Virtual consultation: Digital Agriculture and Inclusion – Priorities for the agricultural research, development and innovation agenda in Latin America and the Caribbean

Technical brief: Notes on digital agriculture, challenges and opportunities

FORAGRO Executive Secretariat
IICA

Digital agriculture

The emerging technologies driven by the Fourth Industrial Revolution are affecting many sectors, including agriculture, leading to the development of Agriculture 4.0 and triggering rapid and large-scale changes. These transformative technologies can be grouped into three major areas: digital building blocks, new physical systems, and advances in biological sciences (Maclennan et al. 2018).

In this framework, digital agriculture (DA) is understood as the application of information and communication technologies (ICTs) in agriculture, for the purpose of generating real-time data for decision-making, facilitating information exchange and developing the capacity to predict future events (IICA 2019).

It is recognized that ICTs can play a key role in achieving the 17 Sustainable Development Goals (D'Almeida and Margot 2018) and, in the case of agriculture and food systems, they promise radical change and transformation throughout the world, towards the elimination of hunger and poverty (Maru et al. 2018). Digital agriculture contributes to the achievement of several goals linked to SDGs 1, 2, 9 and 12. Taking advantage of these technologies also represents a critical opportunity for increasing the interest and involvement of youth in agriculture.

Uses in agriculture

FAO and ITU highlight a number of roles for ICT in agriculture, such as agricultural extension and advisory services, access to climate-smart practices and how to use them, risk management and early warning, access to input and product markets, traceability and compliance with international standards, and access to financial services and insurance (FAO and ITU 2017).

The different digital technologies (Box 1) combine to give rise to several categories of tools for agricultural production, such as the following (USAID 2017):

- **Precision agriculture**: Aerial images and sensors connected to the Internet (IoT) provide georeferenced information that allows differentiated handling of lots within the farm, with applications of inputs and water according to needs.
- **Digital financial services**, which include mobile platforms for monetary transactions, payments, credit, microcredit and digital currencies, among others.
- **Data-based agriculture**: different tools and approaches obtain, analyze and translate data into actionable, timely and context-specific information for farmers. This category includes tools such as early warning alerts and those that allow decisions based on environmental and climate information.

- **ICT-enabled extension**: increases the coverage and accuracy of advisory services through mobile applications, SMS messages, videos to improve technical capacities and automated assistants or chatbots, among many other tools for knowledge exchange

Box 1. Some digital tools with potential in agriculture

Cloud computing: It includes the services provided through the internet for dynamic data processing or remote operation of applications and software. In this sense, three categories of services have been defined: Software as a service (SaaS), Infrastructure as a service (IaaS) and Platform as a service (PaaS).

Big data: allows processing large volumes of data, originated in a distributed way from various sources; it includes both digital programming tools and methodologies that allow handling large volumes of data and extracting new findings and relationships. Data analysis occurs through algorithms -dynamic mathematical operations- designed to interpret the data and guide decision making.

Artificial intelligence and machine learning: through **artificial intelligence**, some programming capacity is incorporated into machines so they can operate on their own in specific circumstances, depending less and less on human intervention. Additionally, greater capacity can be added so that, when events occur and results emerge that were not originally foreseen, machines can "learn", take new decisions, and reprogram themselves, without human intervention. This opens the door to so-called **machine learning**. These technologies enable chatbots, or automated digital conversations, that provide solutions through artificial intelligence.

Internet of Things (IoT): It refers to the digital connectivity of any device to the internet. The latest estimates suggest that there are now more devices connected to the Internet than people on the planet, and that most devices under development will have an Internet connection. In the agricultural sector, the most widely used internet connected devices are the sensors that capture environmental and productive data.

Blockchain: this technology keeps a detailed record of a virtual activity or fixed assets in blocks of digital data. Originally developed mainly to support cryptocurrencies like the popular Bitcoin, blockchain has been evolving and is being applied to other sectors, including agriculture, in financial operations, trade and traceability of products along the chain.

Unmanned aerial vehicles (UAV): Popularly known as drones, they have had an exponential growth aimed at surveillance, messaging, disaster assistance and entertainment. Applied in agriculture, drones are able to monitor visible and non-visible light spectrums through various and innovative types of sensors, creating mosaics that have provided a new "bird's eye view" of crops.

Source: (IICA 2019)

Challenges

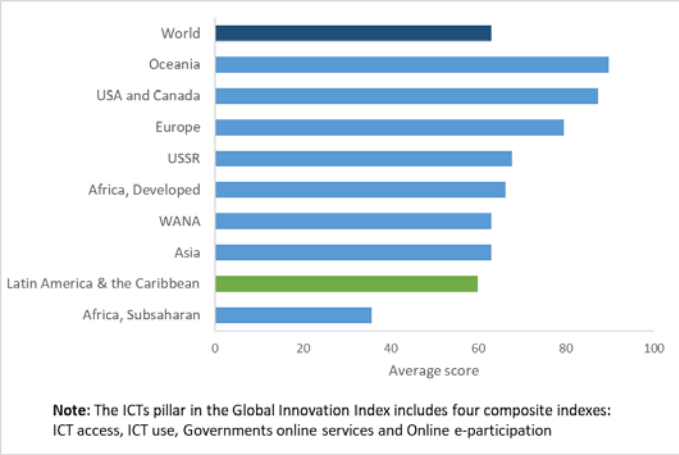
In Latin America and the Caribbean (LAC), one of the challenges to scale the potential and benefits of DA is the connectivity gap (D'Almeida and Margot 2018). LAC is one of the regions with the lowest score in the ICT pillar of the Global Innovation Index (Figure 1) (Cornell University et al. 2019). In addition to this, there are significant gaps between countries and between urban and rural areas (Figure 2).

According to a recent study (Vitón et al. 2019), there are 457 business ventures that offer Ag-tech solutions in LAC, 67% of which correspond to innovations derived from digital technologies. Most of these businesses are oriented towards medium or large producers, which have higher probabilities of hiring their products or services. For this reason, public agencies and the

collaboration of technical and educational institutions are key in promoting and facilitating access to these solutions by small-scale farmers (Vitón et al. 2019).

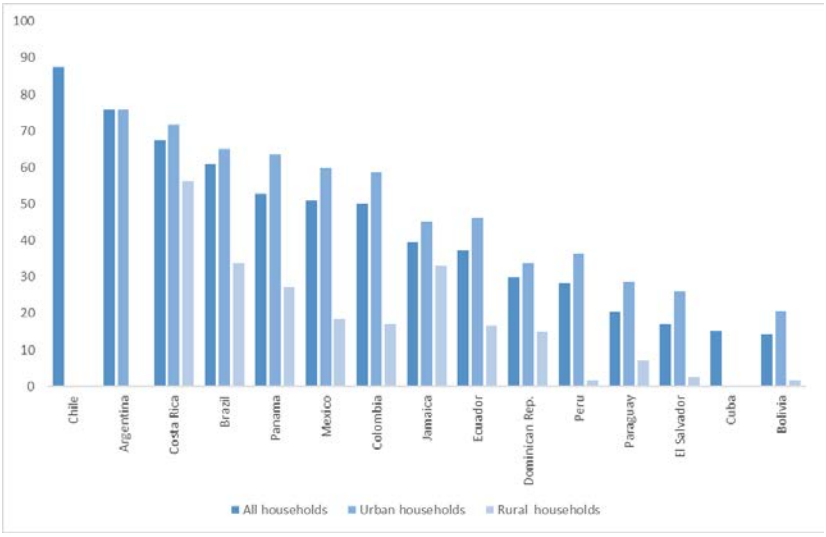
If the different gaps in **access** and **utilization capacity** to digital technologies are not addressed with appropriate policies and strategies, their general impact could be negative, increasing the probability of the most vulnerable being left behind (FAO 2018).

Figura 1. Score on the ICTs pillar in the Global Innovation Index, by world regions.



Source: Data from the 2019 the Global Innovation Index (Cornell University et al. 2019).

Figura 2. Households with internet access, by rural/urban location (%)



Source: ITU World Telecommunication/ICT Indicators database.

In their recent report on policy opportunities for digital innovation, the OECD identifies priority areas for policy adaptation in the digital era: policies on data access, as key ingredients claves for innovation; policies to support innovation and entrepreneurship, including the need to adapt the intellectual property system; research, education and training policies; and policies to develop competitive, collaborative and inclusive innovation ecosystems (OECD 2019). The RDI organizations and institutions can play a significant role in this approach.

The success of emerging technological innovations with greater potential for LAC agriculture will depend largely on the functioning of an innovation ecosystem that enhances the opportunities offered by the region (Vitón et al. 2017). The key elements of the ecosystem are academic research, public innovation promotion agencies, investors, connectivity in rural areas, understanding of technologies and their usefulness by agricultural producers, and public policies that enhance innovation systems (Vitón et al. 2017).

In general, efforts are required by all actors, both public and private, to bridge the **connectivity** gaps; meet the need for **appropriate** digital developments for different types of producers in different regions; improve clarity in the regulation of information **privacy**; and strengthen the **capacities** of producers, of other actors in the agricultural chains and of the agriculture support services, to develop and take advantage of options based on digital technologies.

References

Cornell University; INSEAD; WIPO. 2019. The Global Innovation Index 2019: Creating Healthy Lives—The Future of Medical Innovation (en línea). 12th ed. Ithaca, Fontainebleau, and Geneva, s.e. 451 p. Consultado 7 ago. 2019. Available at https://www.globalinnovationindex.org/userfiles/file/reportpdf/gii-full-report-2019.pdf.

D'Almeida, F; Margot, D. 2018. La evolución de las telecomunicaciones móviles en América Latina y el Caribe (en línea). BID Invest (4):52. Available at https://idbinvest.org/sites/default/files/2018-09/tn4_spa_la_evolucion_de_las_telecomunicaciones_moviles_2018.pdf.

FAO. (2018). Tackling poverty and hunger through Digital Innovation (en línea). s.l., s.e. Consulted 13 Jun. 2019. Available at http://www.fao.org/3/ca1040en/CA1040EN.pdf.

FAO; ITU. (2017). E-Agriculture Strategy Guide, a summary (en línea). Bangkok, s.e. Consulted 15 Jun. 2019. Available at http://www.fao.org/3/a-i6909e.pdf.

IICA. (2019). Tecnologías digitales para la transformación de la agricultura en las Américas: una visión desde el IICA. s.l., s.e.

Maclennan, DW; Meyerson, B; Shah, R; Lambertini, M. (2018). Innovation with a Purpose: The role of technology innovation in accelerating food systems transformation (en línea). s.l., s.e. Available at https://es.weforum.org/reports/innovation-with-a-purpose-the-role-of-technology-innovation-in-accelerating-food-systems-transformation.

Maru, A; Berne, D; Beer, J De; Ballantyne, P; Pesce, V; Kalyesubula, S; Fourie, N; Addison, C; Collett, A; Chaves, J; Maru, A; Berne, D; De Beer, J; Ballantyne, P; Pesce, V; Kalyesubula, S; Fourie, N; Addison, C; Collett, A; Chaves, J. 2018. Digital and Data-Driven Agriculture: Harnessing the Power of Data for Smallholders (online). F1000Research 7(525). DOI: https://doi.org/10.7490/F1000RESEARCH.1115402.1.

OECD. 2019. Digital Innovation: Seizing Policy Opportunities (online). s.l., OECD. DOI: https://doi.org/10.1787/a298dc87-en.

USAID. (2017). Digital Development for Feed the Future: Categories of Digital Tools (en línea). s.l., s.e. Consulted 15 Jun. 2019. Available at https://www.usaid.gov/sites/default/files/documents/15396/Digital_Tools_for_Agriculture.pdf.

Vitón, R; Castillo, A; Lopes Teixeira, T. (2019). Mapa de la innovación Agtech en América Latina y el Caribe (online). s.l., s.e. Available at http://dx.doi.org/10.18235/0001788.

Vitón, R; García, G; Soares, Y; Castillo, A; Soto, A. (2017). AgroTech: Innovaciones que no sabías que eran de América Latina y el Caribe (online). s.l., s.e. Available at https://publications.iadb.org/publications/spanish/document/AgroTech-Innovaciones-que-no-sabías-que-eran-de-América-Latina-y-el-Caribe.pdf.