DIGITAL AGRICULTURE: THE PATHWAY TO SUSTAINABLE AGRICULTURE

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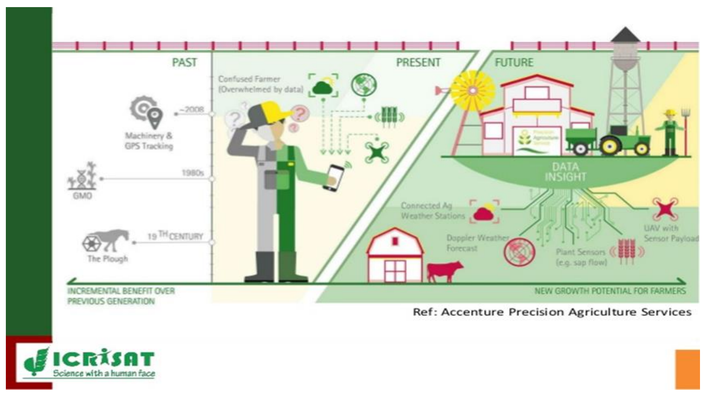
Introduction

South African farmers and those across the world have a challenge to deliver sufficient food to satisfy the expanding needs of food (Santos, 2006). In as much as they work hard to deliver, they experience production reductions, efficiency lessens, and thus food security is compromised. Farmers endure issues of satisfying market demands, while dealing with a number of challenges during the production cycle (Masoumeh et al 2014). The issues farmers deal with on a day to day basis amongst other involve: water scarcity, prevalence of pests and diseases, high infestation of weeds, application of fertilizers to either known or unknown soil nutrient status as well a climate change (Van ES and Woodard 2016). However, Trendov et al (2019) suggests that digital agriculture as well as digital innovations might be part of the solution for farmers across the world. According to Webber et al (2017) digital agriculture aims to revitalise and to help achieve the objectives of the three traditional pillars of agriculture, namely: economic viability, environmentally friendly and socially acceptable. Digital agriculture does not only assist farmers to mitigate the overwhelming effects of climate change but also assist them to adapt and thrive in the Fourth Industrial Revolution (4IR).



According to Trendov et al (2019) digital agriculture refers to the tools with which farmers (smallholder or commercial) use to collect, store, analyze and electronically share data within the agricultural value chain. Furthermore, digital agriculture will help improve the smallholder farmers' access to information. Baumüller (2015) argues that technological innovations and mobile phones help farmers to have access to information related to: farming inputs, market, prices, training as well as funding. Therefore, digital agriculture stand a chance to improve efficiency in the farming industry as well as improve sustainability. However, smallholder farmers have the responsibility or rather, a role to play, which is to adopt the technological innovations such as digital agriculture and artificial intelligence so to improve their productivity.

Objectives

The objectives of the study are:
1. To determine the role of digital agriculture in agricultural productivity.
2. To examine factors affecting smallholder farmers' adoption of digital agriculture.

Methodology

The study reviewed literature relevant to the study theme and objectives. Furthermore, journals, books, and government reports (DAFF) were reviewed. The review of literature concentrated precisely on research findings available, relevant to the role of digital agriculture in ensuring sustainable agriculture.

Results

This paper defines digital agriculture, the role of digital agriculture in ensuring sustainable agriculture and also examines the factors influencing the adoption of digital agriculture by smallholder farmers. The discussion of the results is based on the study's delineated objectives.

Definition of digital agriculture as well as its role in the agricultural sector

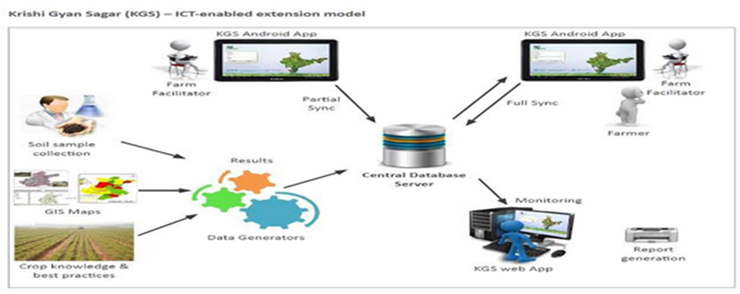
Digital agriculture is the ecosystem of data and ICT, aimed at supporting the rapid development as well as the delivery of timely, targeted information and services so to ensure farming profitability and sustainability while delivering high nutritious but affordable food for all (ICRISAT 2016). However, Van ES and Woodard (2016) defines digital agriculture as the employment of computational and information technologies to improve the profitability and sustainability of agriculture. Furthermore, Digital Agriculture (DA) involves the use of advanced technologies (also used in Precision Agriculture), ICT as well as data available digitally, aiming to support farming by means of services such as the supply of climate related information, agricultural advisory services (on farm – self-service), sap flow and soil fertilizer recommendation.

Pillars of digital agriculture

There are several pillars of digital agriculture. However, this paper explores only two, namely: the basic minimum requirements of digital agriculture (DA) and basic enablers of DA. Basic minimum requirements of DA refers to the minimum conditions required to use the technology and it involves: availability, connectivity, affordability, ICT in education, policies and supporting programmes, the ICT infrastructure, educational attainment (level), computer literacy as well as accessibility (Trendov et al 2019). Basic enablers of DA refers to the factors which facilitates the adoption of the innovations and technologies.

Digital Agriculture Tools (DATs)

There are number of tools or technologies that enable digital agriculture for both crop and animal production. The DATs are many and different, serving different purposes, which is to either access or disseminate real time information with ease (Van ES and Woodard 2016). This include but not limited to: sensors, controllers, computational decision making tools, geo-locationing and communication, yield monitors, precise soil sampling, Unmanned Aerial Vehicles (UAVs), variable rate technologies, robotics, auto steer, automatic milking system, automatic feeding system as well as (RFI) Radio Frequency Identification (Trendov et al 2019 and Lou 2013).



The role of Digital Agriculture (DA) in the agricultural sector

Historically, a number of revolutions happened in the agricultural sector. All the previous revolutions were aimed to enhance efficiency, yields, and profitability (Trendov et al 2019). However, the expected outcomes were not achieved.

Hence, the market forecast suggests that the DA Revolution (DAR) will satisfy the aims of the agricultural sector by best responding well to the current agricultural issues (Webber et al 2017). DA will play a huge role in the agricultural sector to improve efficiency, yields and profitability. Moreover, DA's strength is on the fact that it will deliver to the Sustainable Development Goals (SDG) so to ensure sustainable agriculture (Trendov et al 2019). The table 1 illustrates how the three (3) traditional pillars of Sustainable Development will be achieved.

Pillars of sustainable development	Role of DA in achieving the SDGs
Economic viability	• Increased agricultural productivity • Cost efficiency • Market opportunities
Socially and cultural benefits (acceptability)	• Increased levels and channels of communication • Inclusivity (extension workers, researchers, farmers, marketing agents and financial institutions) • Timeliness • Improved employment opportunities
Environmentally friendly (benefits)	• Optimised usage of resources • Adaptation to climate change

Source: Sithole (11 December 2019)

It is therefore, satisfying to the objective of the study that is to determine the role of digital agriculture in the productivity of the agricultural sector across the world.

Factors influencing smallholder farmers' adoption of digital agriculture

All useful resources and inventions as well as technologies and innovations are to be adopted by users (Trendov et al 2019). However, there are known factors influencing the adoption of such technologies and innovations. Therefore, there are factors influencing the adoption of DA include but not limited to: IT infrastructure and networks in the rural areas, educational attainment, skills and digital literacy, policies and programmes for enabling digital agriculture, financial resources, agricultural stakeholders' social media preferences, the benefits of DA, timely information access as well as climate change effects (ICRISAT 2016 and Trendov et al 2019).

Conclusion

Digital agriculture is the pathway to sustainable agriculture in the world. Furthermore, DA is essential because it helps to improve productivity, efficiency, yields as well as profitability in the agricultural sector. Findings revealed that DA have pillars, namely: the basic minimum requirements of DA and basic enablers of DA. Moreover, DATs used in the DA inventions involves the automatic feeding and milking system, the Unmanned Aerial Vehicle (UAV), yield monitors, sensors as well as GIS. The major role of DA in agricultural productivity is evident in terms of agricultural efficiency improvement, enhanced yields, improved productivity, lowered production costs and improved employment. The factors influencing the adoption of DA have been revealed by the study to be level of education, digital literacy and skills, financial resources, availability and accessibility of IT technologies, social media preferences, climate change effects as well as the policies and programmes for enabling DA.

It is therefore, recommended that further studies be made to examine the effectiveness of the DA in the more practical way than on paper. Studies to evaluate the adoption of DA and its tools in the agricultural sector be conducted. Financial implications of the use of DA and DATs have not been examined, therefore, it is recommended that studies to explore such areas be conducted.

Bibliography

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