

AgTech -ICT applied to bio agroindustry in Latin America. An insight from the innovation ecosystem perspective

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I. INTRODUCTION

The application of Information and Communication Technologies -ICT into agriculture is part of the blow-up of such technologies. However, they came a bit later to agriculture. In fact, the first experiences were recorded in the field of financial field known as FINTECH.

The use of information and communication technologies – ICT in agriculture is longstanding, the first performance monitor for combine harvesters dates back to 1992. It was a form of ICT in closed packages, attached to machinery. Subsequently, advances in software appeared through simulations or predictions whose origin was the scientific-academic sector.

The term “AgTech” was consolidated in the last five years. This term arises from the combination of the terms “agriculture” and “technology. In short, are AgTech technologies or are they companies?

Two definitions are cited as examples. On the one hand, Albornoz (2020) symbolizes the term “AgTech” as a “set of ventures that, using different available technological combinations, are preparing to transform the way agricultural activities function today”.

Lachman et al. (2021) and Bisang et al. (2022) agree in defining AgTech as “those innovations that provide knowledge-intensive services based on digital technologies for the various stages of the agri-food chains, from field production to the industrialization, logistics, and marketing phases.”

It is important to highlight that all definitions focus not only on digital technologies but also on the ventures that give rise to the various solutions mentioned. These innovations often incorporate technologies into inputs like seeds, vaccines, and machinery, with modern biotechnology playing a disruptive role.

The soaring of AgTech implication in Latin America and the Carribean -LAC for the last five years, has been indicated by the growing number of start-ups in the region (Ballesteros, 2022). This article aims to analyze the innovation process around AgTech in LAC, in the frame of the innovation systems approach. In order to do this, secondary information from qualified informants is considered. In the next section, the theoretical approach of the innovation system is

briefly presented. In the third section of this article, qualitative and quantitative information about the innovative ecosystem of AgTech in LAC is presented to emphasize the growing environment of AgTech in Latin America and the Caribbean. Leader countries in agriculture production in LAC are considered when the information is available. The article is closed with a personal reflection.

THE APPROACH OF THE INNOVATION SYSTEMS

The concept of an "innovative ecosystem" is commonly used in AgTech as the framework to describe the innovation dynamics. Talking about "system", means the necessity of diverse actors, both public and private, and the knowledge-intensive nature of innovation reliant on learning processes (Freeman, 1995; Schumpeter, 1976).

The socio-technical context means that innovation is not just a technical process. Innovation happens in a sociological context where society adopts, accepts, rejects, and validates the results of the technical process. The background of this idea is that technology is not universal. Skills and idiosyncratic issues of the society determine acceptance and adoption of a technology in order to solve a particular problem (Sanchez & Bisang, 2011).

AgTech-associated innovative ecosystems are notable for the rapid materialization and disappearance of innovations, demanding a comprehensive understanding of their dynamics.

II. A STYLIZED VIEW OF THE AGTECH VERTICAL AND ITS INNOVATION ECOSYSTEM IN LATIN AMERICA AND THE CARIBBEAN (LAC)

Sotomayor et al., (2021) highlight technologies crucial for Agriculture Production (AP) according to the OECD are Sensors, IoT, Robotics, Drones, Big Data, Cloud Computing, Artificial Intelligence, and Blockchain. They extend this focus by examining AgTech innovation ecosystems in nine Latin American countries -Mexico, Honduras, Guatemala, El Salvador, Brazil, Argentina, Chile, Uruguay, and Colombia. One of the countries, Argentina, while it lacks a national digital agenda, it boasts a robust startup presence, especially in Agriculture 4.0 applications like precision agriculture, precision livestock, and irrigation. In other work, is noted the use of AgTech in Latin America also applied to public advisory services to small farmers (Barrera et al., 2023).

Many authors emphasize the growing role of start-ups in innovation ecosystems, noting public sector actions but with notable coordination gaps. In Argentina, technologies primarily stem from the supply side, lacking clear benefits and relying on private sector institutional frameworks.

Lachman et al. (2021) contribute a private perspective on the AgTech ecosystem through a survey of 135 companies in Argentina between late 2019 and early 2020. These companies operate with specialized technical teams, engaging in Research and Development and innovation -R&D&I, activities individually and collaboratively with institutions like the National Institute of Agricultural Technology (INTA). Challenges identified include economic policy issues and user distrust in new technologies. The study proposes public interventions to bridge the development-adoption gap and establish open innovation programs.

The Secretary of Agriculture, Livestock, and Fisheries of Argentina (SAGYP) conducted a survey¹, identifying 150 startups through which various ecosystems were classified: agricultural technologies addressing problems, technologies enhancing competitiveness, and those with a long-term focus -*e.g.* comprehensive improvement of the livestock company in productive, profitability and marketing aspects. According to SAGYP, AgTech is a vital vertical in Argentina's knowledge economy, supported by public policies and legislative frameworks that have made the agriculture-based-technology the third-largest export complex in the country (Méndez, 2020).

AgTech ventures across LAC present varied reports. Vitón et al., (2019) note 450 ventures, with Brazil contributing 51% and Argentina 23%. In 2021/2022, Radar AgTech Brazil reports 1,574 startups, concentrated in the southeast, indicating substantial growth, though the disparity in the reports requires validation (Dias et al., 2021).

Bert et al., (2023) present an analysis of 90 AgTech ventures in the Andean region - Colombia, Perú, Ecuador, Bolivia, and Venezuela. They carried out an analytical selection to build up a non-representative sample of 90 start-ups more than 50% from Colombia. The authors found a sustained process of growth and consolidation of AgTech companies in the Andean region. In addition, there is a growing number of companies. In all cases, these are relatively young start-ups, mostly founded by highly qualified young entrepreneurs. This situation is quite like that in the rest of LAC.

¹ <https://magyp.gob.ar/agtech/>

Table 1 summarizes the number of start-up ventures according to the different sources.

Country	Subnational region	AgTech Venture	Period	Source
LAC		450	2019	Viton, 2019
Argentina		135	2020	Lachman et. al., 2021
Argentina	Córdoba	72	2021	Garzon & Rosetti, 2021
Argentina		100	2019	Viton, 2019
Argentina		150	2023	https://magyp.gob.ar/agtech/
Brazil		229	2019	Viton, 2019
Brazil		1574	2021/2022	Dias et. al., 2021
Bolivia		4	2023	Bert et. al., 2023
Colombia		53	2023	“
Ecuador		11	2023	“
Perú		21	2023	“
Venezuela		1	2023	“

Table 1: Number of AgTech ventures in LAC according to different sources in the literature. Own elaboration

Private, Entrepreneur, and Seed Capital play a central role in AgTech ecosystems. In the first half of 2021, venture capital investments in Latin American entrepreneurs reached USD 6.2 billion, marking a significant increase from 2019 and 2020. Fintech, E-Commerce, and Software sectors captured most investments, while AgTech, despite its agricultural profile in the region, lags in attracting significant funds. Nevertheless, some AgTech companies received foreign capital investments and engaged in internationalization shortly after establishment (Deloitte & ARCAP, 2021).

Market Place	Country / Region	Source	Link	Description
Technology for the Argentine Farm	Argentina	Secretary of Agriculture, Livestock and Fisheries	https://magyp.gob.ar/agtech/	A government initiative such as IoT (Internet of Things) for irrigation systems, hydroponics production monitoring, comprehensive E-commerce and certification platform for agriculture, livestock, and fisheries products.
AgTech.Ar	Argentina	German - Argentine Dialogue about Innovation for a Sustainable Agriculture. A collaboration between the Secretary of Agriculture of Argentina and the Agriculture Ministry of Germany.	https://www.agtech.ar/login.php?ID=ING	A platform which accelerates the linkage and collaboration between startups, producers, investors, universities and entrepreneurs to increase the sustainability and competitiveness of the national agroindustry.
"Week of the Agriculture" organized by IICA	American Continent ²	Interamerican Institute of Cooperation for Agricultura (IICA) ³	https://bio-emprender.iica.int/iica-opportunities/segunda-semana-de-la-agricultura-digital/#:~:text=Entre%20los%20d%C3%ADas%20de%20AgTechs'%20y%20varios%20actores%20clave	The conference will discuss about technological innovations, digital transformation, and other AgTech related issues to promote agri-food digitalization in Latin America and the Caribbean (LAC). It promotes the digital transformation of the agriculture sector by developing necessary policies to facilitate the transformation.
RIDAG	Iberoamerica ⁴	Iberoamerican Network for Digitalization of Agriculture and Livestock ⁵ .	https://ridag.net/	This initiative is promoted by INTA Argentina, Spain Institute of Agrifood Research and Technology (IRTA), INIA Agricultural Research Institute of Chile, and Uruguay National Institute of Agricultural Research

Table 2: Selected cases of marketplaces for AgTech venture in LAC. Own elaboration

² The American Continent: 35 countries, 3 sub-continent (northern, central and southern). LAC is a subregion of the American Continent.

³ The Inter-American Institute for Cooperation on Agriculture (IICA) is the specialized agency for agriculture of the Inter-American System that supports the efforts of the 35 Member States to achieve agricultural development and rural well-being (<https://iica.int/en>).

⁴ Ibero-America is a term that designates the set of American countries that were colonies of Spain and Portugal plus Spain and Portugal.

⁵ RIDAG is an initiative of the agriculture research institutes from Argentina, Chile, Uruguay, and Barcelona.

The AgTech innovation ecosystem is an arena with a very high intensity of dynamic. As a consequence, it is not possible to see its complete configuration. However, in LAC, it is possible to identify different efforts to create marketplaces for the exchange among the actors in the agriculture ecosystem, such as ventures, government, R&D institutions, etc. Table 2 summarizes selected examples of the marketplace for AgTech ventures in LAC. Exploring these, and other alternatives in the region, it can be seen that they represent overlapped and atomized efforts. The marketplaces of the AgTech as mentioned above are trying to accommodate the technologies growth, regulations, and overall processes of AgTech to support the advancement of agriculture-related technologies.

Regulatory frameworks are crucial in AgTech ecosystems. Nevertheless, currently lacking specific regulations in LAC makes an empty space. In order to compensate for it, actors of the ecosystem adhere to the usual existing regulations governing agricultural practices, tax laws, and business regulations. In contrast to that, in the northern hemisphere, concerns about ethical and regulatory issues related to data use are emerging. Initiatives like the European Union Code of Conduct for Agricultural Data Processing and the U.S. Principles for the Processing of Agricultural Data address these concerns (Vidal, 2022).

III. FINAL REFLECTION

The global emergence of AgTech presents a developmental opportunity for countries in LAC, particularly those specializing in agricultural production (AP). Carlota Pérez, (2010) emphasizes that the rise of new technological paradigms benefits nations focused on natural resource exploitation. As technology's dominance shifts with new advancements, the competitive landscape becomes open to those who leverage their skills. Within the LAC AgTech ecosystem, three vital actor groups are identified: entrepreneurs/developers, investors/venture capital, and users, supported by peripheral entities like institutions and research centers. This dynamic ecosystem has experienced explosive growth since the previous decade, showcasing the constant appearance and disappearance of new actors.

Despite the predominantly agricultural profile of LAC countries, the AgTech vertical lacks the expected relevance, attributed to evolving ecosystems with weak interrelationships among actors. Connectivity issues hinder technology dissemination, and the public sector is urged to play an active role in fostering development. National governments emphasize AgTech actions for creating integrated ecosystems, while subnational jurisdictions focus on local hubs.

Attention is also drawn to the absence of specific regulations, although initiatives are underway in the northern hemisphere.

Disclaimer

The views expressed in the preceding text are the exclusive opinions of the author and do not represent the opinions or positions of the institutions or other persons mentioned or cited in the article.

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