Towards the digitalization of Cameroonian agriculture: current situation, challenges and prospects

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Abstract

The aim of this review article is to highlight the digital solutions available to Cameroonian agriculture. It also looks at the strengths, weaknesses, opportunities and threats of these solutions. In view of the constraints weighing on this sector, notably climate change, prospects are outlined.

Keywords

Digitalization, farmers, new-generation agriculture, sustainability

1. Introduction

In a world where digital transformation is redefining the contours of every industry, agriculture is at the heart of a silent but essential revolution. Although digitalization offers promising prospects for growth and sustainability on a global scale, it remains largely under-exploited, particularly in Africa, where structural challenges abound.

While the FAO (Food and Agriculture Organization of the United Nations) estimates that global food production must increase by 60% by 2050 to meet the needs of a growing population [1, 2], African agriculture remains well behind in the adoption of digital technologies, with only 10% of farms using digital technologies to manage their activities [3]. This digital divide threatens food security and economic development in developing countries, including Cameroon, where agriculture accounts for over 20% of GDP and employs nearly 60% of the working population [4].

According to the United Nations' Sustainable Development Report [5], the integration of digital technologies in agriculture can help achieve the Sustainable Development Goals (SDGs), notably SDG 2 (Zero Hunger) and SDG 8 (Decent Work and Economic Growth). Faced with these challenges, the digitization of Cameroon's agriculture appears to be an imperative necessity to increase productivity, improve efficiency and strengthen the resilience of agricultural systems to climate change and economic fluctuations. In this context, strategic documents such as the National Development Plan 2020-2030 [6] and the National Strategy for the Development of Agriculture [7], which aim for a profound transformation of the sector, emphasize the importance of increased digitalization.

This vision of a modernized agricultural sector is based on optimizing agricultural value chains, digitizing agricultural services and promoting precision farming. However, the challenges that lie ahead are many and complex: geographical disparities in access to technology, the need to train players and insufficient funding to support farmers in this digital revolution [8].

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This article explores the current state of digitalization in Cameroonian agriculture, analyzing the forces at work, the challenges to be overcome and the strategies underway to remove the obstacles that are holding back this digital transition. Through this investigation, we will attempt to identify the prospects for a more productive, more resilient and more competitive agriculture, where digital technologies, far from being a mere trend, become the driving force behind a profound and sustainable transformation.

For beyond the challenges, the stakes are high: we need to give Cameroon's land the opportunity to bear fruit, not just for one country, but for an entire region in search of food security and development.

2. Overview of the current situation

Digitizing Cameroon's agricultural sector is now a strategic imperative for modernizing the sector, boosting competitiveness and guaranteeing sustainable growth. Several innovative initiatives have been launched to support this digital transition, backed by national and international projects. For example, the Agricultural Production Support Program in Cameroon in short PARPAC [9], has deployed a platform for registering agricultural producers, facilitating access to agricultural and financial services and reinforcing the traceability of agricultural activities [1]. This project is part of a digital inclusion logic, in line with the objectives of the Digital Transformation of Cameroon Project in short PATNUC [10], which aims to promote access to agricultural technologies for producers through accessible and adapted digital solutions [3]. At the same time, the SIMC Project [11] has set up a call center enabling farmers to receive real-time information on weather conditions and forecasts, a crucial tool in the face of climatic hazards. This initiative enables producers to better anticipate the risks associated with climate change and adopt more resilient management strategies [5]. Similarly, the Cameroon Agropastoral Portal, in short CamAgro, facilitates networking between producers, suppliers and consumers [12], optimizing agricultural value chains and strengthening cooperation [13]. The Observatory of agricultural inputs, meanwhile, aims to provide a platform dedicated to real-time dissemination of prices and availability of agricultural inputs, a valuable tool for combating price fluctuations and guaranteeing a stable supply [14]. However, despite these advances, digitalization still remains timid in sub-Saharan Africa, where only 10% of farms benefit from digital solutions [3].

Challenges persist: digital infrastructure, access to financing and training for agricultural players remain major obstacles to be overcome. Nevertheless, with the rise of these digital solutions and PATNUC's support for digital inclusion, Cameroon's agriculture is entering a promising new era, offering prospects for increased productivity, resilience in the face of crises and a boost to the country's economic growth. The road ahead is still strewn with pitfalls, but the integration of digital technologies now seems unavoidable if we are to meet the challenges of the future and guarantee the country's food security and sustainable development.

3. Available solutions and outlook

3.1. On agricultural inputs

The quality and quantity of agricultural production depend on inputs, in particular agricultural inputs. In this respect, digitization focuses on the following elements:

3.1.1. Production and marketing of seeds and seedlings

It's well known that when seeds and seedlings are available, of good quality, accessible to growers and well used by them, agricultural production is boosted. Digitization appears to be a catalyst for the development of sustainable agriculture. In fact, the use of drones and sensors offers numerous advantages in terms of monitoring plots, calculating dosages when spraying, and anticipating

invasions of bio-aggressors and plant diseases [15]. The possibility of planting cover crops while protecting crops and soil, facilitating access to difficult plots and exploring vast areas. Once the seeds have been produced, the existence of a virtual market via platforms is an asset for interconnecting seed suppliers and demanders, reducing information asymmetries and seed losses.

3.1.2. Monitoring phytosanitary operations

For a more resilient agriculture, it is imperative to monitor phytosanitary interventions and therefore elements that require information systems on warning, monitoring, pest inventories, exploitation and dissemination of phytosanitary information. For new-generation agriculture, digitalization is still called upon at this level. For example, the implementation of an electronic pest monitoring and alert system enables control of one aspect of phytosanitary intervention. Similarly, the digitized collection and electronic dissemination of phytosanitary information are major assets in the fight against pests and the anticipation of national plagues.

3.1.3. Monitoring of agricultural input markets (fertilizers and crop protection products)

When it comes to monitoring the markets for agricultural inputs, in this case fertilizers and crop protection products, digital transformation seems unavoidable given the evolution of information and communication technologies. In this respect, the existence of a digital platform that provides key information on market monographs as well as information on prices and commercial availability of the inputs sold. With this in mind, Cameroon's Ministry of Agriculture and Rural Development has launched the National Observatory for Agricultural Inputs. The aim of the observatory is to produce, analyze and disseminate information on the legal aspects, availability, accessibility, use and access to aid for agricultural inputs in Cameroon. The aim of the observatory is to provide a platform for disseminating information on the price and availability of agricultural inputs, an essential means of improving the economic and geographical accessibility of agricultural inputs.

3.1.4. Soil management and mapping (land vocation)

In a context where resources are limited and the environment is under heavy pressure, the use of cartography in agricultural production is more than necessary [15]. In the literature, it has been clearly demonstrated that the use of cartography in agricultural production is open to optimal management of resources and limiting waste. For example, Geographic Information System (GIS) maps can be used to analyze topography and soils, and process meteorological data in a more concrete way to decide which crops are best suited to a given plot of land. The existence of a platform that identifies the potential of agricultural land, maps its vocation and highlights the norms for its use is a real opportunity for modern agriculture.

3.2. On professional agricultural organizations

With the rise in power of Information and Communication Technologies (ICT) vitalized by Artificial Intelligence, farmer support, agricultural extension and advisory services have entered a new dynamic [16]. This dynamic, characterized by the availability of information and easy access to agricultural data, makes professional agricultural organizations a key link in the digitization of agriculture. Indeed, in developing countries, it is precisely through professional agricultural organizations that farmers, mostly smallholders, update their know-how and share their experiences. Setting up virtual digital spaces for learning and agricultural extension for the benefit of farmers facilitates the promotion of good agricultural practices, thereby increasing their income. In addition, such spaces provide an awareness-raising base to help farmers limit the induction of disasters and climate change and/or protect themselves in return.

3.2.1. Agricultural extension

With digitization, the methods used to disseminate extension themes have been revamped, and the management of the research-extension relationship, designed to test research results and then add value to them, has been enhanced. For example, in conducting participatory diagnoses or school fields, digitization makes it possible to achieve objectives over a wider geographical area, at lower cost and in a shorter time. It also makes it easier to mobilize the results of agricultural research. It is also natural to think that the digitization of a personalized agricultural calendar (by agro-ecological zone and by production basin) and made dynamic by regular updating, in view of climatic changes, is an undeniable added value of digital technology.

3.2.2. Farm management

With the advent of new technologies, farm management - whether large, medium or small - is taking on a whole new dimension. Thanks to the Internet of Things, geographic information systems and artificial intelligence, farmers can monitor weather conditions, soil moisture levels and crop yields in real time. Integrated management platforms enable crop rotation planning. In addition, advisory support for farms and the strengthening of their managerial capacity is made easier with digital technologies such as e-learning, which offers a panorama of training courses enriched with tutorials and modern communication tools. In Cameroon, there is an observatory of professional organizations which sets up and regularly updates databases on professional organizations. The observatory, housed at the Ministry of Agriculture, uses this data to monitor and analyze the evolution of professional organizations for dissemination and decision-making purposes. As data storage and exploitation are the first heirs of the digital age, this observatory is now being given a new lease of life and is regaining its full consistency.

3.2.3. Agricultural mechanization

In most developing countries, the rate of agricultural mechanization is still low, and not very responsive to digital technology. Yet digital technology offers an unprecedented opportunity for a new generation of agriculture, where technology and nature come together to feed a growing world [6, 17]. Today's agriculture in Cameroon is characterized by the coexistence of peasant, artisanal and conventional mechanical systems, with the use of traditional equipment such as animal traction. It is gradually migrating towards modern mechanical systems, but digital inking is residual or even nonexistent.

3.3. Regulation and quality control of agricultural inputs and products

When it comes to the regulation and quality control of agricultural inputs and products, digital technology is once again called upon for efficiency and effectiveness in the process of certification, homologation and attestation of quality. To ensure that the outputs of Cameroon's agriculture meet conventional regulatory and quality standards, seeds and seedlings used as inputs must be certified. Pesticides for agricultural use must be registered, as must the varieties and species of seeds and seedlings. Phytosanitary products must also be controlled at Cameroon's borders.

To make the most of digitalization, it would not be too much to ask for platforms dedicated to regulation and quality control. A perfect illustration of this is the creation of a digital database accessible online, presenting standards and regulations relating to fertilizers and phytosanitary products, and enabling crop declaration and monitoring of the seed and plant certification process. In addition, Cameroon's agricultural services have a national laboratory for the diagnostic analysis of agricultural products and inputs, which tests, among other things, the attributes of seeds and seedlings that are not visible to the naked eye. These attributes generally relate to germination capacity, specific purity, sanitary condition, moisture content, weight, viability and so on. It also helps strengthen the technical capabilities of inspectors, analysts, controllers and seed laboratory technicians. Such a laboratory will be even more useful if it is equipped with a digital platform that

facilitates dissemination of the results obtained, and offers e-learning services for capacity-building of resource persons.

3.4. On the living environment of farmers

Whether it's a question of technical and topographical studies, agricultural hydraulics or improving the living environment of farmers, we can't help but say that digitization is an opportunity offered to these aspects. In fact, Cameroon has an observatory for improving the living environment in rural areas. This observatory is in a position to benefit from the opportunities offered by digitization in the same way as the previously mentioned observatories. As a digitized observatory, it collects, processes, analyzes and disseminates data relating to the improvement of farmers' living environment. As such, it offers a double advantage: on the one hand, farmers use this platform to acquire the skills they need for an ideal living environment, and on the other, public authorities rely on its indicators to implement policies that generate well-being.

Digitization also makes it easier to maintain and update hydraulic databases, enabling more efficient management of hydro-agricultural projects. Water quality standards for agricultural use are now better disseminated, and in general, technology transfer in irrigation and drainage is better assured, as digitization is a portal that is wide open to learning. As far as technical and topographical studies are concerned, Geographic Information Systems have revolutionized the agricultural sector, facilitating topographical surveys, plot measurements and, in general, the planning of agricultural areas. Under similar conditions and with the same level of investment, production targets are better met with digitization than in a non-digitized context. Time, yield and quality are all improved.

3.5. On agricultural surveys and statistics

Digitization, the driving force behind data science, has propelled agricultural statistics and surveys into a new era characterized by unprecedented precision, speed and efficiency. Data collection is digitized, data processing methods are innovative and adaptable to massive data.

The digitalization of Cameroonian agriculture, within the framework of agricultural surveys and statistics, marks a major step towards more efficient management and better planning of the sector. Indeed, the increased use of digital technologies in the collection, analysis and dissemination of agricultural data makes it possible to respond to the structural challenges facing Cameroonian agriculture, in particular the weakness of traditional statistical systems. Through the Department of Agricultural Surveys and Statistics of the Ministry of Agriculture and Rural Development (MINADER), digital platforms are being deployed to facilitate the collection of data on agricultural production, climatic conditions and farm profitability. These tools allow, for example, real-time data entry via mobile applications by field agents, who transmit the information directly to the databases. This represents a real opportunity to quantitatively and qualitatively improve the supply of agricultural data to decision-makers and researchers.

4. Key challenge

Developing countries are, at the foot of a mountain, ready to undertake the ascent towards the digital agricultural revolution. But the challenges are colossal [8]. In general, limited budgets, failing energy and telecommunications infrastructure and isolated rural areas are all ills that hinder the march towards the digitalization of their agriculture.

Though agricultural digitization in Cameroon presents undeniable opportunities for modernizing the sector and improving resource management, it faces several major challenges. Firstly, limited access to the Internet and adequate technological infrastructure in rural areas remains a considerable obstacle. Secondly, producers' digital illiteracy is a further obstacle. The majority of farmers, especially those on small farms, lack adequate training in the use of new technologies, which limits the effectiveness of the digital solutions on offer. Finally, there are growing concerns about data security, the confidentiality of agricultural information and the management of the large quantities

of data collected. These challenges, though numerous, are not insurmountable; they require a strategic vision to truly make digitalization a lever for sustainable and inclusive development.

5. Conclusion

The results of our investigation show that numerous digitization initiatives have been undertaken for Cameroon's agricultural sector, and their implementation initiated by the government and its partners. However, progress in terms of transferring digital technology to farmers, professional agricultural organizations, agro-industries and other stakeholders remains embryonic. Limited access to energy and telecoms infrastructures in some parts of the country has so far hampered the transmission and appropriation of digital know-how. Looking at the organizational chart of the Ministry of Agriculture and Rural Development [18], as well as the activities implemented in its projects and programs, we can see that Cameroon is planning to set up a number of innovative platforms with a digital outlook. These platforms, housed in observatories, laboratories and information systems, are designed to manage every link in the agricultural chain, from seeds to the marketing of agricultural products. In this way, they connect the players involved in each link of the agricultural sector. By implementing these platforms, Cameroon will be taking a giant step towards digitizing its agriculture.

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Declaration on Generative AI

The authors have not employed any Generative AI tools.

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A. Online Resources

For more information on certain platforms, newsletters and the projects and programs mentioned in this article, visit the MINADER website at https://www.minader.cm.