Digitalization in the agricultural sector in Latin America and the Caribbean

Heterogeneity and public policy

August 2023

Contents

Introduction

Digitalization can transform the economy, including food systems, for the better. Digital innovations improve productivity and strengthen links with product and service markets. A range of new technologies in the agricultural sector promises to revolutionize production models, thanks to new ways of gathering, storing, handling, transferring and analysing large volumes of data.

Digital ecosystems contain public and private goods that are essential for the benefits and full potential of digital innovation to be realized. With regard to public goods, the appropriate telecommunications infrastructure and digital literacy are now critical for inclusive development in rural areas (Sotomayor, Ramírez and Martínez, 2021).

They are fundamental for progress in creating goods such as public information, online communities and technological applications and devices, which are needed for decision-making, technology transfer, connections with markets and the mechanization and automation of tasks.

Given the critical role of infrastructure and digital literacy in accessing new technologies, one might expect a high degree of uniformity across countries; this assumption largely holds true in the most developed economies.

In Latin America and the Caribbean, however, there are significant differences both within and between countries —in their geography, population, economy and institutions— that influence the development of telecommunications infrastructure and the feasibility of providing training in the use of digital technologies.

UNITED NATIONS

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Disparities in access and connectivity infrastructure

Access to electricity and the Internet, as well as the cost and quality of service —and urban-rural gaps in particular— are indicators that enable the measurement of barriers to the penetration of digital technologies in the agricultural sector.

Access to electricity

Access to electricity, high-quality Internet, affordability of services and digital literacy are all enabling conditions for accessing and using digital technologies in agriculture

High-quality electrical power is an essential intermediate good for the use of digital technology. However, lack of electricity is a problem in some countries in Latin America and the Caribbean, such as Guatemala, and across vast swathes of Brazil. Supply also varies depending on the category of rural producer and their location.

In Guatemala, data from the twelfth national population census (INE, 2019) show that 88.1% of households are connected to the grid. However, that figure falls to 75.7% for rural households. The department of Alta Verapaz, where just 33.6% of rural homes have electricity service, has the lowest rate of electrification.

In Brazil, although around 84% of farms have access to electricity, data from the 2017 agricultural census show gaps in access in the interior of the country (IBGE, n.d.). In the south of the country, around 92% of family farms have electricity, while in the north, the figure drops to 70.7%.

Internet connection

In 2019, 66.7% of the population of Latin America and the Caribbean had an Internet connection

According to the Economic Commission for Latin America and the Caribbean (ECLAC, 2020), 66.7% of the inhabitants of Latin America and the Caribbean had an Internet connection in 2019. However, the study shows that just 23% of households in rural areas had Internet access. According to data from the Household Survey Data Bank (BADEHOG), the situation was even more concerning in countries like El Salvador and Honduras, where rural Internet access rates were only 8.4% in 2021 and 8.1% in 2019, respectively.

In Argentina, data from the 2018 agricultural census revealed that just 34% of farms had Internet access. Differences within the country were also significant: 67% of farms in the province of Santa Fe had Internet access, while in Jujuy, barely 6% did (INDEC, 2021).

With regard to the type of connection, most farms access the Internet through a mobile connection, irrespective of the level of telecommunications infrastructure development in the country where they are located. In El Salvador, according to the 2018 Multipurpose Household Survey, the mobile telephony penetration rate for all households was 96.4%, and for households in the agricultural sector, it was 93.9%. The results also show that accessing the Internet through mobile phones is more common in households in the agricultural sector (83.4%) than in other households (64%) (DIGESTYC, 2019).

There is also a significant divide between urban and rural households in Chile. According to a study commissioned by the Undersecretariat for Telecommunications and conducted by Brújula, Investigación y Estrategia (2017), while 87.4% of homes reported having access to the Internet in 2017, the figure fell to 76.7% for rural homes. In terms of the type of connection, just 26.3% of connections in rural homes in Chile were fixed, compared to 68% in urban areas. Meanwhile, according to data from the 2017 National Socioeconomic Survey, 76.1% of the urban population were using the Internet, while 49.6% of the rural population reported doing so (Ministry of Social Development and Family, n.d.).

Cost of Internet service

In no country in the region are the costs of Internet use below the recommended threshold

According to the Broadband Commission for Sustainable Development, the cost of service should remain below 2% of income to be considered affordable. In Latin American and Caribbean countries, the average cost is still quite high, at up to 14% of income for fixed broadband and 12% of income for mobile broadband for households in the first income quintile.

There are no countries in the region in which the cost of Internet is below the recommended threshold for the first income quintile, and only in Uruguay does the cost of mobile broadband account for less than 2% of the income of the second quintile. Next among the countries with the lowest cost for broadband access as a percentage of income are Chile and Costa Rica (ECLAC, 2020).

Digital literacy

Digital literacy is a determining factor for understanding what Internet users do once they are connected

Digital literacy is a determining factor for understanding what Internet users do once they are connected. Low Internet use is directly related to a lack of knowledge of its use or usefulness, a barrier that can be as significant as infrastructure constraints.

In Mexico, 14.8% of rural households report the lack of a local provider or infrastructure as a reason for not having Internet service, while 13.1% point to a lack of interest in or need for the Internet and 12% to not knowing how to use it. The main reason why people in Mexico were not using the Internet in 2018 was a lack of knowledge of how to use it (60.7%) (Sotomayor, Ramírez and Martínez, 2021).

Other connectivity indicators

Information and Communications Technology Development Index

Established by the International Telecommunication Union, the Information and Communications Technology Development Index (ICT Development Index) is a global benchmark for harmonized evaluation of information and communications technology (ICT).

The 2017 ICT Development Index evaluated key aspects of information and communications technologies, combining 11 indicators related to access, use and skills (ITU, 2017).

Among the countries of the region, Uruguay, Argentina and Chile are in the lead according to the ICT Development Index, while those with the greatest lags are Nicaragua, Cuba and Haiti (see table 1).

Table 1
2017 ICT Development Index ranking

	Country	Index score	Index rank (global)	Index rank (Latin America and the Caribbean)
	Uruguay	7.16	42	3
	Argentina	6.79	51	4
	Chile	6.57	56	5
	Brazil	6.12	66	8
	Nicaragua	3.27	130	31
	Cuba	2.91	137	32
	Haiti	1.72	168	33

Source: Prepared by the authors, on the basis of "International Telecommunication Union (ITU), ICT Development Index 2017" [online] https://www.itu.int/net4/ITU-D/idi/2017/index.html.

Rural Significant Connectivity Index

Another interesting indicator is the Rural Significant Connectivity Index, developed by the Inter-American Institute for Cooperation on Agriculture, the Inter-American Development Bank and Microsoft (Ziegler and others, 2020). This index is based on four parameters: regular use of the Internet, suitable devices, adequate data and sufficient connection speed.

In 2020, the Rural Significant Connectivity Index was estimated for seven countries in the region: Brazil, Costa Rica, Ecuador, Honduras, Paraguay, Peru and Plurinational State of Bolivia (Ziegler and others, 2020). The updated version of the report includes estimates for three new countries: Chile, Colombia and Suriname (Ziegler and Arias Segura, 2022).

According to the recent version of the report (Ziegler and Arias Segura, 2022), 56.6% of rural residents, or 36.2 million people, do not have access to significant connectivity. Although this result represents an increase of 7 percentage points compared with the findings of the previous study, a persistent urban-rural connectivity divide, of 36 percentage points, remains.

Extrapolating the results obtained in the study to rural areas in the other countries of the region shows that 72 million people lack access to a high-quality connection. This result, compared with that of the 2020 study (Ziegler and others, 2020), underscores the speed of technology change: in just two years, an additional 9 million rural residents have gained access to significant connectivity.

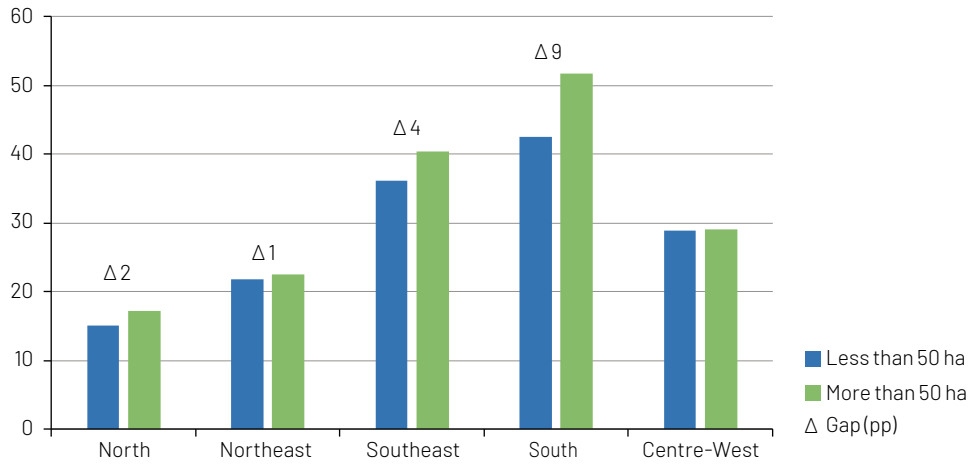
Public policy coordination for digital agriculture: Brazil[1]

Brazil has become a global leader in the agricultural sector

Over the last quarter century, Brazil has become a global leader in the agricultural sector, on the strength of its natural resources, innovation and entrepreneurship. However, its modernization has been characterized by the structural heterogeneity that defines Brazilian agriculture. In the context of agriculture 4.0, the advancement of technologies and their incorporation into the sector were disorganized, prompting public and private sector institutions to implement coordination mechanisms to achieve progress in that regard (Buainain, Cavalcante and Consoline, 2021).

In a country where the connectivity divide limits the potential benefits of agriculture 4.0 (see figures 1 and 2), strengthening institutional frameworks is key for the implementation of effective public policies in this area.

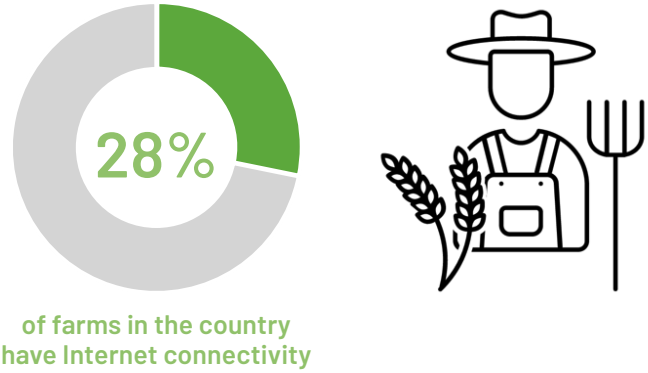
Figure 1
Internet access gap, by region and size of farm, 2017
(Percentage points)



Source: Prepared by the authors, on the basis of Brazilian Institute of Geography and Statistics (IBGE), "Censo Agropecuário 2017: resultados definitivos" [online] https://sidra.ibge.gov.br/pesquisa/censo-agropecuario/censo-agropecuario-2017/resultados-definitivos.

[1] The authors thank Sibelle Silva, former chief of the Department for Agricultural Innovation Support of the Ministry of Agriculture, Livestock and Supply of Brazil and analyst with the Innovation Department of the Brazilian Agricultural Research Corporation (EMBRAPA), for her kind responses to questions on current innovation policies in the agricultural sector in Brazil.

Figure 2
Farms with Internet connectivity
(Percentages)



Source: Prepared by the authors, on the basis of Brazilian Institute of Geography and Statistics (IBGE), "Censo Agropecuário 2017: resultados definitivos" [online] https://sidra.ibge.gov.br/pesquisa/censo-agropecuario/censo-agropecuario-2017/resultados-definitivos.

Public policy advances

Ministry of Agriculture and Livestock: digital agriculture is the fifth strategic pillar for agricultural development in Brazil

The Ministry of Agriculture and Livestock has defined digital agriculture as the fifth strategic pillar for the development of agriculture in Brazil.

The Department of Innovation, Sustainable Development, Irrigation and Cooperatives is the branch of the Ministry in charge of developing public policies for innovation and rural development. Recently, Decree No. 11.332 provided that the Department for Agricultural Innovation Support was responsible for proposing and implementing plans, programmes, projects, actions and activities to foster connectivity in rural areas and with regard to digital agriculture (Office of the President of the Republic, 2023).

Agriculture 4.0 Chamber

One of the main advances in terms of institutional frameworks was the establishment of the Agriculture 4.0 Chamber

One of the main advances in terms of institutional frameworks was the establishment of the Agriculture 4.0 Chamber through a technical cooperation agreement between the Ministry of Agriculture and Livestock and the Ministry of Science, Technology and Innovation.

The Agriculture 4.0 Chamber was born out of a need to define a strategy for rural areas in the framework of the National Plan for the Internet of Things. This plan was developed in 2019 by the Ministry of Science, Technology and Innovation and the National Bank for Economic and Social Development and envisions the Internet of things as a tool for sustainable development in Brazilian society (Ministry of Science, Technology and Innovation, n.d.).

In 2022, the Chamber for Digital Innovation in Agriculture was established in response to the expiry of the technical cooperation agreement between the Ministry of Agriculture and Livestock and the Ministry of Science, Technology and Innovation and in light of the need to further formalize their cooperation.

Chamber for Digital Innovation in Agriculture

Chambers provide discussion forums for stakeholders from the different links in the value chain

The Chamber for Digital Innovation in Agriculture, which was established by the National Council for Agricultural Policy, is one of the 37 sectoral and thematic chambers of the Ministry of Agriculture and Livestock. These chambers provide discussion forums for stakeholders from the different links in the value chain, including producer and industry associations, public service providers and financial institutions.

Objective: to discuss the demand for innovation, technology and connectivity in the agricultural sector to support public policymaking for agriculture in the digital transformation (Ministry of Agriculture and Livestock, 2023).

Meetings: the first meeting took place on 1 December 2022, at which five working groups were created with the following themes: (i) training; (ii) rural connectivity; (iii) strengthening regional innovation ecosystems in northern and northeastern Brazil; (iv) innovative financing (agrofintech); and (v) production chain technologies.

Currently, the organizational structure of the Chamber has been defined, roles have been assigned and there are 53 participating entities.

Although the Agriculture 4.0 Chamber as such is no longer active, it is hoped that the experience acquired and the products of its work, such as the Agriculture 4.0 Chamber Action Plan, will serve as inputs for the new discussion forum, the Chamber for Digital Innovation in Agriculture.

The national rural connectivity policy was established through an institutional agreement involving the Ministry of Agriculture and Livestock and the Ministry of Science, Technology and Innovation. One key input, which serves to guide public policymaking in this area, is the study by Luiz de Queiroz College of Agriculture, which estimated the number of antennas and investment needed to enhance rural connectivity and the potential impact of this investment on agricultural production (Ministry of Agriculture and Livestock, 2021a).

Infrastructure investments require significant resources up front, with returns realized in the long term

Infrastructure investments require significant resources up front, with returns realized in the long term. In this investment process, one alternative for financing the development of communications infrastructure in rural areas is the Telecommunications Services Universalization Fund (FUST).

Telecommunications Services Universalization Fund

The objectives of FUST include spurring the expansion and use of telecommunications networks and services and improving their quality

Established in 2000, the Telecommunications Services Universalization Fund (FUST) was intended, among other objectives, to spur the expansion and use of telecommunications networks and services in the country and improve their quality (Ministry of Communications, n.d.).

However, in response to new demands for connectivity and the need to adjust resources to present-day challenges, the legal framework of the Fund was updated through new initiatives proposed in recent years.

In 2022, a new decree stipulated that the Fund's resources should be allocated to achieve a series of objectives, including: (i) fostering technological innovation in telecommunications services in rural areas; and (ii) providing Internet access for Brazilian public schools, especially those not located in urban areas (Office of the President of the Republic, 2022).

FUST is administered by a management board comprising representatives of the Ministry of Agriculture and Livestock, the Ministry of Science, Technology and Innovation, the ministries of communications, the economy, education and health, the National Telecommunications Agency, telecommunications service providers and civil society.

The National Bank for Economic and Social Development was recently designated as the financial agent responsible for managing the transfer of resources for projects sponsored by the Fund (Ministry of Communications, 2022).

FUST is an important tool for driving and shaping public policies for digital agriculture. Its new legal framework acknowledges the need to provide and improve connectivity in rural areas.

The 5G network bidding process

In November 2021, the National Telecommunications Agency held an auction for 5G network frequencies in the country. This auction was different in that it used a non-collection auction model according to which the companies that won bids had to commit to infrastructure investments that would guarantee expanded connectivity in the country (ANATEL, 2022).

The obligations of the winning companies vary depending on the spectrum block, and include increasing mobile broadband coverage, providing it in areas that lack Internet access and installing 5G antennas.

Connectivity initiatives

The *Comunidades Rurais Conectadas* initiative aims to boost Internet access for rural communities through satellite links

One initiative for boosting rural connectivity is the *Comunidades Rurais Conectadas* hub. With support from the Ministry of Agriculture and Livestock and the Ministry of Communications, it seeks to expand Internet access for the country's remote rural communities through satellite links (Ministry of Agriculture and Livestock, 2021b).

Under the initiative, 134 satellite-enabled Internet access points will be installed to connect 166 rural communities in the north, northeast and centre-west regions.

There are currently 51 points installed across the country.

In the centre-west, the initiative is just one of many to expand rural connectivity and foster digital inclusion. One example is the partnership between C*omunidades Rurais Conectadas* and the *Rede de Centros de Inclusão Digital nos Territórios da Cidadania* programme, which quadruples satellite coverage in remote areas.

In 2021, the Ministry of Agriculture and Livestock and the Ministry of Communications held demonstrations of 5G applications in agriculture for three regions of the country (the centre-west, southeast and south), specifically in the cities of Rondonópolis (Mato Grosso), Sorocaba (São Paulo), Uberaba (Minas Gerais) and Londrina (Paraná). The first real demonstrations of the use of 5G technology for agriculture were held at research centres and universities, and participants included representatives of start-ups, agritech companies, technology providers and telecommunications service operators:

- In Rondonópolis, drone applications were demonstrated in the fields of a model farm belonging to the Mato Grosso Cotton Institute in May 2021.
- In Sorocaba, autonomous sprayers were demonstrated at Centro Universitário Facens in June 2021.
- In Londrina, EMBRAPA Soja organized an event in August 2021 at Vitrine de Tecnologias, which included a remote veterinary appointment and a demonstration of several Internet of Things applications to support decision-making.
- In Uberaba, Instituto Federal do Triângulo Mineiro presented a system to support the diagnosis of degraded grazing land and several other projects, for monitoring the environment, animal health and agribusiness machines, in December 2021.

Other public policy instruments in the region

Chile

The Working Group for Rural Information and Communications Technologies aims to incentivize and encourage the use of information and communications technologies in the agroforestry sector

In 2022, the Agrarian Innovation Foundation and other agencies of the Ministry of Agriculture re-established the working groups launched in 2006, reviving the first Working Group for Rural Information and Communications Technologies. The Working Group aims to incentivize and encourage the use of information and communications technologies in the agroforestry sector (FIA, 2022).

The Government of Chile has a Telecommunications Development Fund, a financial instrument under the Ministry of Transport and Telecommunications, to foster the expansion of telecommunications service coverage, prioritizing rural and low-income urban areas (Ministry of Transport and Telecommunications, 1982).

In recent years, there have been several public tenders in the framework of the Telecommunications Development Fund to subsidize communications service providers that put forward proposals to boost connectivity in Chile. Some of the projects that directly target rural areas are: (i) the *Todo Chile Comunicado – Infraestructura Digital para la Competividad e Innovación* project and (ii) the *Conectividad para la Educación 2030* project (SUBTEL, 2023).

Colombia

In 2019, a detailed report on the current state of digitalization in the agricultural sector in Colombia enabled the establishment of a public policy to drive digital transformation in the sector.

The proposed action plan includes both public and private sector initiatives, led by the Ministry of Information Technologies and Communications and the Bogotá Chamber of Commerce. The objectives proposed to spur the sector's digital transformation include the following:

- Accelerate the digitalization of small and medium-sized enterprises.
- Foster precision agriculture to boost productivity in the agricultural sector.
- Close the mobile broadband coverage gap between urban and rural areas.

The digital transformation action plan mainly targets medium-sized and large producers, meaning that it does not cover all farms in the country

This public policy mainly targets medium-sized and large producers, meaning that it does not cover all farms in the country. According to Katz, Duarte and Durán (2019), public involvement should go beyond technology. Recognizing that small producers face a myriad of barriers to digitalization, it is essential to conduct a study to identify and include all participants in the agriculture value chain in order to determine who the agents of change are (in other words, the digitalization trailblazers).

Concluding remarks

In some countries, there are significant gaps in Internet access and digital literacy (except among medium-sized and large farm operators), owing to a lack of electricity coverage, low levels of basic literacy and education or barriers to access (related to territorial coverage and cost for the user).

Sectoral digital agendas are essential for addressing asymmetries in urban and rural coverage, reducing the gaps between large and small farmers, anticipating the demand for different work skills and coordinating the supply and demand for innovation, which can only be achieved through stakeholder coordination.

The inclusion of digital agriculture and rural connectivity among the responsibilities of the Ministry of Agriculture and Livestock in Brazil and the establishment of a new thematic chamber —the Chamber for Digital Innovation in Agriculture— reflect an institutional commitment to digital transformation of the agricultural sector.

The Chamber for Digital Innovation in Agriculture is a space for discussion in which the demands and challenges of the different value chain stakeholders can be aired.

Digital public policies in the agricultural sector have been strengthened by the budgetary resources and new legal framework of the Telecommunications Services Universalization Fund. These regulations benefit the agriculture sector by prioritizing rural areas.

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