
Methodology Guide for the Diagnostic of Agri-Food National Innovation Systems in Latin America and the Caribbean

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Glossary

LAC -	Latin America and the Caribbean
IADB -	Inter-American Development Bank
STI -	Science, Technology and Innovation
S&T -	Science and Technology
TBC -	Technology-Based Company
USA -	United States of America
FAO -	Food and Agricultural Organization of the United Nations
FAOStat -	FAO Statistical Database
R&D -	Research and Development
R&D&I -	Research, Development and Innovation
IICA -	Inter-American Institute for Cooperation on Agriculture
OCDE -	Organization for Economic Cooperation and Development
NGO -	Non-Governmental Organization
PCT -	Patent Cooperation Treaty
AEP -	Active Economic Population
IPPC -	Innovation Program for Productivity and Competitiveness
PPP -	Purchasing Power Parity
TFP -	Total Factor Productivity
NAIS -	National Agri-Food Innovation System
EU -	European Union
ITV -	Industrial Transformation Value

Presentation: Why a Guide for the Diagnostic of NAIS in Latin America and the Caribbean?

This Methodology Guide constitutes an initiative of the Inter-American Institute for Cooperation in Agriculture (IICA) in relation to the Innovation Program for Productivity and Competitiveness (IPPC). Its purpose is to support Member States in the development and strengthening of public and private institutional characteristics by guiding its users in the design of development policies and strategies for its National Agri-Food Innovation Systems (NAIS). The Guide aims to help create and deepen knowledge of the innovative dynamic of each of the countries and their opportunities to strengthen the innovation process and achieve socio-economic and environmental development of the agri-food sector.

Use of the Guide is aimed at Latin America and the Caribbean, primarily at:

- IPPC personnel of the IICA
- Policy makers and decision makers from the ministerial arena in each country
- Planning directors and managers of public agricultural and livestock innovation organizations
- National and international development agencies

As in any other production segment, the technological innovation process in the agri-food sector requires the commitment and active participation of primary producers, supplies providers, processors, managers, government leaders and social and educational institutions, among others, to develop innovations in the agri-food context and value chains and production complexes.

The dynamic and interaction of the agricultural sector with industry and other economic activities requires practices to be executed which promote articulation between agents, carry out activities for a better exploitation of joint learning and strengthen an appropriation of the knowledge and technologies created.

It is more and more important for this integrated systemic vision to surpass the linear vision which assumes that all innovation comes from public innovation institutions, which, despite still being key pieces of the innovation process, are part of a much more complex puzzle.

The approach to be developed in this Guide is based on the understanding that agri-food innovation systems must be organized in such a way as to strengthen links between different economic and technological agents and to create the conditions to develop agricultural value chains, enabling the knowledge created to be directed at the more valuable creation points and to their local appropriation.

With this in mind, the Guide was structured to enable an integrated diagnostic of a complex multiplayer, multi-institutional subject matter with plural productive and innovative situations. Thus, the Guide user will find himself with a set of indicators and metrics which enable this type of integrated analysis. The objective is to have, in the end, a synthetic diagnostic of the structure and characteristic principles of the Agri-food Innovation System of the country, which helps it make decisions on its agri-food innovation policies.

Evidently, the heterogeneity of the systems situations in each country will demand a subsequent profound exploration incorporating local and national policy specificities in order to do the necessary fine tuning.

The Guide begins by summarizing the conceptual elements of the approach of “innovation systems” and their application to agriculture, including a definition of what “agri-food” involves for the purposes of this Guide. The analysis dimensions are presented to follow, on which the Guide methodology is based, including important aspects for the NAIS diagnostic.

The third part describes the analysis methodology and the application of the Guide to be used by users for the NAIS diagnostic, which is organized into three axes:

- (i) Axis 1 – Characterization of production and the Science and Technology (C&T) system (production situation of the country, knowledge creation, technological command, and production base, etc.)
- (ii) Axis 2 – Characterization of the system players and their role in the innovation induction (who are the main players and what is their role in the system)
- (iii) Axis 3 – Characterization of the institutional nature of NAIS (legal frameworks, stimuli and obstacles to innovation).

The methodological structure concludes with the diagnostic integrator framework, which describes the analysis method necessary to understand and interpret the three axes and the dynamic of the innovative process of the NAIS.

1. What elements does the Agri-Food Innovation Systems approach envisage?

To understand this approach, it is necessary to define what ‘innovation systems’ are and what their application to the ‘agri-food’ sector involves. Since early 2000, the use of the ‘innovation system’ approach has been promoted in agriculture, as shown by several authors, as an alternative for developing countries to exceed the linear vision of the agricultural research process¹ and make better use of knowledge and new technologies with the aim of strengthening and promoting sector innovation capacity (World Bank, 2006).

The increasing use of this approach is the result of a new context, in which innovation has a central role for country development, not only to determine the competitive position of their economies (regional, national or supranational), but also to draw up socio-economic policies for sustainable growth.

Despite the recent application in the agriculture sector, there are several studies exploring the conceptual bases related to the agri-food innovation system. This section highlights some of the definitions and interpretations which are essential to establish the framework of the Methodology Guide on the NAIS.

1.1 From the concept of innovation to that of innovation systems

The universally accepted definition for the concept of innovation is that which is presented in the final review of the 2005 Oslo Manual (OECD, 2005). However, it is understood that the concept of innovation can be summarized, in any definition, as “that which is new (asset or service) in production and social use”. It is a very simple definition which also has a strong impact because it argues that for innovation to occur it is not enough to have a new product, a new technology or new knowledge, but it is necessary for someone to produce it and use it (producers, consumers, contractors, etc.). This is the main reason why the production sector is at the center of innovation systems.

¹ The linear vision considers that the entire innovation process begins in scientific research then moves onto technological development until it arrives at the market in the form of a new product, process or service. In fact, despite the fact that the linear model may occur (and in fact does occur), it is not the only one nor is it the main mechanism of innovation creation. The process is more complex and places the production sector at the center of the innovation dynamic. Therefore, in the innovation systems analysis it is essential to be familiar with the role of all the players involved: producers, associations, supplies and machinery industries, food and raw material processors, vendors (retail and wholesale), food segment, etc.

Figure 1 below shows some of the main concepts of innovation.

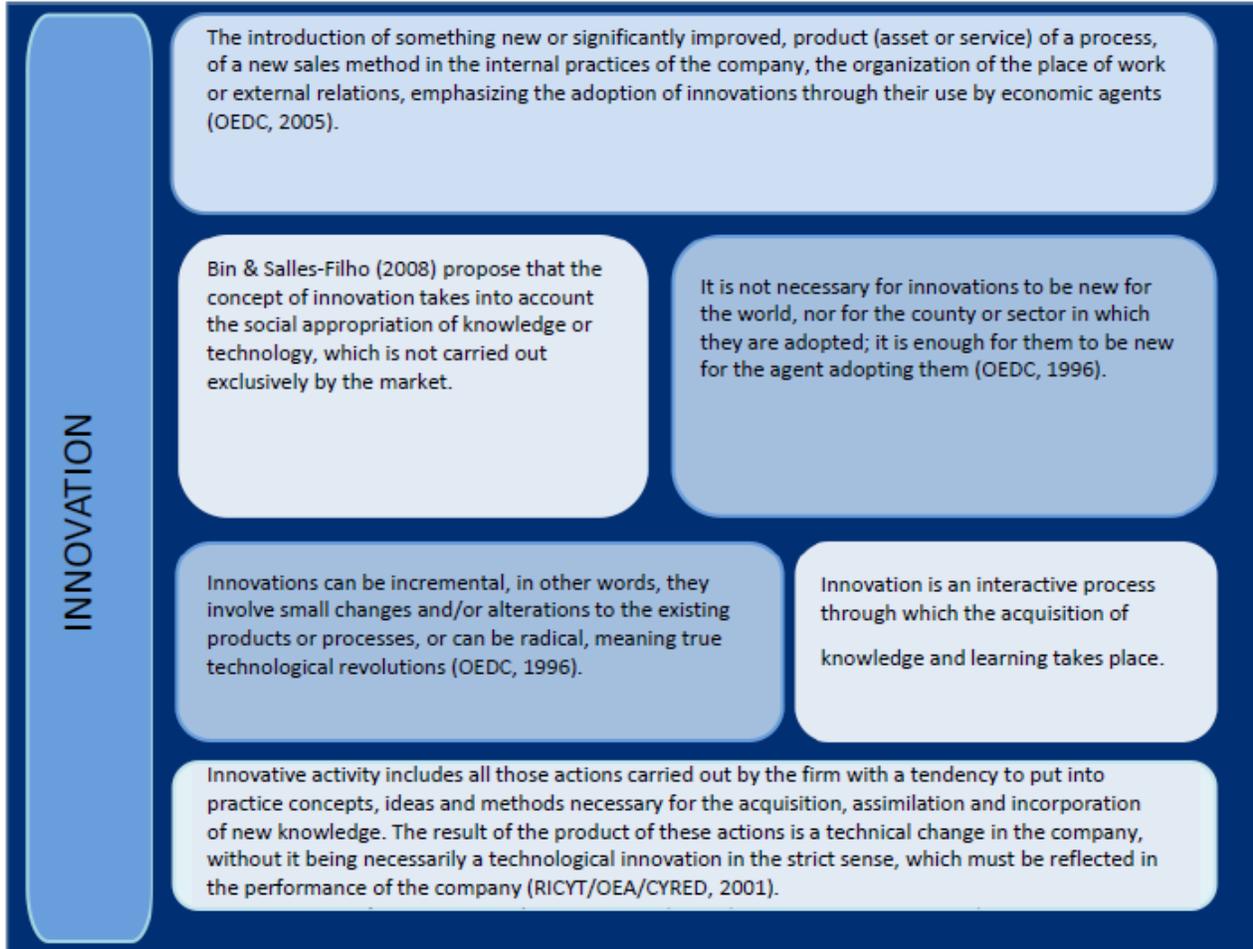
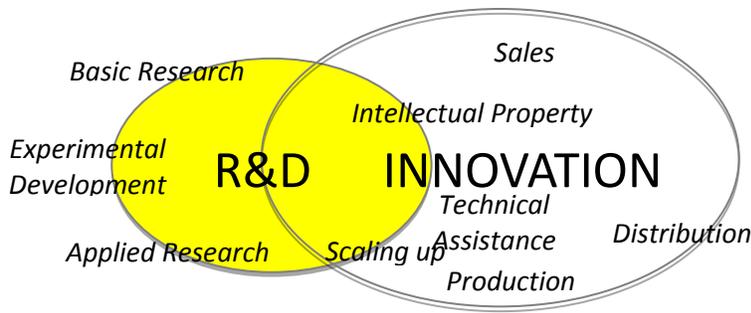


Figure 1: On the concept of Innovation

Source: Prepared by the authors

The basic idea of the innovation system approach is that—as a derivation of the actual innovation concept—it is not enough to consider the typical Research and Development (R&D) or S&T players, precisely because innovation (technological and non-technological) needs other players, such as those involved in production, sales, technical assistance, etc. Therefore, in addition to developing a new technology, it is necessary for other players to be involved in the innovation process, as outlined in [Figure 2](#).



Multiple players, multiple perspectives

Figure 2 – The different spaces, activities and players in Research, Development and Innovation (R&D&I)
 Source: Salles-Filho *et al.*, 2010.

The more systemic and ordered the process, the greater its chances of success. Success can be measured as the ability to create new knowledge, incorporate it into assets and services, produce it, sell it and retain its generated value. By its very nature, it is a collective, systemic and multi-dimensional logic. This is the main reason to use the analytical concept of innovation systems.

From the early 1990s there has been a great diversity of authors and approaches dedicated to developing the concept of innovation systems, primarily in regard to national systems. Authors such as Lundvall (1992), Nelson (1993) and Edquist (1997) studied the shape and content of national systems (NIS). They all agreed that, despite there being no ‘ideal’ NIS structure, the greater effectiveness and better performance of the systems depends on two factors: (i) the alignment of interests and coordination between organizations and public and private institutions and (ii) exposure to international trade.

The first refers to the presence of R&D entities, companies, government and appropriate legal frameworks interacting in a more or less aligned manner. The second factor is related to competitive stimuli, which only the external market places upon the systems as determining factors.

1.1.1 Local, regional and sectoral innovation systems

Despite its generic nature, the analysis of the innovation system approach can be carried out in different ways: national; local/regional; sectoral; and/or technological. Though the national, regional or local and sectoral approaches can be used independently, the most appropriate manner is to consider them as complementary, since in practice they mutually influence each other.

Table 1 presents the innovation systems concepts according to scope: national, local/regional, sectoral and technological

Table 1 – Innovation System concepts according to scope: national, local/regional, sectoral and technological

National Innovation Systems are “. . . an innovation system is made up of elements and relationships that interact in the production, promotion and use of new and economically useful knowledge... a national system comprises elements and relationships located within or deeply rooted in the borders of a national state” (Lundvall, 1992)

- **Local Production and Innovation Systems** are “(...) territorial innovation systems, where the institutional density of the territory, its integrated learning links and the settling of multiple institutionalized relationships (incorporated into co-operative projects, exchange relationships and other initiatives and alliances) into the same space have consolidated local networks into reliable practice communities” (de la Mothe & Paquet, 1998)
- **Sectoral Innovation Systems** are “(...) a group of new products already established for specific uses and the group of players which carry out market and non-trade interactions for the creation, production and sale of these products. Sectoral systems have a base of knowledge, technologies, supplies and demand. Agents are individuals and organizations at several levels of aggregation with specific learning processes, competences, organizational structure, beliefs, objectives and behaviors. They interact through communication, exchange, co-operation, competence and command processes and their interactions are made up of institutions” (Malerba, 2002)
- **Technological and distribution innovation systems**, “whose focus is primarily agent networks for the generation, promotion and use of technologies and for innovation” (Malerba, 2003)

1.2 Agri-food system

The agri-food system concept is not categorical in literature, since there are many interpretations of this idea. In fact, the term comprises two main elements: that of agricultural production (which includes livestock, forest and fish production) and that of food production (which necessarily includes primary food production and processing).

The school which originally started working on the integrated notion of agri-food systems, including agriculture, industry and distribution was the French school with the concept of *Filière* and Agri-food Systems. Louis Malassis is one of the main authors of the integrated perspective between food production and consumption. His publications and studies created the concept of *filière agroalimentaire*, one of the precursors to the concept of food chains. Malassis (1973;1979); Malassis & Padilla (1986) and Malassis & Ghersi (1996) are authors who, from a food perspective, emphasized something which was already being discussed in literature with regard to the fact that agriculture should not be looked at in isolation, only in primary production.

Along these lines, since the 1950s, works using the supply-product matrix pointed to an integrated vision of agriculture with the supplies and processing industry. The seminal work that took this approach was that of Davis & Goldberg (1957) in the United States.

The focus on food and on the food economy in its agricultural, industrial and commercial perspective, as that proposed by Louis Malassis and his collaborators, serves as a reference for this work. Therefore, this Guide is going to use the **concept of agri-food** as “that which respects the production and creation of value

in primary and industrial food production, as well as in the sales, distribution and logistical links which have an influence on the creation and appropriation of value.” That is to say, what is of interest for the issue of national agri-food innovation systems is innovation in the several points of the agricultural food production, processing and sales process (which for this case in particular also includes livestock, forestry and fishing).

2. What is the analytical scope of the Guide?

Taking into account the focus on the innovation system of the agri-food sector, the dimensions for its analysis are threefold, according to that proposed by Malerbo (2003;2006) for the “sectoral systems” study:

- a) Production base, knowledge and technology base
- b) System players and networks
- c) Institutional characteristics of the system

These dimensions outlined below constitute the base for the proposed Guide methodology.

2.1 Production base, knowledge and technology base

The first dimension—**knowledge, technology and production base**—starts from the vision that the sector has a specific knowledge, technology and supplies base, which defines its dynamic and limits. The purpose of this dimension, which **constitutes Axis 1 of the Guide**, is the delimitation and characterization of this specific base, thereby defining how it is organized and what are the most important sectoral indicators delimiting the system.

For the Guide, the knowledge, technology and production base dimension is considered to be the characterization and analysis of the production situation of the agri-food system in the countries, with data on how it is organized and what the primary agri-food production characteristics are, their specifics in terms of products, producers and regions, as well as data relating to the S&T system.

This characterization uses indicators based on historical series of physical production, land or labor productivity, production value, international trade profile, use of technologies and knowledge and R&D investment, among others.

2.2 System players and networks

The second dimension, which constitutes the base of **Axis 2 of the Guide**, considers the group of players and networks of players with important roles in the constitution and the dynamic of sectoral systems. This refers to all categories and organizations which have a relationship that is complementary and of mutual interest in innovation processes.

The importance of the players and their networks is based on the understanding that adopting the innovation system focus is to consider a wider and more complex group of players. That is to say, to consider who participates in the innovation process and who owns the innovation benefits. Consequently, this means building the conditions which enable integration between players and organizations.

From the perspective of an agri-food innovation system, as well as that of the agricultural sector, agents include: the government, the research system, the outreach system, producers and the private sector—for-profit and not-for-profit,—which, as described in the next section, can perform multiple functions in the innovation process.

2.3 Institutional character of the system

The third dimension, basis of Axis 3 of the Guide, refers to the composition and implications of the institutional character of the system. Institutions are understood as rules, routines, standards, laws and behaviors, which influence and outline decision making and, therefore, influence the production organization of the system, knowledge creation, technological changes, interaction between agents and the organization of innovation activities. In this context, institutions that are specific to the sector and also those national institutions which affect the sector are considered (Malerba, 2006).

Policy support for innovation is not the result of a single policy, but a group of policies working together to mold an innovative behavior by interacting with the attitudes and practices of existing behavior patterns. In this sense, institutions establish themselves according to the characteristics and specificities of each innovation system by generating differentials between several systems. For example, the legal framework concerning innovation is one of the most important references for decision making. This dimension also includes intellectual property and tax and financial incentives frameworks, among others.

2.4 Integrator analytical framework

These three dimensions, upon which the axes of the Guide are based, despite being categorical in the sense that they can be analyzed separately, require, for a systemic and inclusive diagnostic, a joint analysis capable of crossing and identifying the interactions between the production and technological profile with the players and institutions. Therefore, an Integrator Analytical Framework is proposed at the end of the Guide, which is a three-dimensional matrix of relationships between the three axes.

3. Methodological step-by-step of the guide

This section presents the application methodology of the Guide with the proposed indicators and metrics for the NAIS diagnostic.

The methodology comprises four steps. The first three are related to the analysis dimensions of the sectoral innovation systems described in the preceding section and the fourth to the integrator framework of dimensions:

- (i) Axis 1 – Characterization of the production system and the TIS system
- (ii) Axis 2 – Characterization of the system players and roles
- (iii) Axis 3 – Characterization of the institutional nature of the system
- (iv) Integrator analytical framework of the three axes

What are the information sources used in the Guide?

In general, the application of the Guide is based on the use of:

- secondary data obtained from easily available international and national sources, or from databases which must be created and systematized for such purpose
- primary data obtained by means of interviews and/or panels with specialists and representatives from the different segments which make up the agri-food innovation system of the country

In other words, the Guide uses quantitative and qualitative data and combines data with analysis and opinions.

¿What characteristics does the methodology of the Guide present?

- it is a **flexible instrument**, which attends to the differences in the countries' level of organization and availability of information, as well as the relative importance that each of the indicators has in the NAIS with the possibility, if necessary, of an adjustment in the indicators and the elements proposed in the Guide to enable amendments to specific realities and to carry out a more adjusted characterization of the NAIS.
- it demands a **minimum standardization of the indicators** in the way in which they are interpreted and used, as well as of the way in which the matrixes proposed in the Guide are filled in by facilitating a methodological convergence, which enables the comparison between the systems of all the countries of LAC.
- it has the ability to carry out a **general, synthetic and elevated comparability diagnostic** between the countries and at the same time enables more detailed in-depth diagnostics.

Synthetic diagnostics are very useful for the IICA since this is an organization which needs to have a broad comparable vision of the countries and their innovation systems. More detailed diagnostics are particularly important for analysis inside the countries since they create more in-depth data and the diagnostic can be used to support decision making and the formation of national policies.

However, the Guide must not be confused with very detailed technical and economic sectoral studies, but what is required is rather a full synthetic characterization of the countries' agri-food innovation systems.

Therefore, it is recommended that detailed data on additional indicators and the description of individual players or laws/standards/specific programs are inserted as an addendum to the diagnostic document. In other words, the application of the Guide must aim to have a summarized presentation of the indicators and analyses of each Axis.

Each of the methodological steps are described below.

3.1 Axis 1 – Characterization of the production base and TIS system

The first step for the application of the methodology is the characterization of the production base of the country's agri-food sector and of its TIS system. It is necessary to be clear about the profile and characteristics of agri-food production by considering the recent evolution and trends of some key indicators related to socio-economic, production and TIS dimensions.

What questions does this characterization aim to answer?

- How has agricultural and agri-food production evolved in the country in the last ten years and what trends can be designed for the near future?
- What is the diversity of production systems in terms of their innovation dynamic and what are their strengths and weaknesses?
- What is the production and technology density of the system in the country?

What indicators and metrics are used?

- The guide proposes a group of indicators with a specific focus to **measure innovation** and which, therefore, go beyond the classic indicators used to measure R&D (Table 2, Table 3 and Table 4). However, some indicators were consciously defined and prioritized which, despite not yet being available, must be produced and made available by the countries.
- Additionally, working with the agri-food sector added a greater complexity to the definition of indicators since it is a sector which does not yet have its own statistics (or has few), yet again reinforcing how important it is for them to be created by the countries themselves.
- The proposed **metrics** aim, as far as possible, to be universal so as to enable comparison between countries and/or regions.
- From the methodological point of view, indicators can be complemented by any existing national studies and analyses in each country which support the characterization of this Axis. Additional indicators or more detailed data must form part of the Addenda to the document.

How are the indicators grouped and interpreted?

The Axis indicators are grouped into two dimensions:

- a) Economical, socio-environmental and production (10 summarized indicators and 24 general indicators)
- b) TIS (13 summarized indicators and 11 general indicators)
 - Each of these dimensions has a group of **summarized indicators** and general indicators, which enable the characterization of this Axis.
 - **Summarized indicators** enable an executive diagnostic—in a relatively flexible way—to identify where the main strengths and weaknesses of the NAIS are.

For a better convergence between national studies, it is recommended that the grouping of data and the nomenclature proposed in this Guide be maintained.

The indicators must be interpreted primarily based on the data (tables and figures), rather than on information which is too extrapolated by what could be drawn from the data.

At the end of each dimension, simple conclusions must be drawn on the most outstanding aspects characterized by this dimension, particularly considering the summarized indicators.

What is the analysis period recommended for measuring the indicators?

The analysis period must be a minimum of five and a maximum of 10 years, with historical series indicating changes and trends.

What is the main information source for the application of this Axis?

This part of the Guide can be developed from national and international secondary data (use of standardized international sources are recommended, such as those of the World Bank, Faostat, RICyT (Science and Technology Indicators Network), IICA; BID (Inter-American Development Bank).

The Axis can be easily updated after the first version.

Table 2 - Indicators of Axis 1: Economic, Socio-environmental and Production Dimension

Dimension	Suggested indicators	Description of indicator	Metric used*	Summarized indicators
Economic, socio-environmental and production (10 summarized indicators and 24 general) (XX general indicators and XX summarized indicators)	Contribution of the agricultural sector to national GDP	Refers to the evolution of the participation of the agricultural sector in the country's GDP	Percentage	
	Contribution of the agri-food sector to national GDP	Refers to the evolution of the participation of the agri-food sector in the country's GDP	Percentage	
	Agricultural sector production value	Refers to the evolution of the production value of the agricultural sector	PPP dollars	
	Agricultural sector production value by agricultural EAP or by worker in the agricultural sector	Refers to the evolution of the production value of the agricultural sector per worker or per agricultural EAP	PPP dollars	
	Production value of the agri-food sector	Refers to the evolution of the production value of the agri-food sector	PPP dollars	
	Agri-food production value by agri-food EAP or by workers in the agri-food sector	Refers to the evolution of the production value of the agricultural sector per worker or per agri-food EAP	PPP dollars	
	Economically active population in agriculture	Refers to the evolution of the percentage of labor occupied in the agricultural sector	Percentage	
	Agricultural and food production per capita	Refers to the evolution of agricultural production and food per inhabitant	Tons of grains per inhabitant	
	Participation of small, medium and large producers in the country's agricultural production value	Refers to the evolution of the participation of different strata of agricultural and livestock producers (by size) in the formation of the country's agricultural production value	PPP dollars/size of producer	
	Participation of small, medium and large producers in the country's food (basic food basket) production	Refers to the evolution of the participation of different strata of agricultural and livestock producers (by size) in the production of foods from the basic food basket	%/size of producer	
	Agri-food trade balance	Refers to the evolution of imports and exports of agricultural products by the country	PPP dollars	
	Basic food basket (or food) trade balance	Refers to the evolution of import and exports of products from the country's basic food basket	PPP dollars	
	Agricultural profit over total rural profit	Refers to the evolution of the participation of agricultural activity measured by profit over the total of economic activity in the rural environment	Percentage	
	Rural population below the poverty line	Refers to the evolution of the percentage of the rural population living below the poverty line	Percentage	
	National and rural inequality	Refers to the evolution of the Gini coefficient (available in the CEPAL database)		
	Level of education of rural producers	Refers to the evolution of the formal level of education of rural producers in the country	% of producers at each level/in each year	
	Carbon dioxide emissions by the agri-food sector	Refers to the evolution of carbon dioxide emissions into the atmosphere by the agri-food sector	thousand metric tons	
	Permanent forest land area over total country land area	Refers to the evolution of the participation of permanent forests in the total land area of the country	Percentage	
	Organic production: seeded area, number of producers and jobs created	Refers to the evolution in organic production measured in the evolution of the seeded area, number of producers and jobs created	ha/year n/year	
	Participation of organic producers in the total of agricultural product exports	Refers to the evolution of the participation of organics in agricultural exports of the country	Percentage	

* Measurement period: 10 years (or the closest possible)

Table 3 - Indicators of Axis 1: Economic, Socio-environmental and Production Dimension (continued)

Dimension	Suggested indicators	Description of indicator	Metric used*	Summarized indicators
Economic, socio-environmental and production (10 summarized indicators and 24 general) (XX general indicators and XX summarized indicators)	Land use	Refers to the evolution of land use with: temporary and permanent crops; pasture; and forest production	ha of each type of use / total area of the country	
	Production and productivity of the 10 main agricultural products	Refers to the evolution of the production and productivity of the ten main products (in terms of production value)	t & t/ha of the group of the 10 main products	
	Cattle production and productivity	Refers to the evolution of cattle production and productivity	total cow's heads and cow/s head per ha	
	Fishing production (capturing and aquaculture)	Refers to the evolution of the production and productivity of total fish production in the country	t of fish product	
	Agricultural productivity	Refers to the evolution of agricultural productivity	Ideal:TFP	
	Launch of new products from the agri-food sector at country level	Refers to the launch of new agri-food products by level of newness: new for who launched it, but already exists in the country new for the country, but already exists in the world new for the world	Number of new products launched in each of the categories per year	
	Industrial transformation value of the agri-food sector (agri-food ITV)	Refers to the evolution of the difference between gross industrial production value and agri-food industrial operations production costs	US\$ or local currency	
	Fertilizer consumption by producer size (small, medium, large)	Refers to the evolution of fertilizer consumption by producer size	t/ha/producer size	
	Evolution of tractors per hectare by producer size (small, medium, large)	Idem for tractors	tractors/ha/producer size	
	Equipped land areas for irrigation by producer size (small, medium, large)	Idem for land area with irrigation	ha with irrigation/total ha under agricultural crop	
	Certified seeds by producer size (small, medium, large)	Idem for certified seeds use	t/ha/producer size	
	Water use	Refers to the evolution in water consumption by the agricultural and livestock sector	m3/ha	
	Infrastructure for agricultural sector transportation and logistics	Refers to the evolution of investment in infrastructure for agri-food products transportation and logistics	PPP dollars/Year	
	Direct foreign investment (DFI) in agricultural and agri-food production and in chemical, biological and mechanical supplies	Refers to the evolution in DFI value in agricultural, agri-food production and in chemical, biological and mechanical supplies in relation to total DFI value	Percentage	

* Measurement period: 10 years (or the closest possible)

Table 4 - Indicators of Axis 1: TIS Dimension

Dimension	Suggested indicators	Description of indicator	Metric used*	Summarized indicators
TIS (13 summarized indicators and 11 general)	R&D investment in relation to country's total GDP	Refers to the evolution of R&D investment in relation to total GDP	%R&D/GDP	
	Agricultural R&D investment in relation to agricultural GDP	Refers to the evolution of investment made in agricultural R&D in relation to agricultural GDP	%R&D/GDP	
	Agri-food R&D investment in relation to agri-food GDP	Refers to the evolution of investment made in agri-food R&D in relation to agri-food GDP	%R&D/GDP	
	Private agricultural R&D investment in relation to agricultural GDP	Refers to the evolution of the participation of the private sector in R&D in relation to agricultural GDP	%PrivateR&D/GDP	
	Balance of technological payments of the agri-food sector	Refers to the evolution of the relationship between the cost of knowledge acquisition (import) and the cost of creating it internally by measuring the country's technological dependency	US\$ or local currency	
	Nationals protected crops by the total of country protected crops	Refers to the evolution of the participation of crops protected by national researchers and organizations in relation to the total of protected crops	% nationals/total	
	Locally generated crops in use	Refers to the evolution of the number of locally generated crops being used by producers	n/year	
	Patents registered in the agricultural field by nationals in relation to the total number of patents in the agricultural field	Refers to the evolution of the participation of patents registered in the country by national researchers and organizations in relation to the total patents registered	% nationals/total	
	Patents in the agri-food sector registered with foreign co-inventors	Refers to the evolution of the number of patents registered in the country with foreign co-inventors in the agri-food sector	% co-inventors / total	
	Patents in the agri-food sector registered in the PCT (USA, EU, Japan and China)	Refers to the evolution of the number of patents registered by nationals in the PCT in the agri-food sector	n/year	
	Licenses granted for the agri-food sector	Refers to the evolution in the number of licenses granted for the exploitation of innovation in the agri-food sector	n/year	
	Spin off from agri-food Technology Based Companies (TBC)	Refers to the evolution of the number of TBC spin offs created per year in the agri-food sector	n/year	
	Country's participation in the publication of scientific articles on the GI base in the agri-food field	Refers to the evolution of the participation of publications with authors from the country in the SI base in the agri-food field	%/year	
	Country's participation in the publication of scientific articles in the agri-food field in other international journals	idem, but over a base of previously chosen Latin American journals	%/year	
	Population with higher education level over the total population	Refers to the evolution of the percentage of persons with further education in relation to the total population	%/year	
	Graduates (upper level) in agrarian and agri-food sciences in relation to the total of graduates	Refers to the evolution of the percentage of persons with further education in agrarian and food sciences in relation to the total of graduates from further education	%/year	
	Graduates with masters and/or doctorate in agrarian and agri-food sciences and innovation management in relation to the total of those educated in these sciences and disciplines	Refers to the evolution of the participation of professionals with a masters or doctorate in the total of graduates in agrarian and food sciences	%/year	
	Researchers in the country in relation to the number of the economically active population (EAP)	Refers to the evolution of the percentage of researchers in relation to the total of the country's EAP	%/year	
	Researchers in agrarian and food sciences in relation to the total number of researchers	Refers to the evolution of the percentage of researchers in agrarian and food sciences in relation to the total of researchers in the country	%/year	
	Researchers in agrarian and food sciences employed in government in relation to the total number of researchers in agrarian and food sciences	Refers to the evolution of the percentage of researchers in agrarian and food sciences employed in government in relation to the total of researchers in agrarian and food sciences	%/year	
Researchers in agrarian and food sciences employed in universities in relation to the total number of researchers in agrarian and food sciences	idem for researchers in agrarian and food sciences employed in government	%/year		
Innovation managers in agrarian and food sciences in relation to the number of EAP	Refers to the evolution of the number of outreach workers, technical assistants or similar from the agricultural and agri-food sector in relation to the total of the country's EAP	%/year		
Product differentiation certifications	Refers to the evolution in the number of certificates issued by national intellectual property institutes (geographical designations, brands) and authorized certificates (social and environmental certificates, such as carbon neutral, organic, corporate social responsibility, agricultural SPAs and biosecurity)	no of certificates issues/year		
Internet access supply (available networks)	Refers to the evolution in the availability of internet access in the rural sector	no of access points/year		

* Measurement period: 10 years (or the closest possible)

What conclusions are drawn from the application of this Axis 1?

Based on this group of indicators, an analysis is done of the data for the characterization of the production, economic, socio-environmental and TIS systems of the country and it concludes with a synthetic description of the characteristics of the Axis (example):

- “... this is a production system based on (export commodities, food production for local or national, mixed, etc. consumption) with production (local, import) of the main supplies with crops “x” and “x” being more developed. The recent evolution process of production has shown a modernization movement of the following products...

... The profile of producers has evolved for an broadening/reduction of small/large producers, who currently consume more/less supplies and labor. These are producers with a lot of/little access to technical, price and market, etc. data and with a “x” education profile...

The system points where the main bottlenecks to broaden innovation are found are the following...

... Furthermore, scientific and technological production in agri-food sciences has expanded by 10 per cent in the last ten years... At the same time, technological production measured by registered patents has expanded primarily due to the participation of foreign companies... Local knowledge creation and appropriation capacity is very limited and the incorporation of technology is preferentially led by the acquisition of supplies and machines...”

“The main challenges of the countries’ production systems are (examples):

- Expand local generation and appropriation of technological innovations in order to expand system production value ...
- Expand local investment in R&D and the number of personnel with further education, as well as the formal education of producers...”

3.2 Axis 2 - Characterization of system players and their role

The second Axis of the Guide is the characterization of the main system players, their dynamic and their roles in the innovation process.

What questions does this characterization aim to answer?

- Who are the public and private players with a leading role in NAIS innovation (not only research players, but also those who are effectively responsible for the incorporation of knowledge and the appropriation of the value resulting from this incorporation, such as producers and their associations)?
- How do the players interact and how do they determine innovation in the NAIS (who are the dominant players and what do the modernizing movement and the innovation dynamic of the system decide)?
- Who are the players with greater value creation and appropriation capacity in the NAIS?
- In short: how could the participation of the players in the systems be characterized with regard to their ability to manage the innovation process and what are the strengths and weaknesses of these players?

¿How are NAIS players and their role characterized?

Characterization of the players envisages two stages: (I) characterization of the role of each group of NAIS players; and (II) characterization of the systemic interactions of these groups.

(I) Characterization of the role of each group of NAIS players

For the identification of the leading NAIS players and to characterize their presence in the country, the Guide proposes the application of the “Characterization of groups of players matrix” represented in [Table 5](#), [Table 6](#) and [Table 7](#).

To facilitate the analysis of NAIS players, five groups are proposed according to the main function they perform in the system, with more specific sub-groups, as listed below:

- a) Supplies providers, with nine sub-groups
- b) Processing industry and sales, with four sub-groups
- c) R&D and promotion agents, with 11 sub-groups
- d) Agricultural and livestock producers, with two sub-groups
- e) Government bodies, with six sub-groups

The steps to complete the Matrix are the following:

1. Consider the situation of the players in the country according to a predetermined scale (fourth column of the tables to follow) related to their geographical presence and participation in local production and R&D. The description of this scale presents minor variations for the different groups of players, which aim to better explain the possible options according to the characteristics of the group.
2. Evaluate the role of each group as an innovation driver in the NAIS by also using a predetermined scale of importance (from zero to three).

The agricultural systems of LAC have very diverse situations. Not only are the countries different with different evolutions in their agri-food production systems, but also the degrees of heterogeneity within the countries can be quite extreme. Furthermore, the types of products, as has already been mentioned, involve very different innovative conditions. This is why assessment of the role of players as innovation drivers varied according to the product. To manage the differences between products, it is proposed that the evaluation be conducted according to the following categorization:

- *commodities*, differentiated into primary and processed and defined as: homogenous products related to production scales and the international market with an innovative registry very focused on productivity and production costs and on process innovations.
 - *non-commodities*, differentiated into primary and processed and defined as: products presenting an innovative registry focused on the aggregation of value and differentiation.
3. Additionally, the “Observations” column may include clarifications on the type of innovation generated by the group of players, as well as whether they are concentrated in any particular region of the country, whether the impact is high only in a production chain, whether the group is represented by few but large institutions/companies, whether the role is played by a type of producer, etc.

What is the primary information source for the application of this Axis?

Axis data are obtained with the help of local specialists, representatives of different NAIS sectors (academic, S&T, private, governmental and production) either by means of structured panels or individual or group interviews.

Additionally, secondary sources may also be used, such as institutional documents describing the functions of the most relevant players or groups of players and evaluation studies of institutions or the NAIS overall.

IMPORTANT: Very exhaustive descriptive details on individual players must be avoided or else placed in an Addendum to the diagnostic document.

Table 5 – Characterization matrix of groups of players: supplies providers and processing industry and sales

Group of players	Players	Description	Situation of the players in the country (use the following scoring scale): 0 – not physically present in the country or present through third party representations 1 – physically present in the country, even with local though insufficient production plants 2 – physically present in practically the entire national territory and with production serving the whole territory 3 – physically present in the national territory; has local production and conducts R&D in the country	Current role of the player in innovation induction in the NAIS (use the following scoring scale) 0 – Irrelevant 1 – Not very important 2 – Important				
				For commodities		For non-commodities	Observations	
				Primary products	Processed products	Primary products		Processed products
Supplies providers	Animal genetics	Refers to suppliers of animal genetics used by livestock producers (cabins, semen vendors, etc.)						
	Vegetable genetics/Seeds	Refers to suppliers of vegetable genetics to producers (seed companies)						
	Agrochemicals	Refers to suppliers of agrochemicals for agricultural and livestock production (fertilizer, pesticide, fungicide etc., companies)						
	Biological products (rhizobia, etc.)	Refers to suppliers of biological products used for agricultural and livestock production (inoculant companies, biological control agent vendors, etc.)						
	Equipment for alternative energy generation (biomass, biodigesters, etc.)	Refers to providers of supplies for alternative energy generation (biogas, biomass, etc. companies)						
	TIC applied to the agri-food field	Refers to providers of specific IT, telecommunications and electronic products and services for the agri-food sector (IT, telecommunications for connectivity and logistics, applied geo-referential information technology companies; precision agricultural equipment importers; software development for sector management)						
	Techno-specialized services networks (service companies)	Refers to the players who provide specialized technical service for the sector, both at a production and management level (service companies)						
	Animal Health	Refers to suppliers of animal health products (vaccines, vitamins, medicines, etc.)						
	Agricultural Machinery and Equipment	Refers to players who supply machinery and equipment to producers for agricultural labor (tractors, ploughs, harvesters, pulverizers, etc.)						
Processing industry and trade	Food and drink industries	Refers to industries charged with the preparation, transformation, conservation and packaging of food for human and animal consumption, as well as the drinks preparation and packaging industry in general (both alcoholic and non-alcoholic beverages)						
	Processing industries for other agricultural and livestock products	Refers to industries charged with the transformation and processing of agricultural and livestock raw materials for non-food use (flowers, textiles, wood, paper, cardboard, tobacco, agro-energy, leather, etc.)						
	Brokers and sales agents	Refers to players charged with the storage, preparation, logistics and/or sale of agri-food production, both for the internal and external market (brokers, cooperatives, associations, mills, etc.), as well as consumer organizations.						
	Food segment agents	Refers to players offering small- and large-scale food services (catering, supermarkets, large restaurant chains, bars, bakers, hotels, etc.)						

Table 6 – Characterization matrix of groups of players: R&D and promotion agents and agricultural and livestock producers

Group of players	Players	Description	Situation of the players in the country (use the following scoring scale): 0 – not physically present in the country or present through third party representations 1 – physically present in the country, even with local though insufficient production plants 2 – physically present in practically the entire national territory and with production serving the whole territory 3 – physically present in the national territory, has local production and conducts R&D in the country	Current role of the player in innovation induction in the NAIS (use the following scoring scale) 0 – Irrelevant 1 – Not very important 2 – Important					
				For commodities		For non-commodities		Observations	
				Primary products	Processed products	Primary products	Processed products		
R&D and promotion agents	Public agricultural and food research organizations	Refers to public organizations responsible for knowledge and technology creation for the agricultural and agri-food sector (agricultural and livestock, industrial, food, etc. research institutions)							
	Private agricultural and food research organizations	Refers to private organizations responsible for knowledge and technology creation for the agricultural and agri-food sector (private companies, technology parks and zones, etc.)							
	Technology transfer agents and organizations	Refers to private agents and/or organizations responsible for technology transfer generated by national agents or acquired abroad							
	Non-Governmental Organizations (NGOs)	Refers to ONGs responsible for the help, technical assistance and knowledge transfer to agricultural and livestock producers, be this technical, social or environmental							
	International or regional bodies	Refers to international and/or regional bodies or programs promoting scientific and technological development of the country's agri-food sector							
	Public further education and research system (universities)	Refers to public universities developing R&D, technology transfer and training (creation of professionals) for the agri-food sector							
	Private further education and research system (universities)	Refers to private universities developing R&D, technology transfer and training (creation of professionals) for the agri-food sector							
	Technical education system (medium level)	Refers to technical schools developing R&D, technology transfer and training (technicians) for the agri-food sector							
	Certifying agents	Refers to public and/or private agencies or bodies responsible for the development of quality standards and issuing of certificates (organic production, environmental seals, social seals, ecological production, etc.)							
	Technology based companies (TBCs)	Refers to producers of assets and services committed to the design, development and production of new products and/or innovative manufacturing processes through the systematic application of scientific and technological knowledge							
Specialized journalism	Refers to mass promotion agents specialized in broadcasting specific information on the agri-food sector (agricultural and livestock press, radio and TV programs, agricultural and livestock TV channels, etc.)								
Agricultural and livestock producers	Individual producers	Refers to the group of agricultural and livestock producers present in the country. To assess their role in the NAIS it is important to differentiate between the different types of producers recognized and categorized in the country, be they grouped by size, predominant labor, income, etc. In other words, each country will use the conventional categorization used for the sector	Not relevant						
	Technically innovative producer associations/networks	Refers to associations/cooperatives/networks or other type of grouping of agricultural and livestock producers of a technical-innovative nature, in other words, responsible for participating in knowledge and technological creation and/or promotion processes for the agri-food sector. Political protest associations are not included							

Table 7 – Characterization matrix of groups of players: government bodies

Group of players	Players	Description	Situation of the players in the country (use the following scoring scale): 0 – not physically present in the country or present through third party representations 1 – physically present in the country, even with local though insufficient production plants 2 – physically present in practically the entire national territory and with production serving the whole territory 3 – physically present in the national territory; has local production and conducts R&D in the country	Current role of the player in innovation induction in the NAIS (use the following scoring scale) 0 – Irrelevant 1 – Not very important 2 – Important				
				For commodities		For non-commodities		Observations
				Primary products	Processed products	Primary products	Processed products	
Government bodies	Ministry of Agriculture Ministry of Science and Technology or similar							
	Ministry of Economy							
	Other ministries (Industry, Labor, Education, Social Development, Environment...)							
	Provincial/local/regional public bodies							
	Other government agents	Includes bodies responsible for intellectual property rights, financing agencies, state development banks, etc.						

A descriptive summary must appear at the end of the characterization of each group of players with the aim of avoiding conclusions or inferences not deriving from the data presented. By way of an example, a summary for the group of suppliers and R&D agents is presented.

- “...NAIS suppliers are typically supplies and machinery companies which sell imported products and technologies and which are monitored by the multinationals who dominate the supplies and machines segments. Therefore, the NAIS does not have its own capacity for local supplies and machines production, nor does it act as a technology developer or adapter for agricultural production. However, the companies selling supplies and machines are large and oligopolized, thereby strongly influencing the modernization and innovation process in the NAIS of the country...
- The local NARI (National Agricultural Research Institute), despite being present throughout the territory, is weak and not very effective in promoting innovation since it passes the most important leading role of the national system onto producer associations...”

(II) Characterization of systemic interactions between the groups of players

In addition to the characterization of the players, it is interesting to analyze the main interactions between the groups, as well as the importance of these interactions for the capacity for value creation and appropriation (successful innovation) within the NAIS by trying to identify the existence of networks and their consequences for the System. To do so, the Guide proposes the application of the ‘Matrix of interactions between the groups of players—*influence and dependence*’,² represented in [Table 8](#).

² The analytical element which complements the characterization of the players is that of connections and flows between them. It is possible to have in a country or in any production situation a very complete group of players, but with scant interconnection and low (or very heterogeneous) capacity for value creation and appropriation. These would be complex, but unbalanced systems in their components and flows. Contrarily, relatively low complexity situations can be found with strong interconnection and convergence between the players, providing positive results for all components. This would be a low complexity, but greater coordination (or equilibrium) situation of components and flows. There are many possibilities, a reflection of the heterogeneity of the historical evolution of the countries and regions and the components and flows of their systems.

The complete ‘Matrix of interactions between the groups of players – influences and dependences’ shows us the most influential and most dependent players. While general conclusions can be drawn from the matrix, it is possible to explore the analysis qualitatively.

Figure 3 enables a spatial localization of the result of the matrix and is an important complement in the analysis of relationships. For example, block A1 represents the players with a greater degree of influence (those who have the highest total score in the line will be the players with more influence in the innovation system, in other words, those who lead the NAIS innovation trajectories more strongly). The block opposite (A3) will show the players who are most dependent and lead very little. Block A2 shows the players who are leaders and dependent on others at the same time (classic examples are local supplies providers who purchase/import technology from third parties, as well as some food processors who induce innovation, but depend on machinery and supplies provided from other industries). Block A4 shows the inert players with little influence on the innovation dynamic of the agri-food sector. The most interesting aspect of this way of analyzing the players’ “game” is that it enables us to think up ways in which a player can migrate from one zone to another. Those in the grey zone, for example, may, in theory, be more easily directed to the country’s policies’ zones of interest.

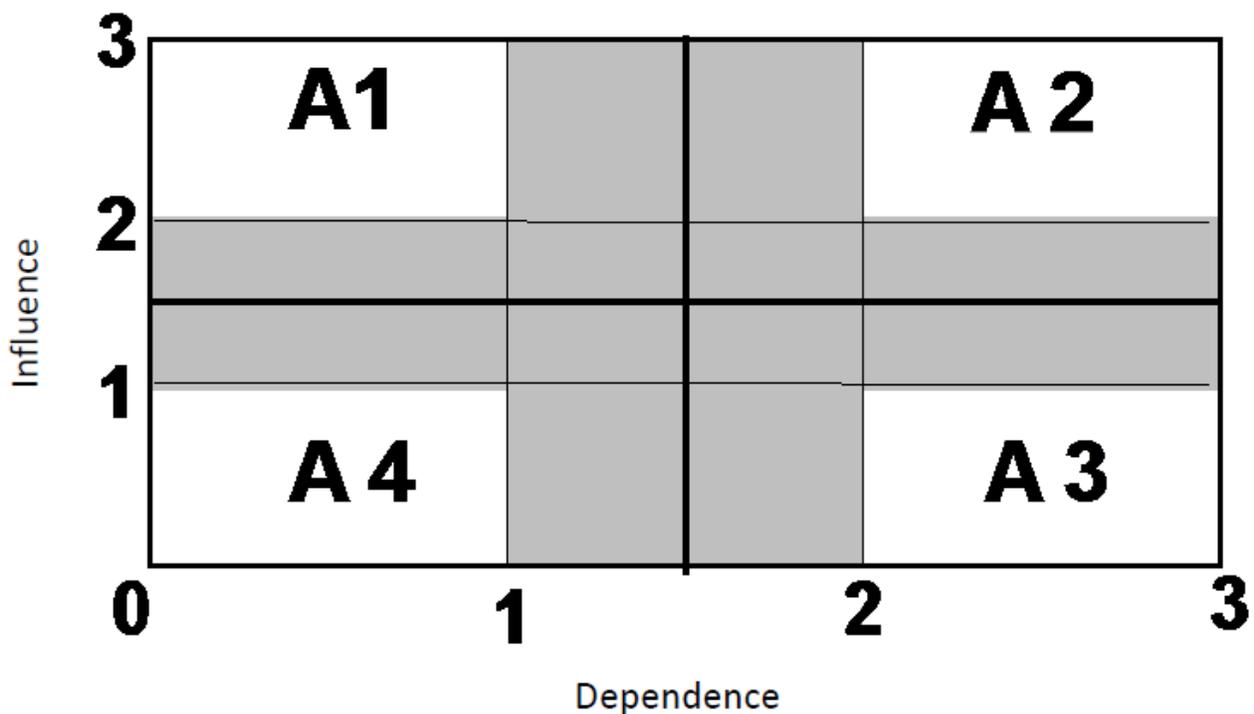


Figure 3: Localization areas of the groups of players in relation to their influence and dependence

What conclusions are drawn from Axis 2?

The conclusion of the **players and roles** axis is a summary of the analysis conducted, by way of an example:

- “...the dominant players of the NAIS are the processing and supplies and machines companies, who strongly influence and dominate almost all the technology supply for agricultural production. Research institutions, regardless of their importance for the adapting of techniques and practices, have a secondary role in the NAIS. Producers have more and more of a relationship with supplies

companies, who occupy almost all the space of the outreach organizations. The creation phase of new techniques, varieties or other technologies, including services, is not present in the country, except for some timely cases with growth potential...”

3.3 Axis 3: Characterization of the institutional nature of the NAIS

Axis 3 complements the previous axes since it incorporates the characterization and analysis of the institutional nature of the sectoral system. As has already been pointed out, institutions are understood as the regulatory, standards and policies frameworks which regulate and serve as a reference for players' decisions.

¿What questions does this characterization aim to answer?

- What are the main regulatory and policy frameworks of the NAIS in relation to the group of policy objectives in terms of production, sales, educational and scientific, technological and innovation activities?
- What influence do these regulatory and policy frameworks have for the arrangement of the NAIS and how do they contribute to innovation adding value in production systems?
- What are the strengths and weakness of the policies and the regulatory frameworks for the development of the NAIS?

¿How is institutionality characterized?

The characterization of institutionality in a broad sense, as well as a brief analysis of policies and legal frameworks, is based on identifying and indicating its most evident effects for the NAIS, which present incentives or disincentives for the development of the system.

Therefore, the application of the 'Matrix for the identification of the main policies and legal frameworks' (Table 9) is proposed, which enables the policy objectives that are really having an impact on sector innovation to be identified.

IMPORTANT: More detailed descriptions on policies, legal frameworks or programs in force to promote innovation in the sector must be placed in an Addendum to the diagnostic document.

For assessment, the policies and/or legal frameworks are split into two large groups, which include more specific sub-groups according to the main objective to be pursued:

- a. Focused on production bases; includes seven sub-groups
- b. Focused on TIS promotion; includes 13 sub-groups

Each policy group is assessed using a predetermined scale (from 0 to 3), which refers to its existence as a group and its practical relevance, in other words, its effectiveness to produce the expected impact on inducing innovation.

At the end there is a column for making comments, where clarifications or specifics exploring the information, such as the specific laws or standards covered by the subject matter, the group of players affected, etc. can be placed.

What is the main information source for the application of this Axis?

Axis 3 data is obtained from both secondary sources and from consultation with local specialists, who may gather in panels to help the discussion and fill the structure proposed in the Matrix for the identification of the main policies and legal frameworks.

Table 9 – Matrix for the identification of main policies and/or legal frameworks

Policy and legal framework objectives		Description of the policy and/or legal framework objectives	Specific policies and/or legal frameworks 0 – does not exist 1 – exists, but has no practical relevance 2 – exists and has little practical relevance 3 – exists and has great relevance in the NAIS	Comments
Production bases	Technology acquisition by producers (innovation by modernization)	Refers to the existence and importance of policies and/or legal frameworks (subsidies) promoting innovation that favors the acquisition of technologies (seeds, equipment, chemical supplies, services, etc.) by producers		
	Supplies and equipment production for agriculture	Refers to the existence and importance of one or several policies and/or legal frameworks incentivizing (such as subsidies and tax incentives, for example) local production of supplies and equipment		
	Sustaining profit of agricultural producer	Refers to the existence and importance of one or several policies and/or legal frameworks promoting the sustaining of producer profit (several types of subsidies, production insurance, minimum prices, etc.)		
	Agricultural product processing	Refers to the existence and importance of one or several policies and/or legal frameworks to incentivize agro-industrialization for processing of and adding value to the agricultural product		
	Sales/distribution	Refers to the existence and importance of one or several policies and/or legal frameworks to incentivize the sale of agri-food production, including international trade (withholdings, international trade treaties, traceability, etc.)		
	Infrastructure and logistics	Refers to the existence and importance of one or several policies and/or legal frameworks to incentivize investment in infrastructure and logistics for the agri-food sector (ports, highways, road-building, etc.)		
	Land use	Refers to the existence and importance of one or several policies and/or frameworks to regulate land use, including reforestation, climate change mitigation and adjustment policies, among others)		
	Land-use planning	Refers to the existence and importance of one of several policies and/or legal frameworks to promote land-use planning		
TIS promotion	Research and development investments public organizations private organizations public-private cooperation	Refers to the existence and importance of one of several policies and/or legal frameworks which promote investment in R&D (programs, projects, infrastructure, personnel, equipment and supplies development, etc.) at different types of organizations, such as public R&D institutions, private for-profit and not-for-profit organizations and public-private co-operations, such as consortia, networks, etc.		
	Protecting intellectual property and technology transfer	Refers to the existence and importance of one or several policies and/or legal frameworks which regulate intellectual property rights related to all segments of the agri-food system (varieties, equipment, frameworks, denomination or origin, software, technology transfer contracts, etc.)		
	Access and use of biodiversity resources	Refers to the existence and importance of one or several policies and/or legal frameworks which regulate access to and use of biodiversity resources		
	Quality and product differentiation certification	Refers to the existence and importance of one or several policies and/or legal frameworks which regulate and/or stimulate quality certification of agri-food products (quality or socio-environmental seals)		
	Management training of producers and workers	Refers to the existence and importance of one of several policies and/or legal frameworks which promote or incentivize management education (production management, accessing and analyzing market information, as well as information on new production techniques, sales training, etc.)		
	Training for innovation management	Refers to the existence and importance of one or several policies and/or legal frameworks which promote and incentivize innovation management education of public or private sector personnel who are going to work in this area (also involves changes to the university curriculum to create differentiated professional profiles)		
	Digital inclusion	Refers to the existence and importance of one or several policies and/or legal frameworks for digital inclusion for all aspects of the agri-food sector		
	Environmental and food biosecurity	Refers to the existence and importance of one or several policies and/or legal frameworks for incentives for investment in biosecurity, both environmental and food (natural and indigenous reserves, etc.)		
	Bioremediation and waste recycling	Refers to the existence and importance of one or several policies and/or legal frameworks for incentives for investment in bioremediation and waste recycling in the agri-food sector		
	Regional consolidation for innovation	Refers to the existence and importance of policies promoting consolidation with other countries in the region or the world to promote innovation		
	Innovation promotion	Refers to the existence of laws directly aimed at promoting innovation		
	Technology transfer and knowledge absorption capacity	Refers to the existence of policies promoting technology transfer and exchange between countries and research groups in areas critical for the future of the country, as well as policies promoting national absorption capacity (such as offset policies)		
	Internationalization policies	Refers to the existence of human resources internationalization policies through the exchange of professionals, researchers and students, as well as the promotion of projects in international networks		
	Innovation promotion focused IED policies	Refers to the existence of specific innovation promotion focused IED policies		

¿What conclusions are drawn from Axis 3?

A synthetic text is suggested with the implications of the group of legal and policy frameworks for the NAIS. By way of an example:

- “...The NAIS is modeled on a legal framework which presents no direct incentives for the participation of the private sector in scientific and technological development. Legal stimuli and policies on private investment in R&D are not very effective at all. Therefore, the legal framework for the protection of intellectual property and technology transfer is not suitable since it does not create the conditions necessary to stimulate investment in advanced technological development. Nevertheless, there are incentives so that producers invest directly in the acquisition of supplies and agricultural machines, but there are no socio-environmental, denomination of origin, or quality certification systems, which means that modernization continues towards a standardization which does not favor small producers. Another point which merits highlighting refers to access to biodiversity, which is not very detailed or controlled and becomes a non-policy...”

3.4 The integrator analytical framework

After identifying the axes, their indicators and analytical objectives, and accepting the issue of the heterogeneity of types of products and producers, an ‘Integrator Analytical Framework’ (IAF) is proposed for the Guide, in which the categories ‘products/producers’ cross with the three axes of the analytical sectoral systems framework, enabling an integrated analysis. Figure 4 shows the IAF.

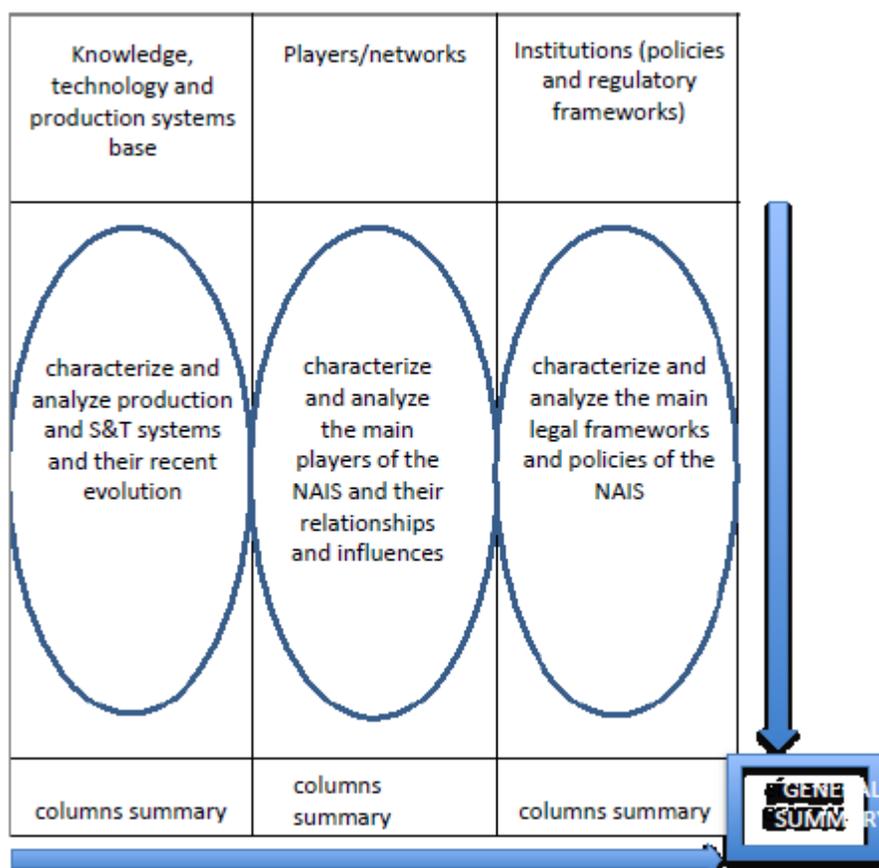


Figure 4: Integrator Analytical Framework of the NAIS (IAF)

The IAF serves as guidance on how to do the analytical integration and subsequently the summary of the NAIS diagnostic. In this way, the Guide is completed by a summary of what is drawn from the IAF.

The idea is to arrive at a final document which presents, in addition to the diagnostic provided by the Guide, a summary from which general conclusions on the NAIS can be drawn, thereby explaining the main reasons (public policies, national strategy, country conditions, trajectory followed, etc.) which led to the situation identified: is it an investor system in internal developments of the country?; what kind of investments are made?; are there local agents capable of playing a leading role in promoting innovation?; is it a system that fully “purchases” technology, knowledge and innovation?, etc. Thus, the IAF expresses the kind of system the country has, which trajectories are being followed and what are the most visible trends.

Once this summary is done, the IAF should present a group of suggestions describing what to do and why to increase capacity to innovate in order to create and appropriate value.

Questions such as: “what is the best system for our conditions and national strategies?”; “where should we go and with what objectives?” must be answered properly, since they are going to depend on the country and the guidelines of the country at a certain time, which refer to internal decisions aligned with other S&T, industrial, economic, social and environmental policies.

As was presented in the conceptual framework of the Guide, there is no single or ideal innovation system that must be sought by all countries. Each country must identify, in accordance with its own national policies and strategies, the weaknesses, strengths and trajectories to be followed in each NAIS.

One example of analysis with the IAS would be:

“In summary, the country’s NAIS presents a commodities focused production profile with non-commodities production ranges and with a strong predominance of supplies providers in innovation promotion. The local NARI, despite being historically present throughout the territory, has little influence on the system. On the other hand, producer associations are key entities in the process of promoting technologies and promote their adoption by producers, as well as training them to handle new technologies. The most influential legal policies and frameworks are precisely those which subsidize the acquisition of technologies (supplies) by producers, thereby characterizing a system that is modernizing itself much more than one which generates technologies and innovations locally. In regard to the processing and sales chain, the county’s system presents no developed industry and the agri-food system continues to be basically primary agriculture and, what’s more, an agriculture of low formal education based more on imitation than innovation capacity.

Investments in agricultural and agri-food R&D are relatively low and, above all, directed at public research not linked to the production sector. R&D investment policies are traditional and focused on adaptive technical production... Finally, the NAIS can be characterized as having low capacity for knowledge creation and appropriation, despite being a technologically up-to-date system in some crops, particularly commodities...”

4. Bibliography

- World Bank. Enhancing Agricultural Innovation: How to Go Beyond the Strengthening of Research Systems. 2006, 135p.
- Bin, A. & Salles-Fliho, S. 2008. Science, technology and innovation management: specificities and conceptual premises. In: International Joseph A. Schumpeter Society Conference - the southern conference, 2008, Rio de Janeiro. International Joseph A. Schumpeter Society Conference - the Southern Conference.
- Davis J. H. & Goldberg R. A Concept of Agribusiness, Division of Research, Graduate School of Business Administration, Harvard University, 1957
- De la Mothe, J.& Paquet, G. Systems of innovation. Kluwer Academic Publishers, 1998.
- Edquist, C. Systems of Innovation Approaches – Their Emergence and Characteristics. In: Edquist, C. (ed.), Systems of Innovation: Technologies, Institutions and Organizations. Pinter Publishers, Londres. 1997.
- Lundval, B.A. National systems of innovation: towards a theory of innovation and interactive learning. London: Pinter, 1992
- Malassis, L.; Padilla, M. Traité d'économie agro-alimentaire, Paris: Cuyas, 1986.
- Malassis, L. Economie Agro-alimentaire, vol. I Economie de la consommation e de la production agro-alimentaires, Paris: Cujas, 1979.
- Malassis, L. Economie agro-alimentaire. Paris: Ed. CUJAS, 1973. Tome 1.
- Malassis, L.; Ghersi, G. Économie de la Production et de la Consommation: méthodes et concepts. Éditions Cujas : Paris, 1996.
- Malerba, F. Sectoral systems and innovation and technology policy. Revista Brasileira de Inovação, v. 2, n.2; p.329-375, 2003
- MALERBA, F. Sectorial systems. How and why innovation differs across sector. In: Fagerberg, J.; Mowery, D.C.; Nelson, R. In: The oxford book of innovation. Oxford, University Press. 2006. Cap. 14. p. 380- 406.
- Malerba, F. Sectoral systems of innovation and production. Research Policy, Volume 31, Issue 2, February, 2002. Pág. 247 – 264.
- Malerba, F. Sectoral systems and innovation and technology policy. Revista Brasileira de Inovação, v. 2, n.2; p.329-375, 2003
- Nelson, R. (ed.). National Innovation Systems. A Comparative Analysis. New York/Oxford, Oxford University Press. 1993.
- OECD. Directorate for Science, Technology and Industry, Committee for Scientific and Technological Policy, "Manual de Oslo", Paris. 1996.
- OECD. Guide for the gathering and interpretation of data on innovation, "Oslo Manual," 2nd Edition. 2005
- RICYT/OEA/CYTED. Normalización de Indicadores de Innovación en América Latina y el Caribe, "Manual de Bogotá", Cuaderno de Indicios II, Buenos Aires, RICYT, 2001 (*Standardization of Innovation Indicators In Latin America and the Caribbean, "Bogotá Manual," II Book of Indicators, Buenos Aires, RICYT, 2001*)

Salles-Filho, S. L.M.; Avila, A F; Alonso, Juan Ernesto O.S.; Colugnati, Fernando A.B. M. Multidimensional assessment of technology and innovation programs: the impact evaluation of INCAGRO-Perú. *Research Evaluation*, Volume 19, Number 5, December 2010, pp. 361-372(12)