



Innovation and technology



**Inter-American Institute for
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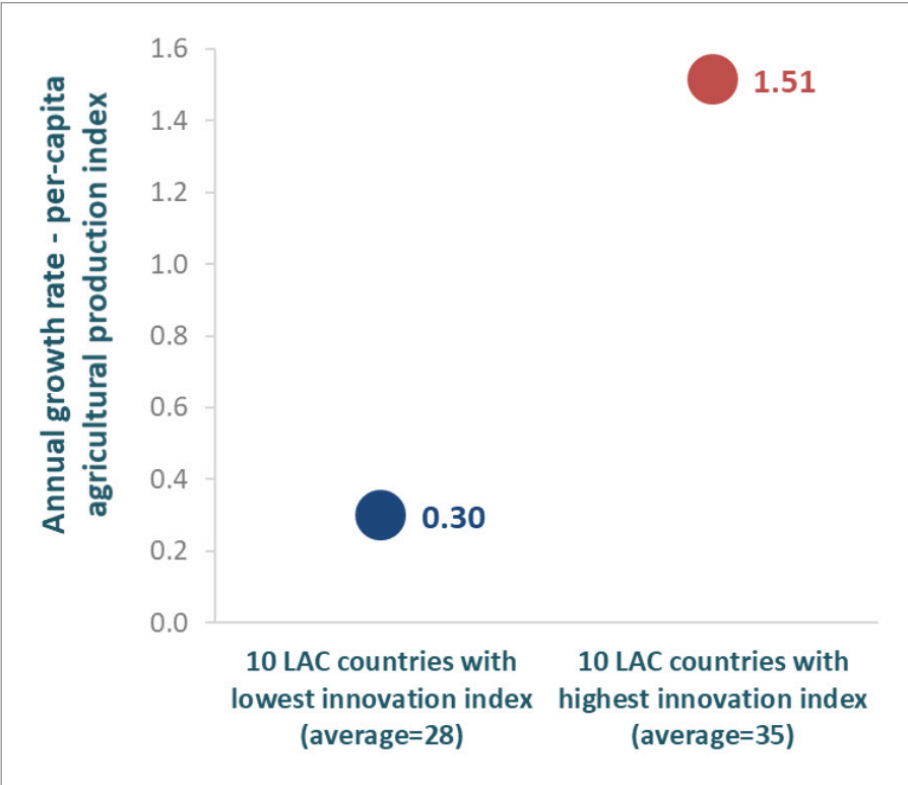


The continued transformation of the world's agrifood systems is essential to improve their capacity to respond to present and future challenges. Around the world, nearly 821 million people suffer from hunger and almost 2 billion have nutritional deficiencies (FAO *et al.* 2018). Moreover, obesity has become a major threat to Latin America and the Caribbean, affecting the population's nutritional health. Approximately 25 % of adults are obese and more than 7 % of children under five years are overweight, a figure higher than the world average of 5.6 % (FAO *et al.* 2018). Achieving the Sustainable Development Goals (SDGs) by 2030 will require inclusive, sustainable and efficient food systems, incorporating nutritional aspects that promote good health among the inhabitants. In a context of growing pressure on natural resources, the challenge of increasing agricultural production to satisfy the needs of a growing population also provides opportunities to improve the quality of life of rural communities (Narmilan 2017).

As one of the primary drivers of productivity and sustainability (OECD 2019), it is essential to promote continuous innovation in technologies, practices and forms of organization to facilitate the development of agriculture, food and nutrition systems. It is widely recognized that innovation plays a major role in efforts to promote increases in short and long-term productivity in all the countries. Similarly, there is evidence of a high correlation between a high value on the innovation index (Cornell University *et al.* 2019) and increased growth of agricultural production (Figure 1).¹

1 It should be noted that the Global Innovation Index does not refer solely to agriculture, but is based on 80 indicators that explore a broad vision of innovation in different areas, including the political environment, education, infrastructure and business sophistication. These indicators include seven categories: institutions; human capital and research; infrastructure (includes use of and access to ICT, ecological sustainability and environmental performance, etc.); market sophistication; business sophistication; knowledge and technology outputs; and creative outputs.

Figure 1. The countries with the highest innovation index present a higher growth rate of agricultural production.



Source: Prepared based on data from the Global Innovation Index (Cornell University *et al.* 2019) and the Agricultural Production Index (FAO 2019).

As mentioned previously, technological innovations are the main factor for increasing agricultural productivity (Vitón *et al.* 2017) and play a key role in the transformation of food systems (Nayyar *et al.* 2018). However, it is always necessary to adopt a holistic approach that contemplates a dynamic innovation ecosystem, involving all interested parties, and which boosts opportunities to start businesses, formulate new and bold policies, make larger investments, expand infrastructure and strengthen farmers’ capacities, among other aspects (Nayyar *et al.* 2018, Vitón *et al.* 2017).



IICA's focus on innovation and technology

The importance of innovation and technology (I&T) is explicitly reflected in the 2018-2022 Medium Term Plan (MTP) of the Inter-American Institute for Cooperation on Agriculture (IICA), which incorporates this area as one of the two cross-cutting issues for action in the context of the five hemispheric action programs (IICA 2018).²

1. Innovation

IICA understands innovation as the application of new knowledge in productive or organizational processes (IICA 2018). Innovating is regarded as a key process for making an impact on the efficiency of production as a whole, and transforming the institutions and businesses of the agricultural and rural world.

Innovation is a concept that has been given many definitions and interpretations in the literature (see, for example, OECD and Eurostat 2018 and Ruane 2019, etc.). In general, some key elements can help us to determine what constitutes innovation (see box). Based on the available literature and IICA's experience, the following definition was developed for this cross-cutting theme:

² IICA's 2018-2022 Medium Term Plan (MTP) established five hemispheric action programs: Bioeconomy and Production Development; Territorial Development and Family Farming; International Trade and Regional Integration; Climate Change, Natural Resources and Management of Production Risks; and Agricultural Health, Safety and Food Quality. It also defined two cross-cutting issues: Innovation and Technology, and Gender and Youth (IICA 2018).

What is innovation?

Innovation in agriculture is the implementation, for the first time in a specific context, of a new or improved product or process, in order to create positive changes that make it possible to satisfy needs, meet challenges or take advantage of opportunities. The innovator is the person who takes decisions in the unit that implements the change. The innovator may be a farmer, a manufacturer, a group of producers or any decision maker. Innovations may be of a **technological, social, organizational and/or **institutional** nature. There are also innovations in products and processes, such as the following:**

- **Products:** goods that are produced (for example, polymers for industry) or services that are provided (for example, ecosystem services).
- **Processes:** ways and means of producing, providing services, marketing, organizing, associating with others, etc. Digitalization is an example.

Key elements or aspects of innovation:

- knowledge, as the basis for innovation;
- novelty, at least for the context in which it is implemented;
- implementation, i.e. it is put into use or applied;
- creation of value or improvement, as the objective of innovation: increased incomes, efficacy, efficiency productivity, competitiveness, equity, resilience and/or environmental sustainability.



1.1. What is needed to innovate?

Innovation in agriculture and rural development takes place in a socioeconomic context and is influenced by the presence (or absence) of **favorable conditions**. Some of the most important conditions include the level of domestic development, institutional and regulatory frameworks, the level of knowledge and human talent, economic and financial conditions, the demands of innovation imposed by society itself and the regional and global environment, among others (World Bank 2007).

In addition to a favorable environment, individuals and organizations must also have the **capacity to innovate**, including the capacity to 1) envision and create new ways of doing things, 2) connect with others to access and understand new information and resources, 3) experiment, test, assess and adapt and 4) work with others to achieve action and change (Allebone-Webb *et al.* 2016).

1.2. Innovation systems

Innovation systems are spaces in which different stakeholders are interrelated and where their knowledge and resources converge to generate changes in a specific socioeconomic context.

Agricultural innovation systems (AIS) are characterized by the group of stakeholders that comprise them, as well as the interactions that take place among them. Improvements in the operation of AIS, through better coordination between different stakeholders, translates into improved capacity for innovation and, therefore, benefits for society. These systems can be visualized and strengthened at the national, regional, local, sectoral or sub-sectoral levels (livestock sector, specific value chain, etc.). Figure 2 presents a diagram of the systemic interrelationships existing between all the public, private, and academic stakeholders of an AIS in the creation, dissemination, adaptation, learning and use of knowledge to implement innovations in agriculture. Innovation processes in the AIS can be triggered by market changes, or changes in demand, but can also be of a technological, environmental or social nature (Figure 2 and OECD 2013).

With regard to technology, it should be noted that some options which are really disruptive for agriculture do not originate in this sector, e.g. digital agriculture tools.

Figure 2. Dynamics of the innovation system.



Source: Adapted from OECD 2013.

The concept of innovation ecosystems has been proposed as a mechanism for enhancing efforts to create multi-actor, cross-sectoral innovation niches that are capable of supporting transitions to sustainable agricultural systems across multiple scales (Pigford *et al.* 2018) Innovation ecosystems share many similarities with the AIS, but in general they are characterized by being more open to different sectors and stakeholders, less structured and more dynamic.

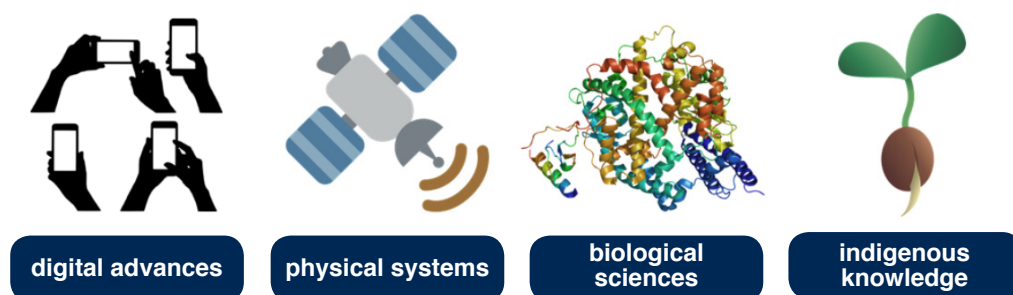
Innovation is often understood to mean the development and transfer of new technologies, which can then be adapted or adopted by farmers, businesses, etc. However, this linear approach tends to provide only partial answers to the need for innovation and seldom allows opportunities to take advantage of the collaborative potential triggered by non-linear approaches. Indeed, the focus on creating conditions that enable individuals, organizations and institutions to undertake innovation processes allows them to address challenges and take advantage of present and future opportunities in a more

effective and sustainable manner. This non-linear approach is the method promoted by most of IICA's initiatives to foster innovation in its technical cooperation programs.

2. Technology

Technology in agriculture refers to the set of techniques and devices that facilitate the practical application of scientific knowledge in agricultural activities. Technological innovation is a type of innovation that involves applying a new technology or technological practice to improve a product or process. Therefore, technology is an input of technological innovation, but it can also trigger innovation processes. Technological innovations are recognized as the main factor in increasing agricultural productivity (Vitón *et al.* 2017) and play a key role in the transformation of food systems (Nayyar *et al.* 2018).

Figure 3. Technological opportunities to innovate.



In agriculture, there are many opportunities to innovate derived from technologies that are new or hitherto unknown in a specific context (Figure 3). The constant advances in digital technologies, such as the Internet of the Things (IoT), big data, block chain technology, mobile applications and artificial intelligence; new physical systems, such as drones and sensors; developments in the biological sciences, such as gene editing, nanomaterials and alternative plant-based proteins and biofortification; and agroecology and ancestral or traditional knowledge, offer alternatives to respond to challenges or take advantage of opportunities. However, these can also lead to new challenges, such as those arising from changes in the agrarian structure and rural employment (IICA 2018), as well as certain negative social or environmental consequences that should be taken into account.

Cross-cutting approach to I&T³



IICA's cross-cutting approach to I&T through its hemispheric action programs, enables the technical teams to work together and add value from an interdisciplinary and innovative perspective. For this reason, I&T activities are planned and executed jointly with those programs. In addition, some outputs that are not specific to any program in particular, are addressed at the hemispheric level from the standpoint of this cross-cutting issue.

What should be done to promote I&T?

Innovation	Technology
<ul style="list-style-type: none">● Strengthen the role of the different AIS stakeholders in promoting innovation processes.● Propose and implement innovation processes in different projects with specific topics, territories or value chains.● Promote interaction and joint work through innovation platforms or similar collectives.● Contribute to the design of policies and strategies that create an environment favorable to innovation.	<ul style="list-style-type: none">● Analyze, systematize and disseminate alternative approaches and new ideas, as well as experiences in technology use.● Promote strategic partnerships with referents in the fields of technology research and development.● Analyze the limitations of existing and prospective technologies.● Examine the potential economic, social and environmental impacts of the available options.

³ For more information about the implementation of actions related to this cross-cutting issue, we suggest a review of the documents outlining the conceptual and methodological approach of each of the hemispheric action programs.

Given its cross-cutting nature, I&T can promote inter-thematic approaches between the hemispheric programs as well as with the cross-cutting issue of Gender and Youth. I&T is also well positioned to link together initiatives associated with digital agriculture within the technical cooperation provided by those programs.

The Institute's support of I&T in agriculture is directly related to its contributions to the achievement of the SDGs, especially Goals 1 (End poverty), 2 (Zero hunger), 10 (Reduce inequality), 11 (Sustainable cities and communities) and 17 (Partnerships to achieve the goals).

IICA's cooperation mechanisms related to innovation

The Institute promotes efforts to harness the results of the cooperation mechanisms related to innovation in which it participates and supports, such as the Forum for the Americas on Agricultural Research and Technology Development (FORAGRO), the Regional Fund for Agricultural Technology (FONTAGRO) and the cooperative research and innovation programs (PROCI).

In this way, the Institute has forged partnerships with many important institutional stakeholders in order to drive agricultural innovation on the American continent, and to promote and enhance partnerships for the purposes of technical cooperation.

The cooperation mechanisms have their own processes for defining plans and agendas with different institutions or bodies for decision-making purposes. In order to reaffirm its status as a strategic partner, IICA must participate actively in those bodies, thereby being able to contribute to the definition of specific innovation agendas within those mechanisms, and promote technical cooperation in general.



About IICA

As the specialized agency of the Inter-American System in agriculture, the **Inter-American Institute for Cooperation on Agriculture (IICA)** supports the efforts of its Member States to achieve agricultural development and rural wellbeing. Established in 1942, the Institute promotes hemispheric cooperation with the aim of creating a more competitive, inclusive and sustainable agricultural sector, capable of feeding the region and the world. IICA's current technical cooperation model is organized around five technical hemispheric action programs and two cross-cutting issues.

The **technical programs** are: 1) Bioeconomy and Production Development; 2) Territorial Development and Family Farming; 3) International Trade and Regional Integration; 4) Climate Change, Natural Resources and Management of Production Risks; and 5) Agricultural Health, Safety and Food Quality.

Innovation and Technology, together with Gender and Youth, are the **cross-cutting issues** present in all the programs. These act together in a coordinated manner and with an interdisciplinary approach to ensure coordinated responses to the challenges faced by the Institute's 34 Member States. Thanks to its permanent presence in each of these States, IICA has an incomparable advantage in terms of facilitating and advancing the improvement of agricultural policies and practices in the Americas.

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