

Transforming agriculture in Africa using digital technologies: a perspective from the Regional Universities Forum for Capacity Building in Agriculture

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Abstract

This paper presents a conceptual underpinning for African Digital Agriculture Programme (AfriDAP), a proposed initiative to accelerate transformation of agriculture in Africa using digital technologies. It outlines a perspective of the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) for transformation of agriculture in Africa using digital technologies. RUFORUM brings together higher agricultural institutions in Africa, development partners in and outside Africa to address a continental challenge of transforming African agricultural higher education, science, technology, and innovation (AHESTI). The proposed AfriDAP will seek to achieve, within this strategic framework, the goal of digitalization of agriculture ecosystem in Africa whilst addressing three programmatic areas: Digital learning and sharing technologies for agriculture, data science development (research, big data management and capacity building for agriculture), and incubation and innovations for digital agriculture entrepreneurship and startups.

Key words: Africa, Digital agriculture; digital learning; data science; big data; incubation and innovations

Résumé

Cet article présente les fondements conceptuels du programme Africain pour l'agriculture numérique (AfriDAP), une initiative proposée pour accélérer la transformation de l'agriculture en Afrique à l'aide des technologies numériques. Il présente une perspective du Forum Régional des Universités pour le Renforcement des Capacités en Agriculture (RUFORUM) pour la transformation de l'agriculture en Afrique à l'aide des technologies numériques. RUFORUM réunit des Institutions Supérieures Agricoles en Afrique, des partenaires de développement à l'intérieur et à l'extérieur de l'Afrique, afin de relever le défi continental consistant à transformer l'enseignement supérieur agricole, la science, la technologie et l'innovation en Afrique (AHESTI). Le programme AfriDAP proposé cherchera à atteindre, dans ce cadre stratégique, l'objectif de numérisation de l'écosystème agricole en Afrique tout en abordant trois domaines programmatiques: l'apprentissage numérique et le partage des technologies pour l'agriculture, le développement de la science des données (recherche, gestion de données volumineuses et renforcement des capacités pour l'agriculture),

et l'incubation et les innovations pour l'entrepreneuriat et les startups dans l'agriculture numérique.

Mots clés: Afrique, agriculture numérique; apprentissage numérique; science des données; données volumineuses; incubation et innovations

Introduction

Using digital technologies can transform Africa's Agricultural systems in different ways such as expanding farmers' access to capital and resources; disrupting value chains through economies of scale, allowing smaller players to be integrated into the value chain; and disrupting the management of natural resources through precision tools, helping to boost food production sustainably. This is referred to as digital agriculture whereby Information Communication Technologies (ICTs) such as internet and mobile devices, that have become vital in transforming farmers' lives, are deployed to support different agriculture value chain processes. Application of such digital tools potentially presents economic and environmental benefits that could come through reduced use of water, fertilizers, herbicides and pesticides besides the farm equipment (Banu, 2015). For example, with the touch of a button on their mobile device such as a phones, farmers can be able to do a diagnosis of the viral infections of their plants and store the data remotely or send the information to a cloud based repository. Digital agriculture also brings about opportunities for all the stakeholders (farmers, buyers, consumers, etc.) in the agriculture value chain to interlink. Through the digital platforms the stakeholders are able to interact freely from across the world (Roy and Ghosh, 2013) and access a variety of information on soil, land, plants, and other resources more widely available, allowing farmers to apply inputs like fertilizer and water in a more precise manner. Using modern digit technologies such as mobile internet technologies (Hu *et al.*, 2016) provides a great opportunity to generate massive digital data for future use in making decisions for effective agriculture. However, Africa is not well prepared in the use of the digital tools to benefit from the potential they bring and maximize profits within the agricultural value chain. It is therefore important for Africa, to innovatively rethink the models of adoption of digital agricultural that will be self-reliant and sustainable. A programme that can support in bringing together different stakeholders to participate in the value add to digital agricultural is inevitable for the 21st century.

African Digital Agricultural Programme (AfriDAP)

As part of transforming African agricultural higher education science technology and innovation (AHESTI), the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), a network of 114 universities in 38 African countries (see www.ruforum.org) in collaboration with other development partners is proposing a programme for African Digital Agriculture (AfriDAP) as a mechanism to accelerate transformation of agriculture in Africa using digital technologies. AfriDAP premises on digital technologies playing a pivotal role in the agricultural value chain transformation which Africa needs to eradicate poverty, steer prosperity, motivate innovation and entrepreneurship. The programme is geared to further strengthen the African opportunities of being competitive at the global stage and within the knowledge economy. There are three key programmatic pillars to realize AfriDAP (Figure 1): The first one being digital learning and sharing technologies

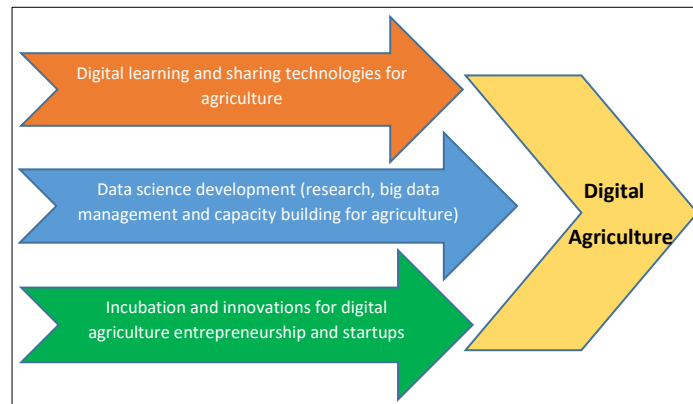


Figure 1. African digital agriculture programme (AfriDAP)

for agriculture (to support effective teaching and learning experience ubiquitously within agriculture sector). The second is data science development which encompasses data science research, big data management for agriculture and capacity building in data science.

The third is incubation and innovations for digital agriculture entrepreneurship and startups which is meant to support and sustain both the first and second pillars of the AfriDAP in a low-cost manner. The three pillars are supposed to coherently work in harmony to produce a self-sustaining digital agriculture ecosystem that depends on African generated resources and technologies. With the current trends of population growth, it is clear that the African population is expected to continue growing and it is the youngest in the world. Therefore, there is a strong need to produce enough food to feed this ever growing population through the use of modern digital technologies that can utilise the available resources such as farm land in a more effective way. Also, the young generation is not only digital savvy but prefers to interact with digital tools to perform majority of the day to day tasks which include agriculture services and hence making sure the environment is well prepared. Food production through traditional and basic knowledge of soil and weather conditions remains a common norm in the African continent. However, such practices known by the aging population is gradually being lost and therefore it is resulting into poor yields in many rural areas of the continent. This is further worsened by the climate change dynamics which are becoming hard to predict and determine for proper agriculture planning. Embracing digital agriculture in Africa will help to improve on the different activities within the agriculture chain processes hence more yields and improved food production in terms of quality and quantity will be realised. RUFORUM as a network of African universities is leading this agricultural digital transformation with support from partners.

Digital agriculture for Africa

Agriculture in Africa has largely been driven by traditional and basic knowledge of soil and weather conditions despite availability of digital technologies in the continent. This is normally associated with low yields and poor quality agricultural products. Studies show that crop yields have been falling in many areas in Africa due to in part, declining investments in research and infrastructure including digital technologies. On the other hand, as a result of an increased population, food

demand has been on the increase. This has inevitably resulted into a widening gap between the food production and the demand for food consumption. Investment in digital agriculture can help fill the gap between food production and its demands. This is because digital agriculture has proved to be successful in increasing the productivity and improving the quality of agricultural yields in other parts of the world such as India. RUFORUM – led initiative for digital agriculture for Africa is focused in three programmatic pillars as explained in the subsequent sub-sections.

Digital learning and sharing technologies for agriculture. In order to adopt digital agriculture in Africa in a more effective format, there must be a deliberate effort to provide ubiquitous education or training using low and cost-effective means. Development of digital learning and sharing of knowledge platform to key players in agricultural value chain is needed in order to provide relevant skills needed to drive digital agriculture. Higher agricultural education institutions in Africa along with other partners promoting agricultural development in the continent must work together to develop digital platforms for learning and which can also be used for sharing educational resources ubiquitously in the agriculture ecosystem. Higher Agricultural education institutions in Africa under the umbrella of RUFORUM could play a big role in harnessing the digital technology potentials for enhancing agricultural productivity in the continent. This can be done by promoting effective teaching and learning experience ubiquitously using digital platforms and making easily available digital contents to trigger development of suitable skills, attitude and knowledge across the RUFORUM Network. This will contribute to agricultural transformation by “strengthening innovative capacity, or the ability of individuals and organisations to introduce new products and processes that are socially or economically relevant, particularly with respect to smallholder farmers who represent the largest group of agricultural producers” in Africa (Spielman *et al.*, 2012).

Digital learning and sharing platforms can go a long way to address the inadequate skills gap within higher agricultural education institutions in Africa and will boost their capacities to facilitate the coordination of economic activities by equipping the new graduates with the required practical skills. These practical skills are crucial for knowledge transfer to the smallholder farmers who are the primary focus in the African agricultural sector. Most smallholder farmers continue to rely on traditional methods of farming and they have limited knowledge and skills to enhance their productivity. Further still, with the emergence of cheap mobile technologies, reduced costs of the internet and improved free digital content, there lies an opportunity for university students to have access to resources from anywhere, at any time and at their own wish.

Data science development for agriculture. Agriculture is undergoing a digital revolution with the advancement of data science and technology. Today, there are digital technologies to support high level of precision, information storage, processing and analyzing that was previously impossible due to technological limitations (Bronson and Knezevic, 2016). Data science development which comprises of data science research, big data management for agriculture and capacity building in data science enhance the ability for exploiting vast new flows of information to fundamentally improve decision making to support agricultural

transformation. Through Data Science research, agricultural higher education institutions are in position to provide requisite knowledge and technologies to farmers that can support agricultural productivity by exploiting big data analytics. The use of digital technologies is most likely to support community-based participatory research and to treat knowledge as an action strategy for change and rendering visible of the excluded knowledges around the globe in what is referred to as decolonization of knowledge (Hall and Co-holders, 2017). De-colonizing knowledge in digital agriculture means making meaning from the current dominant knowledge, understanding and expectation of what society should be like, how modern digital agriculture should be practiced, what kind of knowledge is accepted as relevant for the transformation needed. The explosion of digital data is therefore important to support decision making, and hence know fundamentally more about the agriculture value chain. RUFORUM recognizes that developing capacities of the higher agricultural education institutions in Africa will help in developing skills and knowledge required to exploit the massive data to cause the transformation that Africa needs.

Incubation and innovations for digital agriculture entrepreneurship and startups. Agricultural higher education institutions must create a steady supply chain for agricultural innovations that can sustain the digital agricultural era. This is ably possible through establishing a system that can nurture and develop more innovations for the agricultural sector. The incubation process makes sure that great agricultural ideas are nurtured to transform into innovations. These innovations can also further be nurtured to transform into startup companies that can be supportive in transforming the agriculture value chain. For example, pedagogical innovations can support learning and remote access to courses for students and farmers in a way that reshapes their skills, behavior and attitude towards engaging in productive agriculture. In order to defuse innovations incubated within the agricultural higher education institutions, use of digital technologies can promote the practice of university-community engagement, entrepreneurship and startups. Learning with the community or service-learning, where students and lecturers apply their knowledge and skills in a chosen community to improve the lives of people in that community can be facilitated by the use of digital technologies. Social innovation by students, which can be done in consultation with student unions, associations and clubs. This can be facilitated using various digital platforms where student initiate learning projects which have a social impact. RUFORUM believes that setting up digital technologies incubation and innovations in the higher agricultural education institutions in Africa will therefore act as a stimulus for entrepreneurship and startups.

RUFORUM as a platform to champion Africa's digital agriculture programme

RUFORUM, being a Pan African organisation that brings together 126 universities in 38 African countries, has a vision of *Vibrant, transformative universities catalyzing sustainable, inclusive agricultural development to feed and create prosperity for Africa*. It is in line with RUFORUM's vision to strengthen the capacities of universities by increasing opportunities for transformative student learning, creating and advancing research excellence, enhancing university innovation and knowledge generation, enhancing university community engagement, supporting policy dialogue and reform and supporting the involvement of women in agriculture. In order to achieve this vision RUFORUM places strong emphasis on digital agriculture spearheaded by all member universities and in collaboration with other stakeholders across the globe. Taking into account the needs for higher agricultural education institutions in Africa, RUFORUM plays a pivotal role in bringing together multiple stakeholders interested in transforming Africa's digital agriculture. RUFORUM

has initiated partnership with OCP Group, World Bank and other key stakeholders to discuss the implementation of the AfriDAP.

Conclusion

This paper has highlighted the critical issues that are pertinent in the development of the digital agriculture sector in Africa and why digital agriculture should be one of the focus areas for the transformation of Africa. The paper has also provided the basis for RUFORUM's coordinating role in the proposed AfriDAP. A RUFORUM's perspective of AfriDAP has also been highlighted in a three-pillar framework for AfriDAP whilst emphasizing the need to strengthen digital technology capacities of higher agricultural education institutions in order to spur the needed agricultural transformation.

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