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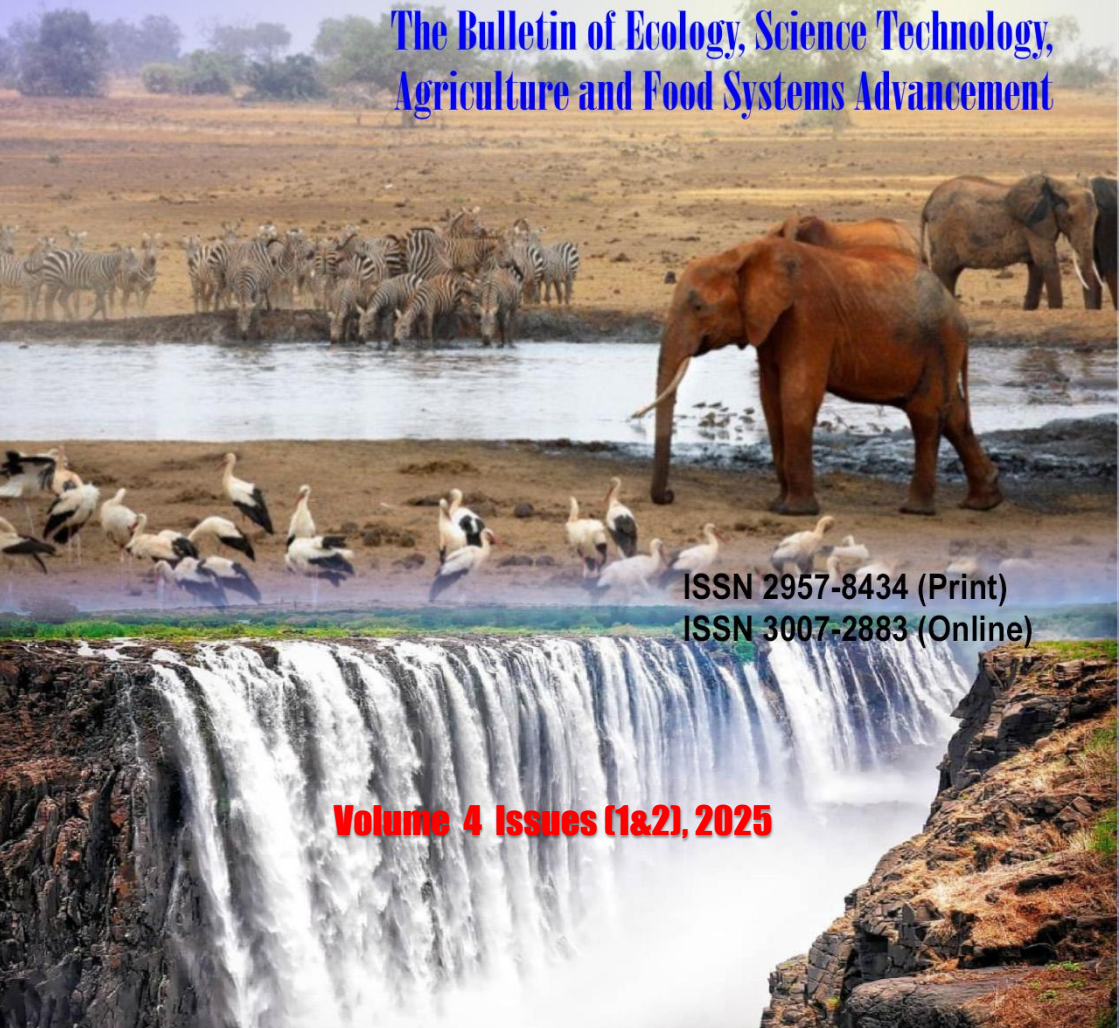
The Zimbabwe Ezekiel Guti University
The Bulletin of Ecology, Science Technology, Agriculture and Food Systems Advancement



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The purpose of *the Oikos - The Zimbabwe Ezekiel Guti University Bulletin of Ecology, Science Technology, Agriculture and Food Systems Review and Advancement* is to provide a forum for scientific and technological solutions based on a systems approach and thinking as the bedrock of intervention.

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LEVERAGING DIGITAL PLATFORMS TO PROMOTE FOOD SECURITY AND SUSTAINABLE AGRICULTURE IN ZIMBABWE

JOSPHAT CHITOMBO[1]

ABSTRACT

Agriculture is one of the chief anchors of the Zimbabwe's economy with a contribution of more than 9% to the GDP. The agricultural sector has faced unprecedent challenges which impacted the smallholder farmers' ability to maximise their yields and, hence, revenues. Various challenges are impacting smallholder farmers' ability to effectively maximise their productivity on their land. The issues include limited access to markets, limited advisory services from agriculture extension officers, limited capital as well as logistics and procurement limitations. The digital agriculture platforms have emerged as the solution to tackle bottlenecks in agriculture extension services, access to markets, weather services, finance, procurement services and logistics. Welthungerhilfe (WHH) has been developing digital apps for smallholder farmers such as Kurima Mari and Agri-Share. These apps have been adopted with the objective of propelling the achievement of the zero hunger United Nations Sustainable Goals (SDG) through increased productivity, which culminates in higher yields and revenues. This study's aim is to establish the extent to which WHH digital platforms are able to promote food security and sustainable agriculture through enhanced productivity and improved livelihoods amongst smallholder farmers. A qualitative approach to data

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collection through the use focus groups and structured questionnaires is employed. The findings reveal the capability of the digital agricultural platforms to solve key challenges faced by smallholder farmers. The study also establishes the relationship between the use of digital platforms and an increase in agriculture productivity, resulting in improved livelihoods of farmers. The study identifies the challenges faced by the farmers in utilising digital agric platforms. It also shows opportunities that can be exploited by the farmers through technology in driving sustainable agriculture.

Keywords: digital agriculture, digital apps, Kurima Mari App, Agri-share App, productivity, livelihoods, challenges, opportunities, benefits, digital transformation, smart farming, agri-ecommerce, digital advisory, value creation

Introduction

Zimbabwe has been facing perennial droughts, coupled with a drastic drop in agricultural productivity since the year 2000's land reform programme which resulted in many rural farmers becoming smallholder farmers (Richardson, 2005). Zimbabwe used to be the bread basket of the Southern African Development Community (SADC) (Tonini, 2005), agriculture being the anchor of the economy, with more than 20% contribution to the GDP and exporting to major European markets (Moyo, 2014). Digital agriculture has ushered on the potential of an alternative approach to deal with bottlenecks in the agriculture ecosystems as these provide the farmers with access to extension services, marketing eco-systems, financial inclusion, transport services and logistics as well as supply chain management (Munyua, H *et al*. 2009). WHH has developed the Kurima Mari (LimaMali) and agri-share digital agricultural platforms with the aim of improving smallholder farmers' productivity and addressing challenges in the agricultural sector (CCARDESA Report, 2022).

This study therefore seeks to evaluate the extent to which the digital platforms have enhanced smallholder farmers' productivity and assessment of the existing digitally enabled agricultural value chain services to bring insights into how the digital platforms are articulating

the inefficiencies and creating opportunities for farming improved efficiencies. The study focuses on how the digital platforms are enabling farmers to tackle issues related to finance, markets, agronomy and logistics within the various value chains. In Africa, particularly in Zimbabwe, the majority of farmers are smallholder farmers and climate change is adversely affecting their livelihoods (Musungwini *et al*., 2023). Smallholder farmers' survival depends on good harvest and on marketing of their farm produce. WHH has been providing digital support to farmers through the Kurima Mari and Agri-share apps used by Zimbabwe's smallholder farmers (CCARDESA Report, 2022).

According to McDonagh *et al*. (2017), smallholder farmers play a pivotal role to food security globally and more so in developing countries. Despite this critical role in food security, they are highly constrained by numerous challenges which include climate change, cost of production, credit access and financial resources constraints that impact their sustenance, sustainability and growth. Digital agriculture has emerged as an answer to addressing smallholder farmers' challenges and, as such, many digital solutions are already existing to serve the agriculture sector. However, these technologies are beyond the reach of many smallholder farmers, due to underdeveloped or non-existent digital ecosystems (Gumbi *et al*. 2023). The challenges which smallholder farmers face impact them at every stage of the agriculture cycle which consists of the farming planning and acquisition of inputs up until harvesting, processing and marketing of the produce. Most of these agriculture challenges are as a result of limited access to trusted and timely agri-information (Chandra and Collis, 2021). For example, the farmers' access to financial capital can be stalled by financial illiteracy and the lack of capacity to avail the necessary information for credit worthiness appraisals. Throughout the farming cycle, smallholder farmers have limited access to weather and climate information, limited knowledge on available viable acquisition of inputs, approaches and planting techniques and limited markets information that could allowed them to connect to high end consumers for their produce. Digital technologies have been proven to breach the information deficiencies by mitigating the information asymmetries through real-time and precise

data access that aids smallholder farmers in their decision-making at every stage of the agricultural cycle (UN Report, 2021).

The accelerated application of smart, digital and precision agricultural technologies has offered a historic opportunity to improve agricultural productivity of smallholder farmers in developing countries and to generate the rural transformation needed for achieving the SDGs by 2030. To address the existing barriers to the adoption of these technologies, it is important to invest in digital literacy in rural areas, establish a new generation of agricultural extension services, make digital platforms user-friendly for smallholder farmers and build infrastructure for agricultural e-commerce (*ibid.*).

The Objective of The Study

The objective is to understand how WHH digital platforms are improving livelihoods and enhancing agricultural productivity among the smallholder farmers in Zimbabwe across the various agricultural value chains. The research, therefore, seeks to establish the extent to which the digital agriculture platforms are improving livelihoods through enhancing farmers' productivity. The study would therefore:

Research questions

The research sought to answer three research questions:

1. What are the benefits of the digital agriculture platforms to the value chain actors?
2. How are the digital agriculture platforms addressing challenges being faced by the smallholder farmers and other value chain actors?
3. What are the opportunities and challenges being experienced with the current digital agriculture platforms?

Literature Review

Critical Assessment of Digital agriculture platforms in Zimbabwe

The revolution of agricultural digitalisation has led to the development of different digital platforms with a wide range of applications across the agricultural value chains to support farming resilience and sustainability. Several innovative agricultural ICTs are being applied in the agricultural sector, including cloud computing, big data analysis, artificial intelligence, machine learning, digital communication technologies (mobile phones), digital platforms (e.g., e-commerce platforms, agro-advisory applications and e-extension websites), precision agriculture technologies (sensors and wearable devices), advanced imaging technologies (satellite and drone imagery) and automated machinery and agricultural robots (Chandra and Collis, 2021.) Digital platforms can be difficult to be adopted by low-literate farmers at times, despite the applications having proved their usefulness to various agricultural value chains (Sekabira *et al*., 2023).

However, the disruption to food systems by COVID-19 exposed opportunities that could be exploited by the use of digital agriculture platforms and motivated farmers to adopt technology in order to shrug off the traditional challenges. The pandemic uncovered interconnected vulnerabilities linking livelihoods and agriculture value chains sustainability as countless farmers and suppliers around the world experienced food losses because they could not market their food or hours were restricted (Blay-Palmer *et al*., 2021).

Recently, Zimbabwe has seen a rapid growth in the use of digital agriculture platforms. The digital agriculture innovations platforms include, among many others, Ecofarmer, VayaTractor, E-Mukambo, Smart Farmer, Mutasa Auction Floor, Zim-Mall, Kurima Mari, Agri-share and Induna (CCARDESA Report, 2021). Some of these digital apps provide weather-based insurance, real-time location-based weather information and farming tips to over 80 000 smallholder farmers (Parwada and Marufu, 2023). According to the World Food Programme (WFP) Report (2022), digital agriculture platforms have enabled farmers

to get farming advice in real-time, make online payments for inputs and services and access extension services from a tap on a phone, services that were previously available only through pamphlets and meetings. Some technology players in Zimbabwe have alluded to the fact that digital agriculture applications are not yet directly benefitting smallholder farmers as these require specific appropriate smart phones, whereas the majority of the farmers are using basic feature phones (CCARDESA Report, 2022)

Value Creation by Digital Agriculture Platforms

The use of digital platforms presents an efficient solution for the ongoing production obstacles, as this has been coupled with the revolution of technology vehicles such as robotic vehicles and drones, computers, radio, internet services, social media and mobile applications (Hashem *et al.*, 2021).The value creation dimension of digital platforms consists of the key resources and activities that agriculture supply chain players utilise in order to create value, as this relates to platform technology and network externalities (Osterwalder and Pigneur, 2013). For the digital platform marketplaces, the core fundamentals entail the creation of trust and helping participants discover an acceptable price for their transaction partners (Bakos, 1998). The transaction pricing mechanism for the agriculture platforms makes use of a model in which the technology provider, the suppliers and/or the buyers set the price. Digital marketplaces, therefore, create trust as they facilitate value chain actors to review historical transactions of the participants (Pavlou and Dimoka, 2007). The digital platform model provides a distinguishing capability as to whether platform players mutually review each other, whether the platform itself provides a review based on standardised metrics, or whether none of these mechanisms is in place (Täuscher and Laudien, 2018).

One of the core advantages of digital platform business models is the efficiency and speed with which transactions are executed, coupled with a significant lowering of transaction costs, as well as to the occurrence of exceptional market dynamics (Srinivasan, 2021). Platform-based business models provide a technology for problem-solving through match-making mechanisms which then minimises the occurrence of

transaction costs (Evans and Schmalensee, 2006). Another benefit is realised as a result of the high number of players within the network or the community whereby each side easily finds its respective counterpart (Rohn, D *et al*., 2021). It is easier for the farmers to sell their products online to many off-takers (buyers), who also, in turn, have access to a variety of suppliers within the market to compare the diverse commodity offerings. As more participants get attracted to a platform, the more valuable it becomes to suppliers and buyers and vice versa (Gawer and Casumano, 2014).

Digital agricultural applications are being integrated with other intelligent systems such as remote sensing, farmers' inputs, machine and sensor data, public data and other private-entity-held data to provide real-time information on market prices, weather forecasts and extension service (Gebresenbet*et al*., 2023). The data architecture and design of these platforms provide access to agriculture information, understanding farmer's needs and obtaining market information. The digital platforms present a way for new services and opportunities in striving for sustainability and transformation of the agricultural value chains (Hrustek, 2020.) With these apps, farmers can connect to their farms at anytime from anywhere through IoT-enabled devices.

The digitisation of farmers' practices and experiences improves their capabilities at every stage of the agriculture cycle, enabling them to increase productivity and efficiency. Since the applications make use of open APIs and interoperability layers, this allows for interface with remote sensing and precision agriculture tools and, as such, fosters the optimisation of resources, reduces waste and enhances their decision-making capabilities. Farmers are able to access real-time information on weather patterns, soil quality, crop varieties and market prices through the digital platforms, helping them in more informed decision-making (Stupina *et al*., 2021).

Value creation is also through the creation of synergies with key stakeholders in the value chain such as the bundling of services with

financial institutions, insurance companies, manufactures, unions and many others (Ajambo *et al*, 2023). The digitalisation of trading activities along the agricultural value chain, which includes marketing, distribution and logistics, provides a single view across the entire supply chain. The interface to blockchain, IoT (Internet of Things) and big data helps farmers and off-takers to track the movement of farm produce and services, enables the supply chain optimisation, thereby reducing waste and improve profitability for the farmer. This also improves market access for smallholder farmers, enabling them to sell their products at better prices and reach a broader range of buyers (*ibid.*). The incorporation of agricultural extension officers' working ways into the digital apps enables farmers to easily access the AGRITEX extension at the click of a button, overcoming logistics barriers. This enables extension officers to provide timely and relevant information to farmers on topics such as crop management, pest control and marketing (Nyarko and Kozári, 2021).

Digital platform technologies foster collaborations and partnerships along the agricultural value chain, thus bringing stakeholders to work together toward common goals. This helps smallholder farmers to connect with traders, input suppliers, financial providers and other stakeholders, enabling them to collaborate and share knowledge and resources. Through digital inclusivity, stakeholders can work together to develop innovative solutions to challenges such as climate change, food insecurity and rural poverty (Agyekumhene *et al.*, 2020). According to the African Union, digital technologies enable a resilient and inclusive digital economy as they bring in the capability of the system to continuously offer services and adapt to ongoing changes in agricultural value chains. The platforms foster efficient decision-making by smallholder farmers as heterogenous agricultural data are availed timely and accurately (Union, 2020).

Critical analysis of Kurima Mari App

Kurima Mari roughly translates to "earning money through farming". The app was developed by the German aid organisation WWH and its aim is to improve access to the market and provide advice for small-scale farmers. The app's functions are available offline as most farmers

do not have access to a stable network in their area or cannot afford internet access (Techzim Report, 2018). The Kurima Mari app is a response to smallholder farmers in Africa who do not have sufficient access to market information – which often results in them under charging their products (Gwaka, 2017). The lack of access to information makes it difficult for smallholder farmers to respond to price fluctuations or weather changes, apply new farming techniques and increase their yields (CCARDESA Report, 2022).

The app provides farmers with various information concerning crops, livestock, nutrition, financial services (for agriculture business), selling tips and markets for buyers and sellers. All that information can be read by many people in Zimbabwe as the app can be used in three different languages, English, Shona and Ndebele (Nyajeka and Duncombe, 2022). Approximately 34 000 smallholder farmers across the country are using the digital mobile to improve the quantity and quality of their harvests by giving them current information on production practices. The apps facilitate linkages, weather advisory services, add efficiency to commodity systems, which, in the long, run help increase farmer's yields and make them more profitable (Mayoyo *et al*., 2023).

Critical analysis of Agri-share app

The AgriShare app was launched in March 2019. It is a free-to-use shared services mobile solution for mechanised agriculture. It links owners of agricultural equipment like tractors, shellers and lorries, to farmers and other actors in the agricultural value chain. It has over 53 000 registered users. The app allows farmers to share resources and offer services (CCARDESA Report, 2022). For example, a farmer who has no tractor can use the app to display and rent tractors in a certain area, or with certain specifications. People can use the app to find a mechanic and make a direct booking. In some African countries such as Uganda, the app has connected thousands of farmers to rent or hire agriculture resources from manufactures and this is the same model which has been adopted by WHH in Zimbabwe (Ajambo *et al*., 2023)

The Potential of Digital Agriculture Platforms

Agricultural innovation platforms are increasingly seen as a panacea for mitigating the agricultural value chain challenges through enabling the co-evolution of different elements in the innovation process (Swaans *et al*., 2013). In 2020, the African Union (AU) adopted the Digital Transformation Strategy for Africa (2020-2030) which presents a vision of an integrated and inclusive digital society and economy in Africa. It recognises a digital economy as a key factor in stimulating economic growth and jobs, reducing inequality and promoting sustainable growth (African Union, Report, 2020). Zimbabwe is ranked 7 out of 16 in the benchmark assessment, suggesting that it has some key foundational elements necessary for a robust digital economy. The benchmark assessment suggests that Zimbabwe's digital economy is in transition and it seems that there is a lot in the pipeline in terms of development of policies, strategies and legislation. There are few policies, strategies and legislation governing the innovation space with regards to digital technologies that can be applied to the agriculture sector (CCARDESA Report, 2022).

According to Nyamadzawo (2011), digitalisation has been actively embraced in Zimbabwe's general strategies, but efforts should be made to provide a clearer mandate on how technologies are best incorporated into the agriculture sector and balance the trade-offs involved in greater digitalisation. There is a focused attempt by the Government of Zimbabwe to prioritise and stimulate the agricultural economy and to actively embed digital technologies within the economy (Makiwa, 2018). There are constraints though in the sector, affected by limited access to capital, ICT skills shortages and low investment in research and development (R&D). To ensure effective participation and implementation of platform activities, efforts ought to be made to fulfil the platform's promise as a forum for mitigation of transaction cost challenges such as inadequate markets for both output and inputs, customised products and inputs and lack of valuable agricultural information (Ezeomah and Duncombe, 2019). Digital technology opens vast untapped potential for farmers, investors and entrepreneurs to improve the efficiency of food production and consumption in Africa. From precision farming to an efficient food supply chain, technology

could bring major economic, social and environmental benefits. Indeed, the sheer optimism across the startup ecosystem is that extreme hunger can be sharply reduced in Africa in this generation, by significantly transforming the industry that employs most of its citizens (Kim *et al*., 2020).

Digital agriculture has provided farmers with reliable marketing information which helps them reach their markets more effectively, at lower cost and with wider opportunities (Ferris, 2014). There are augmented agricultural digital platforms: for example, digital farm registries, digital marketing platforms and agricultural observatories. Adoption is enhancing agricultural digital skills and literacy: for example, providing targeted training for farmers, particularly for women and extension agents, empowering women in agriculture using ICTs and advice provided (Gwaka, 2020). There is also promotion of the deployment of digital solutions in agriculture as solutions to schedule sprinkler irrigation systems and enhance the quality and productivity of land and eventually increase farmers' incomes (Abioye, 2022). E-agriculture information systems, with content such as on health, nutrition and educational advice can empower women by addressing the multiple responsibilities they have in caring for families as well as farming. Using digital apps' financial services for sending and saving money enables rural woman farmers to have some sort of autonomy over their finances, as well as the implementation traceability solutions to be able to respond to the quality standard requirements and help large buyers track, manage, pay and reward small producers (Nyajeka and Duncombe, 2022)

Mobile devices and platforms are increasingly being mainstreamed into agricultural value chains. While the extant literature on the use of mobile devices for agriculture has focused on their use for the provision of m-services through short messaging services (SMS), unstructured supplementary service data (USSD) and voice calls, there is growing evidence of the adoption and use of a new wave of digital platforms (mobile apps, web apps and online databases) in agricultural value chains in developing regions (Ezeomah and Duncombe, 2019). As

debates on the disruptive potential of digital platforms in agriculture for the developing countries are still at a nascent stage, investigations into the current use of digital platforms in agricultural value chains, has shown the potential to cause change in a number of value chain processes (Kim *et al.*, 2020).

In as much as the potential is there for everyone to emulate, the majority of rural smallholder farmers own the basic feature phones capable of voice, text and basic functions and yet, mobile Apps are designed for smartphones (Makiwa, 2018). Most of the digital platform innovations in developing countries such as Zimbabwe being developed for agriculture and fairly in the initial stages, are being supported by donor funds. Ultimately, the innovations are often limited to specific areas. Also, the development of most of these apps are not human-centred, as there is little consultation with the ultimate users as the developers are driven merely by existing ideas. This being the case, most apps being developed for rural communities are not adapted for rural communities and fall short in the delivery of the expected value (Gwaka, 2020).

Research Methodology

To answer the research questions, the study uses a qualitative case study research design. This enabled the generation of an in-depth and multi-faceted understanding of the innovations around the digital agriculture platforms and the impact on the smallholder farmers with regards to enhanced productivity and the betterment of their livelihoods. The design of this research is that of testing already existing hypotheses in the use of digital agriculture platforms by smallholder farmers. Yin (2014) contends that qualitative research case studies can be used to test already existing theories. The research focuses on WHH digital agriculture platforms and their usage by the different agriculture value chains. The typical value chain categories include:

- Poultry farming
- Horticulture
- Beef Farming
- Piggery

- Staple crops farming

Research Findings

The empirical findings are categorised according to the research questions, themes, elements and sub elements.

Benefits of the Digital Agriculture Platforms (RQ1)

The findings with regards to this research question, "What are the benefits of the digital agriculture platforms to the value chain actors?" are outlined in Table 1. These findings are discussed thereafter.

Table 1: - Benefits through the digital platforms

Theme	Element	Number of Respondents	Percentage (%)
Agri-Ecommerce	Access to National and Global market prices	50	90.9%
	Advertising my farming produce	37	67.3%
	Creating my own market places	51	92.7%
Digital Advisory	Access to AGRITEX information data bank	32	58.2%
	Access to plant and animal diseases data bank	16	29.1%
	Access to weather information	33	60.0%
	Farmer to farmer collaboration	12	21.8%
Digital Financial Services	Access to financed farming inputs	11	20.0%
	Access to insurance services	8	14.5%
Digital Procurement of Services	Access to agriculture equipment	12	21.8%
	Access to cheaper agriculture inputs	12	21.8%

Most benefits accrued were in the Agri-Ecommerce category, where 90.9% of the respondents indicated that they used the apps to get access to market prices, 67.3% alluded to the fact that they advertised their produce on the platforms and 92.7% were able to geo- tag their location as they create their own online market places on the platforms. Pressed for more details during the focus groups discussions, the respondents were able to publish and communicate to the market when their produce were ready for uptake as one of the biggest benefits which ensured timely purchase by off-takers and thus preserving the quality and containing their production costs.

The digital Advisory ranked second on the benefits to farmers, with 58.2% of the respondents having been able to use e-extension services provided by the platforms and thus eliminating the challenge of unavailability of agriculture extension officers. Some of the respondents (60%) indicated that they were able to access real-time weather information, making it easy for them to respond to upcoming weather conditions.

Digital Financial Services ranked third with 20% of the respondents having been able to use the platforms to access subsidised or discounted farming inputs and 14.5% having been able to utilise insurance services. An elaborate discussion during the focus groups showed that a few inputs suppliers had created discounted packages for farmers who are enrolled on the platforms.

The digital procurement services were popular amongst the crop farmers who were able to engage with the logistics services and equipment service providers such as tractors and haulage trucks. This benefit was acknowledged by 21% of the respondents.

Challenges addressed by digital platforms (RQ2)

The findings with regards to this research question, "How are the digital agriculture platforms addressing challenges being faced by the

smallholder farmers and other value chain actors?" are outlined in Table 2. These findings are further discussed thereafter.

Table 2: Challenges addressed by Digital Platforms

Theme	Element (Challenge)	Respondents	Percentage
Agri-Ecommerce	Limited access to markets information	53	96.4%
Digital Advisory	Limited accessibility of agriculture extension officers	45	81.8%
	Remote farm logistical accessibility	14	25.5%
	Limited knowledge on plant and animal diseases	31	56.4%
	Lack of timely local weather information	22	40.0%
Digital Financial Services	Limited access to agricultural finance	21	38.2%
	Limited access to agriculture insurance	15	27.3%
Digital Procurement of Services	Limited agricultural equipment & inputs	18	32.7%

As per the response data, 96.4% of the participants reckon that digital platforms are able to address produce marketing challenges in the form of limited access to markets information; 81.8% believe that the platforms can articulate challenges related to digital advisory, especially limited access to agriculture extension services, crop and animal diseases and lack of timely weather information access, 38.2% believe that there limitations of agricultural finance and insurance services and 32.7% assert that the platforms can articulate challenges related to procurement services such as that of equipment and inputs.

Opportunities through Digital Platforms (RQ3)

The findings in Table 3 are in connection with the perceived opportunities which are brought about by the digital platforms. In particular, which areas are most likely to benefit more or are better positioned to ride on the digital platforms?

Table 3: Opportunities through Digital Platforms

Theme	Percentage	Element
Agri-Ecommerce	98.2%	Publishing geo-location of farms/markets
		Creating own market places
Digital Advisory	89.1%	Real-time information access
		Adopting best farming practices
		Self-education on new agriculture value chains
		Extension services
Digital Financial Services	9.1%	Access to agricultural finance - inputs discounts
		Limited access to agriculture insurance
Digital Procurement of Services	21.8%	Limited agricultural equipment &inputs
Smart Farming	50.9%	Ready access to information and farming Advisory services in real time
Bundled Services	16.4%	Bundles packages value chain players

The key findings show that agri-ecommerce is perceived to be a palatable area where agriculture value chain actors can benefit from the digital platforms, with 98.2% of the respondents concurring. Digital advisory comes second with 89.1% and Smart farming with 50.9% and procurement services with 21.8%, whereas 16.4% of the respondents are confident that digital platforms can be used to bundle or packages agriculture services for specific value chain actors.

Challenges in the use of Digital Platforms (RQ3)

The Table.4 outlines the challenges which the respondents indicated during focus group interviews as impeding the effective usage of the digital apps.

Table 4. Challenges in the usage of the digital apps

Theme	Element
Connectivity Challenges	Limited cellular network/Internet connectivity in remote areas
	Constant electrical power cuts
	Lack of smart phones
Economic Challenges	High inflation rate - hence cannot fully depend on Market prices
	High fraud rates
	Cost of Internet data bundles
Data Privacy Issues	Cyber security issues
	Data Privacy and security
Knowledge Transfer	Lack of training on the app usage
	Don't know the full functionality of the apps
Social Issues	Lack of trust on the value chain actors

Relationship between Digital Platforms and Agricultural Productivity

As per Table 5, the majority of the respondents strongly agreed to the assertion that digital apps have increased their agricultural productivity.

Table 1.5: Digital apps increasing productivity

Farmer Type	Response				
	Strongly Disagree	Disagree	Indifferent	Agree	Strongly Agree
Communal (Rural) Farmer	0%	0%	0%	75%	25%
Small Holder Farmer (Urban)	0%	0%	25%	42%	33%
Small Holder Farmer (Rural)	0%	0%	0%	64%	36%
Agri-Business Off-taker	0%	0%	0%	100%	0%
Small-scale Commercial Farmer	0%	0%	50%	50%	0%

Three quarters (75%) of the communal respondents agree, whilst 25% strongly agree. For the smallholder farmers (urban), 42% agree, with 33% strongly agreeing to the notion, whilst 25% are indifferent. The smallholder farmers (rural) all concurred with the statement that digital apps increase agricultural productivity, with 64% agreeing and 36% strongly agreeing.

Enhanced livelihoods through the use of Digital Platforms

Figure 1 shows that 60% of the respondents agreed that the use of digital apps has enhanced their livelihoods, 25.5% a strongly agreeing to the notion, while 14.5% of the respondents were indifferent (they neither agreed nor disagreed).

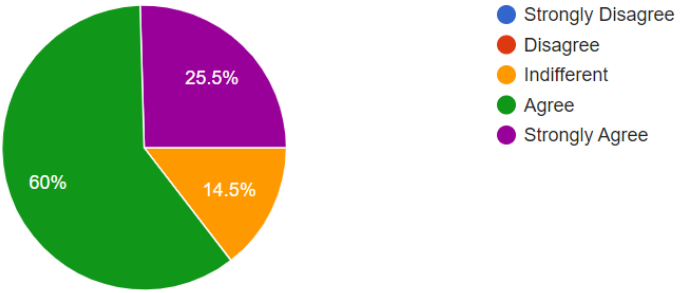

Figure 1: Digital apps enhancing livelihoods

Conclusion and recommendations

The study reveals that the digital apps, Kurima Mari and Agri-share, have been able to increase agricultural productivity for the smallholder farmers, as well as enhance their livelihoods. The majority of the farmers confirms the notion of increased productivity and better livelihoods. The increase in the production output is directly linked to increased revenue for the farmers, hence improvement in the standards of living. The results show that across all the value chains, there is assertion and confirmation of the benefits derived through the use of the digital apps in all the key categories that is Agri-Ecommerce, Digital Advisory, Digital Financial Services and Digital Procurement of Services. Prominent among the benefits are access to markets, access to e-extension services, digital procurement, logistics services and availability of agronomy data.

The study reveals that some of the key challenges which the smallholder farmers are facing with traditional farming practices and how the apps have been able to provide solutions to some of the challenges, especially around markets and the issue of remote logistical challenges.

The findings also show which has the most opportunities for the farmers if there are to effectively use the digital technologies. The Agri-Ecommerce and Digital Advisory services themes came out top of the

list as farmers perceived that they are more untapped potentials in these areas.

To maximise the utilisation of the digital apps, the following are some of the recommendations

1. The findings reveal that farmers are not fully aware of the functionalities of the apps. As a result, there is need for WHH management to continually reach out to the farmers and educate them on the capabilities of the digital apps, regarding the benefits that accrue when using the Apps. This will increase adoption and create awareness, hence increasing demand for the services.
2. There is need to support digital literacy activities as most smallholder farmers lack the basic skills in using mobile gadgets beyond receiving and making calls. Observations during the focus group workshops revealed how farmers struggle to navigate to access the services and thus need to enhance the insights on what more they can utilise the smart phones for in the context of the digital apps.
3. Poor Internet connectivity and unavailability of electricity often means that most of the time, farmers have no real-time access to data, thus making the apps' off-line capabilities very vital. It is, therefore, critical for WHH to bundle the services with infrastructure providers such as solar systems providers and MNOs to ensure that there is increased real-time information access.
4. WHH should also enhance its partnership with government agriculture agencies to ensure that trusted agronomy data are loaded onto the digital apps through interoperability layers with legacy government data platforms.

REFERENCES

Abioye, E.A. *et al.* (2022). Precision Irrigation Management Using Machine Learning and Digital Farming Solutions. *Agri-engineering, 4*(1), 70-103.

African Union (2020). The Digital Transformation Strategy for Africa (2020-30).

African Union Report (2020). The Digital Transformation Strategy for Africa (2020-2030).

Agyekumhene, C. *et al.* (2020). Making Smallholder Value Chain Partnerships Inclusive: Exploring Digital Farm Monitoring through Farmer Friendly Smartphone Platforms. Sustainability, 12(11),.4580.

Ajambo, S. *et al.* (2023). Digital Agriculture Platforms: Understanding Innovations in Rural Finance and Logistics in Uganda's Agrifood Sector (Vol. 5). Intl Food Policy Res Inst.

Ajayi, Oluwatosin, V. (2023). A Review on Primary Sources of Data and Secondary Sources of Data. *European Journal of Education and Pedagogy*, *2*(3), 1–7. www.ej-edu.orgdoi:http://dx.doi.org/19810.21091/

Bakos, Y. (1998). The Emerging Role of Electronic Marketplaces on the Internet. *Communications of the ACM, 41*(8).

Blay-Palmer, A., Santini, G., Halliday, J., Malec, R., Carey, J., Keller, L., Ni, J., Taguchi, M., & van Veenhuizen, R. (2021). City region food systems: Building resilience to COVID-19 and other shocks. *Sustainability (Switzerland)*, *13*(3), 1–19. https://doi.org/10.3390/su13031325

Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) (2022). Assessment of Digitalization in the Agricultural Systems of the SADC Region: Situational Analysis Report.

Chandra, R. and Collis, S. (2021). Digital Agriculture for Small-scale Producers: Challenges and Opportunities. *Communications of the ACM, 64*(12).

Eisenmann, T., Parker, G., & Van Alstyne, M. (2006). Strategies for two-sided markets. *Harvard Business Review*, *84*, 92-101+149.

Evans, D. S., Hagiu, A. Schmalensee, R. (2006). *Invisible Engines.* Cambridge: MIT Press.

David-West, O., & Evans, P. C. (2016). The Emerging Platform Economy Series No. 2, The Rise of African Platforms A Regional Survey Olayinka David-West. *The Center for Global Enterprise*, *July*. https://doi.org/10.13140/RG.2.2.35887.05280

Ezeomah, B. and Duncombe, R. (2019, April). The Role of Digital Platforms in Disrupting Agricultural Value Chains in Developing Countries International Conference on Social Implications of Computers in Developing Countries. Cham: Springer International Publishing.

Ferris, S. *et al.* (2014). Linking Smallholder Farmers to Markets and the Implications for Extension and Advisory Services. *MEAS Brief, 4*(10).

Gawer, A., & Cusumano, M. A. (2014). Industry platforms and ecosystem innovation. *Journal of Product Innovation Management*, *31*(3), 417–433. https://doi.org/10.1111/jpim.12105

Gebresenbet, G., Bosona, T., Persson, H., Mandaluniz, N., Chirici, G., Zacepins, A., Komasilovs, V., Pitulac, T., & Nasirahmadi, A. (2023). A concept for application of integrated digital technologies to enhance future smart agricultural systems. *Smart Agricultural Technology*, *5*, 100255. https://doi.org/10.1016/j.atech.2023.100255

Golafshani, N. (2003). Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report, 8*(4).

Gumbi, N., Gumbi, L., & Twinomurinzi, H. (2023). Towards Sustainable Digital Agriculture for Smallholder Farmers: A Systematic Literature Review. *Sustainability*, *15*, 12530. https://doi.org/10.3390/su151612530

Gwaka, L. T. (2017). Digital technologies and sustainable livestock systems in rural communities. *Electronic Journal of Information Systems in Developing Countries*, *81*(1), 1–24. https://doi.org/10.1002/j.1681-4835.2017.tb00598.x

Gwaka, L. T. (2020). T*he Potential of Digital Platforms in Revitalising the Livestock System in Rural Zimbabwe*. *May*, 1–21. https://doi.org/10.20944/preprints202005.0169.v1

Gwaka, L.T. (2022). Computer Supported Livestock Systems: The Potential of Digital Platforms to Revitalise a Livestock System in Rural Zimbabwe. Proceedings of the ACM on Human-Computer Interaction, 6(CSCW2).

Liu, X. (2013). Full-Text Citation Analysis: A New Method to Enhance. *Journal of the American Society for Information Science and Technology*, *64*(July), 1852–1863. https://doi.org/10.1002/asi

Hanafizadeh, P., Khosravi, B., & Tabatabaeian, S. (2020). Rethinking Dominant Theories Used in Information System Field in the Digital Platform Era. *Digital Policy Regulation and Governance*, *ahead-of-print*. https://doi.org/10.1108/DPRG-09-2019-0076

Hashem, N. M., Hassanein, E. M., Hocquette, J. F., Gonzalez-Bulnes, A., Ahmed, F. A., Attia, Y. A., & Asiry, K. A. (2021). Agro-livestock farming system sustainability during the covid-19 era: A cross-sectional

study on the role of information and communication technologies. *Sustainability (Switzerland)*, *13*(12). https://doi.org/10.3390/su13126521

Hrustek, L. (2020). Sustainability Driven by Agriculture through Digital Transformation. *Sustainability 12*(20).

Joo, H.-Y., & Seo, H.-M. (2016). Design of Platform Business Model in Public Sector: Role & Responsibility for Governance. *International Journal of U- and e- Service, Science and Technology*, *9*(2), 59–66. https://doi.org/10.14257/ijunesst.2016.9.2.07

Kenney, M., & Zysman, J. (2016). Summit on Human Gene Editing. *Issues in Science and Technology*, *32*(3), 61–69.

Kim, J. *et al.* (2020). Scaling Up Disruptive Agricultural Technologies in Africa. World Bank Publications.

Makiwa, P.J. (2018). Developing and Validating an ICT Adoption Framework for SMEs in Developing Countries: A Case of Zimbabwe. Doctoral Dissertation, University of Pretoria.

Mayoyo, A. *et al.* (2023). Digital Climate Adaptation in Agriculture Profile for Zimbabwe.

Merriam, S.B. (1998). *Qualitative Research and Case Study Applications in Education. Revised and Expanded from "Case Study Research in Education."* San Francisco, CA: Jossey-Bass Publishers

Mlčúchová, M. (2022). A Review of Platform Business Models. Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration.

Munyua, H., Adera, E. and Jensen, M. (2009). Emerging ICTs and their Potential in Revitalizing Small-scale Agriculture in Africa. *Agricultural Information Worldwide, 2*(1).

Musungwini, S. *et al.* (2023). Emerging ICT Technologies for Agriculture, Training and Capacity Building for Farmers in Developing Countries: A Case Study in Zimbabwe. *In Applying Drone Technologies and Robotics for Agricultural Sustainability*, 12-30. IGI Global.

Mutekwa, V.T. (2009). Climate Change Impacts and Adaptation in the Agricultural Sector: The Case of Smallholder Farmers in Zimbabwe. *Journal of Sustainable Development in Africa, 11*(2)), 237-256).

Nyajeka, P., & Duncombe, R. (2023). *The Use of Mobile Phones by Women Livestock Keepers in Zimbabwe*. https://doi.org/10.1145/3572334.3572401

Nyamadzawo, J. (2011). Digital Opportunities for Economic Growth and Development for Zimbabwe. ZEPARU Working Paper Series (ZWPS 05/11). Available online:: http://www. zeparu. co. zw/sites/default/files/2018-03/2011% 20digital% 20opportunities% 20for% 20economic% 20growth% 20and% 20 development% 20for% 20zimbabwe. PDF [Accessed on 7 June (2023].

Osterwalder, A., & Pigneur, Y. (2013). Designing Business Models and Similar Strategic Objects: The Contribution of IS. *Journal of the Association of Information Systems (JAIS)*, *14*, 237–244. https://doi.org/10.17705/1jais.00333

Parker, C., Scott, S. and Geddes, A. (2019). Snowball Sampling. SAGE Research Methods Foundations.

Pavlou, P.A., Lie, T. and Dimoka, A. (2007, November). An Integrative Model of Mobile Commerce Adoption in Proceedings of the Conference on Information Systems and Technology (CIST/INFORMS), Seattle, WA.

Richardson, C.J. (2005). The Loss of Property Rights and the Collapse of Zimbabwe. *Cato J., 25,* 541.

Srinivasan, R. (2021). *Platform Business Models*. Singapore: Springer.

Stupina, A.A. *et al.* (2021, September). Digital Technologies as a Tool for Improving the Efficiency of the Agricultural Sector. In IOP Conference Series: *Earth and Environmental Science (Vol. 839*, No. 2, P. 022092). IOP Publishing.

Techzim Report (2018, October 24) The Kurima Mari Mobile App is for You if You are into Farming.

Von Grebmer, K. *et al.* and (2008). Global Hunger Index: The Challenge of Hunger 2008 (No. 594-2016-39943).

Wagner, J. (2020). Deutschland De Report (2020). Smartphones Aid the Harvest: How an App from Welthungerhilfe is Helping Farmers in Zimbabwe. Three Questions and Answers. Word Food Programme (WFP) (2022). Zimbabwe Annual Country Report 2022.