rural farming (Dhir & Mishra, 2025) and empower the community by providing agriculture-related information at the right time and place, and through peer-to-peer learning through social media. However, the same study revealed that there are substantial challenges: accessibility, digital literacy, connectivity and language.

Mobile phone ownership was very high, with 98% of the surveyed smallholder farming households owning a mobile phone, but only about 25% of them using it to access agricultural information, indicating a significant disconnect between phone ownership and use (Krell et al., 2021). Factors affecting the adoption of mobile agricultural services are the ownership of a smartphone, membership in a farmer organisation, gender and education level (Landmann et al., 2021). While contexts vary, age, education and farm size had been found to be the main determinants of smartphone use by farmers in Germany, where the adoption rate is higher than in other countries (Michels et al., 2020).

A science metanalysis revealed an average yield gain of 4% and a 22% chance improvement of adoption of recommended inputs when agricultural information was provided through digital technologies, with benefits likely to be 10 times greater than the cost (Fabregas et al., 2022) of agricultural information transmission. Among the youth, the impact of the use of smart phones on market access, financial services and peer networking is significant.

3.2 Social Media: The Knowledge Layer

In many parts of the Global South, social media platforms (Dilleen et al., 2023), especially what's-app, YouTube, and Facebook have emerged as the primary sources for farmers' agriculture information. A study in Pakistan revealed that rural youth's sources of information were higher

than formal government extension service (mean = 1.95), YouTube (mean = 2.43) and their own experience (mean = 2.78) (Aparo et al., 2022). In India, WhatsApp and YouTube were found to be the most widely used platforms for disseminating agricultural information to farmers (Ma et al., 2023).

Farming groups on the social media platform Myanmar Facebook were studied, and social media emerged as a technology that integrated into the existing processes of economic and social exchanges and was used both for disseminating market information and for innovating in agriculture (Unay-Gailhard & Brennen, 2022). Most importantly, peer trust is a key factor: Vietnamese studies showed that the neighbourhood effects and observational learning (observing neighbours achieve success) strongly influence social media uptake for knowledge sharing among farmers (Unay-Gailhard & Brennen, 2022).

In the case of youth, social media serve to reduce the activation energy of agricultural learning. Its familiar interface and the format of the platforms such as YouTube and Instagram, which allow for visual storytelling, means that young people can experience agriculture in a way that is contemporary and aspirational, not old-fashioned and labour-intensive.

3.3 Precision Agriculture, IoT and Drones

Moving further up the digital agriculture chain precision farming, Internet of Things (IOT) sensors and drone technology is an opportunity and a challenge for youth as it is a very technical space. Some of the IOT applications in smart farming are Crop health monitoring, smart irrigation, tracking of soil, monitoring of pests, and monitoring of livestock (Abbasi et al., 2022). Reviews of digital farming technology adoption and diffusion patterns (Wolfert et al., 2017; Shang et al., 2021; Ronzhin et al., 2025) show that

The autonomous robotics, machine learning and big data analytics are the three key enabling technologies that are driving agriculture 4.0 (Javaid et al., 2022), according to Agriculture 4.0. Entrepreneurship is a particularly attractive opportunity for youth regarding drones. The Africa Goes Digital consortium is a platform of young African firms offering drone-based agricultural services that show how youth can be not only farmers, but agricultural technology service providers as well (Ayamga et al., 2023). However, the consortium also noted that regulatory issues related to drone usage and the price of sensors remained "high" challenges.

Malaysia, a study with the Technology Readiness Index, showed that optimistic and innovative youth have higher perception of benefits from the adoption of IoT, whereas insecure and uncomfortable youth have higher perception of risks and lower perception of readiness in adopting IoT (Samsudin & Sumin, 2025). This discovery highlights the importance of psychological and attitudinal factors in technology adoption, in addition to the technical ones.

According to a detailed Indian drone barriers review, there are six types of barriers in India: technical, social, behavioural, operational, economic and implementation. The main problem with the economic barrier to youth participation is the initial investment in drone equipment, which further underlines the need for public funding or shared-service business models (Puppala et al., 2023).

3.4. Artificial Intelligence and Machine Learning

AI and machine learning are becoming pivotal components of the agriculture 4.0 paradigm, helping predict yield, early disease detection, optimise irrigation, and adapt to climate change. Random Forest model, CNN model, and XG Boost model have shown their predictive power in

various crops, and various geographies (Marinello et al., 2023). But, among most young farmers in rural areas of developing countries, direct interaction with AI tools is limited.

For youth, the more direct route is through AI-driven applications and guidance, where the complexity is removed: AI without technical knowledge, only practical suggestions. The challenge is to ensure that these tools are localised, available in vernacular languages and are designed for low bandwidth. With GPS driven smart phones becoming more common, the ability to deliver personal, location specific AI tips and guidance is increasing in significance.

3.5. E-Commerce and Digital Marketplaces.

Digital market platforms are one of the most direct routes for youth to earn income from agriculture, without involving traditional intermediaries. Studies in Sub Saharan Africa have revealed that e-commerce platforms have notably helped to enhance access to markets for smallholder farmers, which in turn has helped to enhance smallholder farmers prices and minimization of post-harvest losses (Morepje et al., 2024). The 'Petani Muda Keren' (Cool Young Farmers) network in Indonesia applied collective e-commerce and saw monthly income increase 34.5% higher than farmers who did not use the network (Syahrir et al., 2025; Irawan et al., 2023), in part by using network-branded e-commerce.

But a Chinese study of e-commerce for small farmers revealed a more complicated scenario: e-commerce offers a new marketing channel and a bigger customer base, but also creates a situation where farmers can grow increasingly reliant on quasi-monopolistic platforms that extract revenues based on the amount of traffic they get and algorithmic control (Ma et al., 2023). Market access vs platform dependency is an important policy issue for youth-centric digital agriculture programmes.

3.6. Blockchain for Transparency and Trust

Block-chain can provide a route for young people in agriculture to become part of high value, traceable and transparent supply-chains, which will provide premium prices for verified, traceable products. Block-chain resolves problems of food fraud, quality control, and trust between farmers, retailers, customers, and other food participants by creating an unalterable record of every transaction (Kamble et al., 2020) along the food supply chain. The complexity of the technology, the costs of implementation and its energy use, however, make youth's involvement with block-chain relatively indirect as players in block-chain enabled supply chains, not as block-chain developers (Adewusi et al., 2023).

Table 2: Digital Technologies and Their Relevance to Youth Agricultural Engagement

Technology	Agricultural Application	Youth Entry Point	Key Challenge
Smartphones & Mobile Apps	Market prices, weather alerts, extension services, agronomy advice	High; low-cost devices available	Digital literacy, connectivity
Social Media (WhatsApp, YouTube, Facebook)	Peer learning, knowledge sharing, marketing, community building	Very high; familiar platforms	Misinformation, trust
IOT Sensors & Smart Farming	Soil monitoring, irrigation automation, livestock tracking, crop health	Medium; requires training	High cost, technical skills
Drones (UAVs)	Crop monitoring, precision spraying, seeding, field mapping	Emerging; entrepreneurship opportunities	Regulation, cost, maintenance
AI & Machine Learning	Yield prediction, pest/disease detection, climate adaptation	Low; requires advanced skills	Data availability, complexity

E-Commerce Platforms	Direct farmer-to-consumer sales, price discovery, market access	High; familiar digital commerce	Platform dependency, logistics
Block-chain	Supply chain traceability, food safety, reducing fraud	Low; complex technology	Implementation cost, scalability

Author compilation.

4. Barriers and enablers that impede youth engagement in digital agriculture. The 'hidden barriers' and 'enablers' preventing youth from engaging in digital agriculture.

4.1. Digital Divide in Rural Agriculture

The digital divide is a divide between people who have and do not have access to digital technologies as well as access to and ability with digital technologies, in the case of agriculture. A review of 157 studies covering digital developments and rural development in advanced countries revealed that there is a persistent, and increasing gap, in the quality of data infrastructure between urban and rural areas, and that rural communities are paradoxically the least well connected, yet most in need of improved connectivity (Salemink et al., 2017). These differences are even greater in developing countries. A study in Spain revealed that there is a digital divide within rural areas, and it is the most severe for vulnerable groups such as women, elderly and the unemployed. The gap between access and use to the internet is reduced by investing in network infrastructure, but targeted digital skills training is needed to close the capability gap in China (Salemink et al., 2017). Policy interventions should be tailored to each of the three aspects of the digital divide: access, use, and capability.

The ability gap might not be as extreme for youth as for older people. The young people are digital natives; many are more adept at their devices than their parents are. But the ability to use digital tools in agriculture isn't just about using a smartphone, and it takes specific training to manage the use of apps, drone flight and data analysis.

4.2. Systemic Barriers

Table 3: summarises the most important barriers that were found in the 20 searches that were carried out for this chapter.

Table 3: Systemic Barriers

Barrier Category	Specific Barriers	Evidence Source
Infrastructure	Poor rural internet connectivity, electricity shortages, limited network coverage	Nigeria, India, Sub-Saharan Africa
Economic	High cost of devices & data plans, low income, limited credit access	Pakistan, Kenya, Ghana
Digital Literacy	Lack of skills to use apps, language barriers, low educational attainment	Indonesia, India, Nigeria
Social & Cultural	Negative perceptions of farming, gender discrimination, cultural norms	South Africa, Bangladesh, Ethiopia
Regulatory	Restrictive drone regulations, data sovereignty concerns, land tenure insecurity	Africa Goes Digital consortium
Policy Gaps	Youth-unfriendly agricultural programmes, inadequate financial support, production-centric policies	Kenya, Tanzania, Cameroon

4.3. Social Identity and Career Perceptions

Social stigma of field work as a vocation possibly is the most neglected obstacle in the literature. A perception of agriculture as low status, low income, and for the "without alternatives" has been consistently shown in studies in Indonesia, India, Japan, and South Africa. In Hokkaido, Japan, the farming preference among adolescents was completely given up even in areas where labour shortage was severe in agriculture, in favour of science and technology careers.

The study in Australia reported that attitudes towards rural life and working opportunities strongly predict young people's intentions to relocate to rural areas, with experience of rural living even showing that attitudes were much more positive than those of rural work. This discovery highlights the need for experiential learning, that is, for providing positive, contemporary experiences with digital farming with urban youth by visiting schools, having internships, and portraying digital farming in media.

Here digital technology serves as a signal and a tool. If farming is perceived to be attached to drones, apps, data analysis and e-commerce, that makes it more appealing to young people who are more used to these technology aspects. Changing the image of agriculture to a technology career isn't just a makeover; it's a necessary part of communication strategy (Metelerkamp et al., 2019).

5. Peer Learning, Social Networks & Community Infrastructure

A key result from the literature is the importance of social infrastructure among the technical infrastructure for youth digital engagement in agriculture. The study in Indonesia is informative: after controlling for education, farm size, and access to credit, the membership in the ‘Petani Muda Keren' (PMK) was shown to be a significant positive factor affecting farmer income ($\beta=0.282$, $p<0.01$) apart from the independent effect of digital adoption ($\beta=0.347$). It wasn't only about technology access, it was about peer mentorship de-risking adoption, collective action for market access and the building of a modern farmer identity (Syahrir et al., 2025).

The Africa Goes Digital research also revealed that WhatsApp and Twitter played vital roles in the organisation as tools for the dissemination of knowledge among other members of the consortium, and for providing external visibility and enabling partnerships, respectively (Ayamga et al., 2023). These platforms are very effective at putting communities of practice into practice, which are “groups of practitioners sharing a concern, a set of problems, or a passion about a topic which deepen their knowledge and expertise by interacting on an ongoing basis (Dolinska & d'Aquino, 2016).”

In the literature on agricultural innovation systems, communities of practice programs among farmers have been shown to be more empowering towards innovation (Chaudhuri et al., 2021; Laforge & McLachlan, 2018; Oreszczyn et al., 2010) than programs that are only expert supported, when they provide access to external knowledge sources. As a result of this finding, the implications of extension service design are clear, in that extension programmes should not deploy individual extension agents but rather facilitate peer learning groups with regular opportunities (Dolinska & d'Aquino, 2016) for access to technical expertise.

Corn Belt (USA) farmer network studies showed a significant correlation between farmer network participation and the adoption of conservation practices, especially those engaged in face-to-face networks. The most significant variable was the adoption outcomes and the importance of the role of trust and social capital in technology diffusion was enhanced through the building of relationships within the network (Asprooth et al., 2023).

6. Gender aspects of youth digital agriculture

Gender, youth and digital agriculture are among the most complicated and less researched literatures. In addition to the gender digital divide, however (only 24.6% of rural women compared to 48.7% of rural men have Internet access in India), young women are also constrained by cultural limitations on mobility and by unequal access to land and assets, which restrict their access to and use of digital agricultural tools.

Investigation into e-wallet agricultural input programme in Nigeria revealed that young women in rural areas were not keen in participating in the programme because of cultural and traditional context rooted in beliefs and practices which foster discrimination. The study recommended Nigeria's agenda of agricultural transformation could not succeed if the youth would not be included; however, the programme design did not consider the constraints faced by the youth (Uduji & Okolo-Obasi, 2018), and young women.

Mobile phone use was found to have a significant positive impact on the empowerment of rural women agricultural entrepreneurs in Bangladesh in the five dimensions namely economic, social, technological, psychological and political. It was observed that the composite empowerment index increased from 37.47% to 61.92% after the adoption and the highest increment was observed in economic empowerment (Rahman et al., 2023). This discovery confirms that the use of digital tools can effectively change the power dynamics when young women have access to them.

The AI-facilitated Gender Empowerment Ecosystem (AIGEE) framework from Morocco suggests that AI can complement and strengthen institutional and community environments to boost productivity and increase women's agency in agri-food value chains. But the framework underscores the importance of using AI not just for its technical capabilities, but also for its connection to policies that are inclusive, knowledge systems that are localized, and the building of local capacities (Moutik, 2025).

Systematic underrepresentation of youth (and women) in leadership and decision-making positions in R&I projects was observed in research on gender and youth participation in African agricultural research and innovation. The study identified a need for an intersectional lens, one that would consider the unique challenges and needs of various community groups, and a need for investment in the translation of R&I results into entrepreneurship opportunities available to young women (Yami et al., 2019 ;Yami et al., 2024).

7.Youth Agri-tech Entrepreneurship and Start-up Ecosystems

With the advent of Agri-tech as a new entrepreneurial space, new avenues are opening for digitally literate youth to be involved in agriculture without necessarily becoming farmers. AI-powered startup profiles in Agri Food- Tech highlight these companies as key players who can transform Agri- food innovation systems with new technologies and solutions to solve global sustainability and food security problems (Klerkx & Villalobos, 2024), in a narrative that celebrates their role as solutions to global challenges.

Top success factors in the case of Agri-tech start-ups in India were identified as access to low-cost and innovative funding options, provision of infrastructure and incubation support, skill development and training of farmers, and cross domain quality solutions. The study on Technology Business Incubators in Jammu & Kashmir and Punjab revealed that demographic parameters like age, education and income in addition to incubation services, play an important role in the success of startups.

Agricultural entrepreneurship is no longer limited to traditional farm-based models; it now carries with it the introduction of innovation ecosystems, digital platforms and inclusive business models, which were identified as one of the key themes detected during a systematic review of agricultural entrepreneurship literature. This redefinition of the term ‘agricultural entrepreneurship' is very important for the young people, who might want to develop technology-based companies providing services for farmers, rather than farming themselves (Klerkx & Villalobos, 2024).

This is the example of Agri-tech start-ups in Andhra Pradesh, India who have created various job opportunities ranging from technical to on-field support jobs, increased local economic growth and reduced urban migration. But researchers warn that many Agri-tech startups continue to reinforce current socio-technical imaginaries—small enhancements instead of actual fundamental change, especially in the context of large-scale commodity farming.

Social media and ecommerce are preliminary steps that are often a young person's first introduction to agricultural entrepreneurship in developing countries, before they go onto more capital-intensive precision agriculture services. The entrepreneurial talent building framework for Agri-Tech Pioneers suggests education across disciplines, innovation clusters, and the farmer's role in co-creating technology as the three critical components to developing a new breed of agricultural innovators (Yoon et al., 2021).

8. Theories of technology adoption.

Theories that allow for engagement with a body of literature that is necessary to understanding the reasons that youth are adopting or resisting digital agricultural technologies. More than a dozen relevant models were identified in a comprehensive review: the Technology Acceptance Model (TAM), Diffusion of Innovations Theory (DOI), Theory of Planned Behaviour, Social Cognitive Theory and the Unified Theory of Acceptance and Use of Technology (UTAUT).

TAM and DOI are most applied in the context of youth and digital agriculture. TAM emphasises the constructs of perceived usefulness and perceived ease of use as the key factors affecting intention to adopt. The Diffusion of Innovation (DOI) curve was developed by Everett Rogers and is used to describe the spread of innovations within social systems through a communication channel over time, with a focus on the innovation's relative advantage, compatibility, complexity, trialability, and observability (Dissanayake et al., 2022).

In Ghana, personal innovativeness had a strong impact on food security awareness (β=0.574), relative advantage (β=0.699), and compatibility (β=0.687), all of which had a strong impact on behavioural intention to adopt digital innovation. Most importantly, there was a moderating effect of agricultural experience on the compatibility-adoption intention link, indicating that pre-existing familiarity with agriculture led to a more positive attitude towards the digital tools that were compatible with current farming practices.

But adoption-based models are criticised for their reductionism in terms of the complex sociotechnical rearrangements that happen when new technologies are introduced into farming systems. A reconfiguration approach offers a set of four analytical lenses: propositions (what changes are offered), encounters (how farmers are dealing with the technology), dispositions (values and experiences that farmers bring), and responses (actual practices that emerge). This more nuanced framing is especially pertinent in the case of youth: their dispositions to agriculture

are still being formed, and they can shape technologies as well as technologies shape them (Engås et al., 2023).

9. The policy frameworks and institutional responses.

Youth digital agricultural engagement is a multi-sector policy phenomenon, involving agricultural policy, ICT and digital infrastructure policy, education and training policy, land reform policy and gender equity policy. A study on youth participation in agriculture in Africa revealed that existing agricultural development programmes are failing to address the structural problems that underlie youth participation, in favour of production and inputs, with a lack of addressing markets, social protection and digital skills (Geza et al., 2022).

In Kenya, despite government efforts to alleviate food insecurity and hunger, the study noted that there were no policies in place that actively promote youth engagement in agriculture. Simple linear regression indicated that agricultural policies had a statistically significant impact on youth participation, but the policy landscape for the youth was still not sufficiently youth-oriented to effect change at (Osabohien, 2024) scale.

Youth with access to land titles were seen to invest much more time and resources in farming and land size as well as educational attainment were found to have influenced participation in the land titling programme in Tanzania. Findings highlight the importance of land tenure security as a prerequisite for youth agricultural investment and adoption of digital technology (Msangi et al., 2024).

With regards to the viability and employability of rural youth enterprises, the Three-Year Special Youth Plan (TYSYP) in Cameroon demonstrated that government financial interventions positively and significantly affect these outcomes but not for women, thus reinforcing the need for gender-specific interventions.

The overarching framework for youth digital agricultural policy is the SDG framework at macro level. Youth digital agriculture is directly involved in SDG 2 (Zero Hunger), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, innovation and infrastructure), SDG 10 (Reduced inequalities), and SDG 13 (Climate action). EU member states' research revealed that digital transformation, as defined by connectivity, digital skills and internet usage, has a significant impact on food security outcomes and poverty reduction (Sachs et al., 2019).

To transform the digital agriculture landscape in developing countries, a much more comprehensive policy framework is recommended, covering five broad areas: digital infrastructure, data interoperability and governance, digital markets, incentivising the private sector, and the digital cultural landscape. These areas have specific implications for youth, ranging from the issue of affordability of connectivity to the availability of culturally relevant digital agricultural content (MacPherson et al., 2022).

Table 3: Policy Recommendations for Youth Digital Agricultural Engagement

Policy Area	Recommended Action	Expected Outcome
Digital Infrastructure	Invest in rural broadband, subsidise smartphones and data plans	Reduce access divide; enable mobile agriculture services
Digital Literacy	Integrate digital agriculture into school curricula; train extension workers	Build a pipeline of digitally skilled young farmers
Finance & Land	Youth-specific credit schemes, land titling programmes, start-ups grants	Remove capital barriers to youth-led Agri-enterprise

Community Networks	Support peer learning groups, Agri-preneurship, hubs, mentorship platforms	Accelerate technology adoption via social learning
Gender Inclusion	Targeted programmes for young women; remove cultural barriers to access	Equalise opportunity; harness full agricultural workforce
Regulatory Reform	Streamline drone regulations; establish data governance frameworks	Enable youth-led Agri- tech enterprises to operate and scale

Author compilation

10.Research gaps & future directions

10.1. Methodological Gaps

Most studies are descriptive and cross-sectional; few studies have longitudinal data regarding a sustained youth engagement in digital agriculture over career stages.

Most quantitative studies use self-reported measures of adoption that do not have a standardised definition, which hinders comparisons across studies.

Many studies have small sample sizes (typically < 200 respondents) and therefore may lack generalizability to other contexts in rural areas.

Experimental or quasi-experimental designs are very limited; most of the evidence of the effect of digital agriculture on youth outcomes is based on observation studies that may suffer from selection bias.

10.2. Population Areas of Concern

There is a higher concentration of literature on Sub-Saharan and South/Southeast Asia, whereas youth digital agriculture in Central Asia, the Middle East, Latin America and Pacific Island nations is under-researched.

Rural youth are generally better attended than urban and peri-urban youth in agriculture who are a growing population.

There is practically no literature available on the experiences of differently abled youth or indigenous youth in digital agriculture.

Yet, there is little research on Generation Z (1997–2012) per se rather than on ‘youth’ in general.

10.3. Conceptual and Theoretical Gaps

The connection between digital identity, online community membership and agricultural career aspirations is theorised but not rigorously tested.

The viability of youth Agri-tech start-ups, in terms of sustainability of their businesses, whether they can provide them with sustainable livelihoods or not, is not clear.

There is little research that has explored the intersection of youth's climate change adaptation behaviours and digital technology adoption.

The intergenerational transfer of knowledge (older and younger farmers learning together) in digital agriculture is under theorised.

11. Synthesis and Conclusions

The information reviewed in this chapter leads to a few clear conclusions. First, digital technology has the capacity to change the conditions youth can work, live, and earn a living in agroecology when access and skills are overcome, and digital technology can increase employment and income,

productivity and market access. The impact of ICT use on youth employment in agriculture could be around 21% and the community-based digital farming networks have shown that the members earn more than their non-members by 30%.

Second: Technology is not the only solution. The most successful interventions reported in the literature involve the use of digital resources as paired interventions with the infrastructure of communities: peer learning networks, mentorship programmes, collective market platforms, and targeted identity-building activities that reimagine farming as a contemporary and aspirational career. The most effective interventions in the literature reported are paired interventions that include digital resources and the infrastructure of communities in the form of peer learning networks, mentorship programmes, collective market platforms, and deliberate identity-building exercises that reimagine farming as a contemporary and aspirational career. Social and psychological aspects of youth involvement in agriculture are crucial in addition to the technical ones.

Third, the digital divide exists and persists in rural agriculture — yet it can be halted. The investments in rural connectivity, affordable devices, localised content and digital literacy training will make a huge dent in the access and use gaps. Deeper investment in agricultural education and extension is needed for the capability gap, defined as the ability to derive meaningful agricultural value from digital tools.

Fourth, gender is still an important fault line. There are additional marginalisation factors for young women that conventional digital agriculture programs do not consider. Gender responsiveness must form an integral part of any youth digital agriculture initiative, not an add-on.

Fifth, the policy context must keep up with technology. There are limited policies in most countries to the digital dimension of agriculture in youth-specific policies. Security of land rights, access to finance, certainty over regulatory frameworks for new technologies such as drones, and inclusive extension services serve as the pillars for digital engagement in agriculture.

In the future, Agriculture 4.0 technologies (AI, IOT, robotics, block chain and big data) combined with ever-growing digitalisation of rural populations, will provide the conditions for a real change in the youth's role in agriculture. This transition will be just, equitable and sustainable based on the decisions made today by governments, development agencies, teachers and young people.

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