

Tropical Agriculture Platform (TAP)
Innovations in the Agriculture of Central America:
Progress, Institutional Capacity and Policy Needs
CIAT-FAO

Innovations in the Agriculture of Central America: Progress, Institutional Capacity and Policy Needs

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The opinions in this document are the sole responsibility of the author.

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ACKNOWLEDGEMENTS FROM THE AUTHOR

This paper has been commissioned by the International Center for Tropical Agriculture (CIAT) under the guidelines provided by the TAP (Tropical Agriculture Platform) Secretariat at the Food and Agricultural Organization (FAO), as part of the TAP Initiative.

Its purpose is to provide a Regional synthesis report on capacity needs assessment for agricultural innovation with capacity gaps identified and analyzed, including recommendations to strengthen agricultural innovation systems (AIS) and draft policy recommendations to address the capacity gaps. This study is part of the TAP Initiative and is targeted at Central America and selected countries in Africa and Asia.

Much appreciation is expressed for guidelines from the TAP team, collaboration from Simone Staiger-Rivas and suggestions from Eduardo Trigo, Francisco Enciso and Elcio Guimaraes. The author acknowledges the contributions of all those persons who responded to the questionnaire and provided interviews.

This final version of the paper incorporates suggestions received at the workshop of 24 April 2013 occasioned by the Central American Cooperation Program for Research on Basic Agricultural Products (PCCMCA) in La Ceiba, Honduras; at the meeting with consultants responsible for research in other regions within this study; from staff of the FAO and the TAP steering committee gathered in Rome on 2 May 2013; at workshops for the presentation of findings at the Secretariat of the Central American Agricultural Council (CAC) on 16 May 2013; at the workshop with senior staff from the Interamerican Institute for Cooperation on Agriculture (IICA), on 31 May 2013; and at a workshop with CIAT staff in Managua, Nicaragua on 14 June 2013. Comments from Karin Nichterlein and Philipp Aerni to the last version of the report, have helped considerably to clarify the presentation.

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ABBREVIATIONS AND ACRONYMS

AIS	Agricultural Innovation System
BCIE	Central American Bank for Economic Integration
CAC	Central American Council of Ministries of Agriculture
CAESPA	Center for Strategic Analysis and Policy (at IICA)
CATIE	Center for Research and Education in Tropical Agriculture
CEPAL	Economic Commission for Latin America
CFC	Common Fund for Commodities
CGIAR	Consultative Group of International Agricultural Research
CIAT	International Center for Tropical Agriculture
CLAD	Latin American Center of Administration for Development
CIRAD	Centre International for Research in Agriculture – France
COMIECO	Council of Ministers of Economy
CONICA	Commission for Research and Agricultural Education in Peru
CONCYTEC	Council of Science and Technology
COSUDE	Swiss Development Cooperation Agency
EU	European Union
FAO	Food and Agriculture Organization of the UUNN
FARA	Forum for Agricultural Research in Africa
FECAGRO	Federation Agricultural Producer Associations
FECALAC	Federation of dairy Industry Associations
FECESCABO	Federation of Beef Cattle Producers Associations
FHIA	Fundación Hondureña de Investigación Agrícola
FONTAGRO	Regional Fund for Agricultural Research
GFAR	Global Forum on Agricultural Research
HDI	Human Development Index
ICTs	Information and Communication Technologies
IFAD	International Fund for Agricultural Development
IICA	Interamerican Institute for Cooperation on Agriculture
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
INCAE	Central American School of Business Administration
INIAs	Generic name for National Agricultural Research Centers
INTA	Costa Rican National Agricultural Research Center
LAICA	Costa Rican Sugarcane Producers and Industry Association

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MAG	Ministries of Agriculture and Livestock
NAIS	National Agricultural Innovation Systems
NARS	National Agricultural Research Systems
OIRSA	Regional International Organization on Agricultural Health
PCCMCA	Central American Cooperation Program for Research on Basic Agricultural Products
PCP	Mesoamerican Scientific Partnership Platform
PITAs	Programs for research and technology generation, Costa Rica
PNIA	National Program for Innovation in Agriculture, Peru
PROMECAFE	Regional Program for Improvement of Coffee
RUTA	Regional Unit for Technical Assistance
SEARCA	Southeast Asian Regional Center for Graduate Study and Research in Agriculture
SICA	Central American Integration System
SICTA	Central American Agricultural Research System
SIDE	International Services for Agricultural Enterprise Development
SIECA	Central American Secretariat for Economic Integration

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SUMMARY

This paper has been prepared under the guidelines provided by the TAP Secretariat at the FAO, as a contribution to the TAP , an initiative of the G.20, which includes near 40 partners, facilitated by the FAO.

Its purpose is to provide a Regional synthesis report on capacity needs assessment for agricultural innovation, with capacity gaps identified and analyzed, including recommendations to strengthen agricultural innovation systems (AIS) and draft policy recommendations to address the capacity gaps. This study is part of the TAP Initiative and is targeted at Central America and selected countries in Africa and Asia.

This report was guided by the consideration that *Innovations in agriculture* are recognized as such when they are already used to some extent by producers. The stages preceding the use of innovations may include formal research or farmers' experimentation. Innovations in agriculture include technological and managerial alternatives.

Institutional capacity is understood in its broader sense as referring to a system which includes: legislation and rules of the game, which must be understood and fulfilled by all actors; policies, which, when properly implemented, provide guidelines for private actors' decisions and investments; organizations (public and private) which have adequate capacity (see below); mechanisms that facilitate interaction and partnerships among actors (platforms, networks, etc.) and *ad hoc* financial mechanisms (venture capital, competitive funds, etc.) to facilitate private investment.

Capacity of an organization is referred as the capacity to perform properly in a system. It requires amongst other things, qualified, motivated and well paid staff; efficient internal procedures; equipment; physical facilities; information systems that allow fulfillment of tasks; sufficient and timely funding; proactive attitude; and positive image. Therefore, improving the capacity of an organization requires investment and not just in training personnel.

The rationale for building capacity of innovation systems and participating organizations is most justified in the context of the need to assure the benefits of markets of technological and managerial goods and services accrue to all actors in agriculture. Also, such capacity is needed to be prepared to perform properly in growingly uncertain and challenging environments.

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The analysis here presented includes:

- A review of institutional and agricultural conditions in Central America, in order to identify particular aspects in the Region, which are of relevance to understand innovation and institutional issues in the National Agricultural Innovation Systems (NAIS)
- Analysis of innovations and arrangements within the value chains of several products in order to highlight specific aspects of innovations, factors influencing them and evidence regarding the role of different actors in these kinds on subsystems.
- Description of the functioning of the NAIS, in order to highlight, in particular, the role and conditions of the National Agricultural Research Centers (INIAs) as presumed central actors in these systems; and the participation of other actors.
- Analysis of the Central American Agricultural Research System (including CATIE and SICTA) to describe the activities they do, their contributions to institutional capacity and suggest actions towards this goal.
- Analysis of regional cooperation initiatives undertaken by international and bilateral agencies interested in providing assistance that will foster innovations in agriculture, and particularly to improve capacities.
- Recommendations to improve the capacity of the NAIS and to the TAP regarding possible actions this Initiative could undertake

The **methodology** included: A review of bibliographic references provided by FAO and CIAT and others in the author's files; statistical data and an institutional directory available at SIDE's files; an electronic survey of actors who are part of the NAIS in Central America; interviews with some of these actors; and workshops to discuss preliminary findings.

Highlights about the Region make reference to differences in income and therefore purchasing capacity, which are central to the direction agriculture in each country has taken to generate rural income and food security. Some countries prefer supporting basic crops for local food, while others encourage income generation options. The regional institutional base, both public and private, is important to allow regional larger scale programs to assure economies of scale in research. Economies of scale at country level do not support the idea of national systems in isolation, so rethinking the regional bodies is an issue addressed. A common market of 40 million people is an

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asset, as international trade agreements offer opportunities, and also challenges, to compete with importable products. Vulnerability to climate conditions is a major challenge and determines the need and the innovation possibilities in agriculture.

Regarding **agriculture**, the distribution of land reveals that almost 40 percent is dedicated to maize and beans, the basic food of the rural and urban poor. These lands are in turn the most fragile lands, they are located primarily on slopes; and very few farms have access to water for irrigation. In the cases of maize and beans farms the market drive is in general low; however it has proved to be positive in inducing innovations in a few cases especially in the case of beans. The rest of the land is on commercial crops as coffee, sugarcane, bananas, rice, oil palm and pineapples. Vegetables are grown in a small part of the area. Pastures account for as much as eleven million hectares, an amount equivalent to all crops referred above.

Less than seven percent of the land under cultivation is irrigated—a very small proportion. Most irrigated lands are under cultivation with sugar cane and rice. There is significant potential to improve productivity and income through using water and irrigation technology for maize, beans and vegetables.

The food import bill is growing and the agricultural export portfolio, favored by trade agreements, is at risk due to the low purchasing capacity of developed countries and overvalued exchange rates in the Central American countries. The vulnerability of agriculture makes productivity more variable and at the same time adds to risk aversion. Innovations must seriously consider how to overcome this challenge

Regarding **policies influencing innovations in agriculture**, they come from many authorities, including the ministries of agriculture. The most influence is exercised by ministries of the economy and trade. Inter ministerial coordinating mechanisms are very limited and tend to function for specific matters and short term emergency situations. There is a need to review policy instruments to cope with new challenges; in addition, institutional capacity for policy implementation is limited. Influence on policies also comes from export-oriented value-chain organizations, as well as among those seeking commercial protection

Innovations along value chains reveal important arrangements which influence innovations. They are influenced by market drive as a force; the pull effect exercised by agroindustry; the influence of leading enterprises; the role of producer organizations, as

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a force to stimulate the extension of innovations. Complementary roles are played by various other institutional actors. Public and private sector actors related to the agricultural chains have similar capacity constraints; however the importance of budgetary limitations is greater in public entities, while lack of incentives is more significant in the private sector.

Regarding **actors in the national agricultural innovation system**, two points are emphasized: First, the systems include a wide array of such actors and recognize the several means through which they interact, including alliances, contracts or just market relations. Second, in the case of Central America, nearly 1 000 such actors have been identified and all of them play a role in the system and have particular interests.

In relation to the **functioning of the NAIS**, the capacity and role of the INIAs to stimulate and facilitate interaction between actors is very limited; alternative entities must be created for this role. Limitations in capacity are also evident among other actors in the NAIS, affecting their effective participation. Among the weaknesses in the systems is the absence of facilitating mechanisms as platforms, and of financial mechanisms, as venture capital, competitive funds, among others.

Regarding the **Regional Agricultural Research System**, CATIE has made valuable contributions to the development of human resources for research and education, with beneficiaries from all Latin American countries and some from other countries. Also, the outputs of research are well recognized throughout the region. SICTA has played a useful role in facilitating the dissemination of knowledge on relevant research issues and in the upgrading of research staff at the INIAs, there is a strong need to rethink its role and functions and to include the participation of more actors beyond public research entities. Both CATIE and SICTA have the potential for a more significant role in support to the development of institutional capacity for agricultural research and innovation. For this, they need this subject matter to be in their agenda and program structure; and to have the personnel with the required qualifications.

International cooperation in agriculture, especially in the form of regional and national projects, is abundant and dispersed. It has been of help in improving the capacity of personnel, facilitating mechanisms for interaction among the national agricultural entities, and contributing to the quality of research. However, there is no strategy, nor evidence, that the capacity of public and private sector institutions has been improved thanks to the contributions of the agencies and projects related to international cooperation in agriculture.

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Before specific **recommendations** in the three pillars of TAP, a general and most important suggestion to the TAP Secretariat is to convey a Task Force that utilizes the suggestions made in the Regional capacity assessments to present a proposal for actions. On this regard it should be recognized that TAP is a forum of near forty international organizations, which can make group recommendations, yet it is not an executing agency. On the other hand, there is not currently a specialized body with operational capacity to undertake the tasks which have been recommended in this study, and summarized below.

Considering that this has to be a multidisciplinary effort, it is suggested that the Task Force of TAP is defined considering the potential contributions of international organizations as the World Bank, IADB, IFAD, FAO, IICA, CGIAR, GFAR and other agencies willing to commit to work on these issues. Regional work plans should be considered. This Task Force should generate a strategy and to seek adequate funding, as *seed money* to promote country level strategies and investment programs in close relation with loans for agriculture. Their effort needs to be heard by a wider audience of national authorities that can make decisions on this matter. Of particular relevance is to convey the message to ministers of Planning and ministers of Finance, as improving institutional capacity requires funding, not usually included in current allocations.

This Task Force could use existing Fora to gain support. This includes for example the FAO Regional Conferences, the banks' annual meetings, the Interamerican Board of Agriculture (conveyed by IICA) and others. However, most important is to have first an action plan. The Task Force would benefit from contributing its message at key country level Fora for discussion if these issues.

Below are the specific possible recommendations to governments, which TAP should consider when giving guidelines to the above suggested Task Force in order to elaborate its proposal for action. Following the TAP Secretariat guidelines, the **recommendations** are organized in the three blocks of the TAP strategy: Policy Dialogue, Market Place and TAPipedia. Even though these recommendations apply mainly to the case of Central America, they are of relevance for other regions.

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On Policy Dialogue:

- Considering the many policies influencing agriculture and food supply and particularly innovations in agriculture, governments would benefit from creating agricultural councils, in which the relevant ministers participate. Leadership could be provided at presidential level for the council to have political clout and the minister of agriculture could lead the Secretariat. Representatives of the private sector in agriculture and the food industry could be invited to participate in the Dialogue and in defining policies.
- As a result of the Dialogue, governments must define the most essential policies and commit public resources to high quality strategic research in public entities, together with support for other actors through competitive funding for research, leading to public goods.
- There should be pressure for research to respond better to the needs of those most dependent on agriculture. This is necessary to take advantage of the Regions' biodiversity and the challenges they faces on food security and adaptation to climate vulnerability. Attention on this matter must reach the highest authorities and leading producer organizations.
- Dialogue and action should be taken soon, in order to shift international cooperation from technical assistance to well-conceived programs that contribute to improve institutional capacities. On this, it is not enough the traditional reorganization and the training of personnel. Investments are needed to improve institutional capacity, including improved management, equipment, resources, planning and evaluation systems, Hiring of qualified personnel and paying better salaries and providing incentives, etc.

On Market Place:

- Fostering innovations in agriculture happen in the context of a changing scenario, where communications and market relations play a major role at national and global level, and where multiple actors have much to contribute. Thus, promoting interaction, partnerships and technology related business must be encouraged.

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- Recognizing the low capacity of the INIAs, an option is to create a public-private council with a technical secretariat with responsibility for leading the functioning of the NAIS, and with a more profound view of market relations. For this purpose, guaranteed government funding, as well as partners' contributions and commitment, must be assured and followed up to evaluate results.
- Mechanisms must be created that allow more intensive participation of actors in the NAIS, including competitive funds, platforms, networks that are not limited to researchers in public entities, and incentives for cooperation among actors in the value chains, with others in the NAIS.

On TAPipedia:

- NAIS should evolve towards stronger international relations through networking, for which the CGIAR Centers, FAO and the regional organizations could provide guidelines and assistance.
- Public agricultural sector entities and producer organizations should extensively share innovations in agriculture. Those referenced in this study in the case of Central America are only a sample of the many alternatives and cases.
- Advance documentation of costs and benefits must be made to improve the credibility of recommendations. Using renewed methods to extend knowledge like Information and Communication Technologies (ICTs) with a higher quality of useful information requires much support, especially to reach more actors. Encouraging young people into small agricultural businesses and molding children on positive attitudes towards agriculture and nature has proved useful and must be pursued.

A final comment: ISNAR had a mandate on assisting countries to build agricultural research. The research and innovation systems have evolved substantially. A renewed approach is necessary. ISNAR, has not been replaced by a substantive effort to support the development of agricultural innovation systems within the scope of the challenges ahead, and there is a gap in international cooperation on these aspects. Therefore, the suggestion made regarding a Task Force to make proposal on this matter is commended.

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1. INTRODUCTION

1.1 Background

This study is part of the Tropical Agriculture Platform (TAP) an initiative of the G.20, which includes near 40 partners, facilitated by the FAO. Through the TAP, the partners seek to support the development of agricultural innovation systems in the least developed agricultural countries. The first step is to conduct regional needs assessments, as well as regional reviews of ongoing initiatives, to improve institutional capacity development. Research teams in Central America (CIAT), Africa (FARA) and Asia (SEARCA) are carrying out the regional needs assessments.

This paper has been commissioned by CIAT under the guidelines provided by the TAP Secretariat at FAO, as a contribution to the TAP Initiative. Its purpose is to provide a Regional synthesis report on capacity needs assessment for agricultural innovation with capacity gaps identified and analyzed, including recommendations to strengthen agricultural innovation systems (AIS) and draft policy recommendations to address the capacity gaps. This study is part of the TAP Initiative and is targeted at Central America and selected countries in Africa and Asia.

Although the study focuses on Central America (seven countries) the findings are relevant for other countries in Latin America, and hopefully also for countries in other regions. Moreover, the issues addressed in the study, in the context of tropical agriculture, are also valid for capacity development for innovations in agriculture in other non-tropical environments.

1.2 Some caveats

The rationale for building capacity of innovation systems and participating organizations is most justified in the context of the need to assure the benefits of markets of technological and managerial goods and services accrue to all actors in agriculture. Also, such capacity is needed to be prepared to perform properly in growingly uncertain and challenging environments. On this regard, this study has differentiated two concepts: institutional capacity and the capacity of an organization.

Institutional capacity is understood in its broader sense as referring to a system that includes legislation and rules of the game, which must be understood and fulfilled by all

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actors; policies, which, when properly implemented provide guidelines for private actors' decisions and investments; organizations (public and private) which have the adequate capacity (see below); mechanisms which facilitate interaction and partnerships among actors (platforms, networks, etc.) and *ad hoc* financial mechanisms (venture capital, competitive funds, etc.) to facilitate private investment.

Capacity of organizations means the capacity to perform properly in a system. It requires, amongst other things, qualified, motivated and well paid staff; efficient internal procedures; equipment; physical facilities; information systems which allow fulfillment of tasks; sufficient and timely funding; proactive attitude; and a positive image. Therefore, improving the capacity of an organization requires investment, and not just in training personnel.

For in depth discussions on these matters, the reader is referred to North (1997), the World Bank Report-2002 on Institutions for Markets (2002); the World Bank Report-2008 on Agriculture (2008); the WTO Notes on Good Government and Institutions in their Annual Report for 2004; Piñeiro (2009) and other authors who explain the importance of investment in institutional capacity in particular, to cope with new challenges, including those brought by the liberalization of markets.

A brief comment on innovations in agriculture: This report was guided by the consideration that *Innovations in agriculture* are recognized as such when they are already used to some extent by producers. The stages preceding the use of innovations may include formal research or farmers' experimentation. Innovations in agriculture include technological and managerial alternatives.

1.3 Levels of analysis and hypothesis

The analysis here presented includes:

- A review of institutional and agricultural conditions in Central America, in order to identify particular aspects in the Region, which are of relevance to understand innovation and institutional issues in the National Agricultural Innovation Systems (NAIS)
- Analysis of innovations and arrangements within the value chains of several products in order to highlight specific aspects of innovations, factors influencing them and evidence regarding the role of different actors in these

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kinds on subsystems. Although only a few cases are analyzed, the objective is that the diversity of conditions in them provides suggestions for other cases.

- Description of the functioning of the NAIS, in order to highlight, in particular, the role and conditions of the National Agricultural Research Centers (INIAs) as presumed central actors in these systems; and the participation of other actors.
- Analysis of the Central American Agricultural Research System (SICTA) to evaluate its effectiveness and suggest aspects for the review of its mandate and instruments.
- Analysis of regional cooperation initiatives undertaken by international and bilateral agencies interested in providing assistance that will foster innovations in agriculture, and particularly to improve capacities.
- Recommendations to improve the capacity of the NAIS and to the TAP regarding possible actions this Initiative could undertake

The hypotheses which follow are specific to of each the levels of analysis.

Regarding the agriculture of the Region and its institutional base:

- There is a substantial duality in agriculture, with a large sector of small producers that grow primarily maize and beans, have low market drive, and have limited organization; and commercially oriented agriculture that grow many other crops and livestock, which have a value chain approach, value adding orientation and usually are better organized.
- Policies influencing agriculture come from many authorities, including the Ministries of Agriculture and their collateral sectoral entities; but the most influential are the ministries of the economy and trade.
- Institutional capacity is in general limited, and it is more notorious in the public and private entities of the agricultural sector

Regarding innovations in value chains:

- Innovations in agriculture are diverse and tend to be particular to specific crops and livestock within agricultural chains in which several partners interact.
- The extent of innovations and the benefits provided are varied and are explained by many factors, including structural conditions in agriculture, and the

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participation of actors, as well as the influence of providers of inputs and services, the role of producer organizations, and market forces.

- The quality of research outputs is determined by the potential of innovations and their utilization by agricultural producers.
- Policies are central to improving the capacity for performance of actors in agricultural chain innovation systems but also to create an adequate environment; some policies are biased towards interest groups and are not in place to benefit all producers.

Regarding national agricultural innovation systems:

- The number and diversity of actors in the NAIS are many, including the INIAs, universities, producer organizations, research centers and private firms related to the business, and to inputs, seeds and services, which make possible the producers' innovations; hence there is a need to revise current views about a narrower set of actors.
- The INIAs, responsible for public sector research and leaders of the NAIS, have very limited capacity to play both roles.
- The actors in the NAIS interact weakly through partnerships and only slightly better through markets, because they lack instruments that facilitate interactions.

Regarding the Regional Agricultural Innovation System in Central America (SICTA):

- Given that the NAIS in the Central American countries have serious constraints, a regional system sustained in such weaknesses, has limited capacity.
- The number and variety of actors in Central American agriculture offers a possibility for a wealthier Regional Agricultural Innovation System.
- The Central American Agricultural Research System (SICTA) has made valuable contributions, yet its redesign is necessary.

The role of international cooperation

- Cooperation for agriculture in Central America is abundant and dispersed.
- Some international actors contribute to generating and making available technological innovations; fewer contribute to management-oriented innovations.

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- They made fruitful contributions to improve the quality of human resources with responsibility for research, but very limited contribution was made to the development of institutional capacities of the NAIS and the SICTA.

Although the study places special attention on innovations and institutional aspects that have direct implications for small-scale producers, it makes clear that there are no AIS that are specific for those producers. Also, even though the study refers to the Central American Region, the differences amongst the seven countries are obvious, as the institutional setting, capacity of public and private sector organizations, levels of education of producers, etc. contribute to creating differentiated conditions for innovations in agriculture.

1.4 Methodology guidelines

The methodology guidelines were provided by the TAP Team and they are included in the Annex 1. The methodology was described as a desk study, with resources allocated for that purpose. Field work was not anticipated. This study is based on five sources of information:

- Review of bibliography, including references provided by FAO and CIAT and others available in the author's files
- Statistical data and an institutional directory available in SIDE's files
- Survey of actors who are part of the NAIS in Central America
- Interviews with some of these actors
- Workshops to discuss preliminary findings.

For the Central America study, the Consultant and CIAT suggested a questionnaire for a survey to some actors in the NAIS. The questionnaire received additional suggestions from the TAP Secretariat and it was adopted for the three regional assessments (Annex 2).

The figure below indicates the origin of the sample of respondents to the survey, a fact that assures diversity of opinions from different perspectives. A total of thirty-three actors responded to the questionnaire from a total of one hundred that received it. The sample of one hundred was taken at random from the original file provided by SIDE, and included persons in seven groups of actors: working at a national public institution,

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international public institution, private sector organization, international private sector enterprise, university, supplier of technical assistance and managers of private forms in agriculture. Private sector organizations included representatives from producers in several scales and dedicated to different products.

The questionnaire utilized to gather the opinions is included in Annex A. Given that the numbers of respondents is limited and also given that many of the responses are qualitative, no statistical analysis was performed for the opinions.

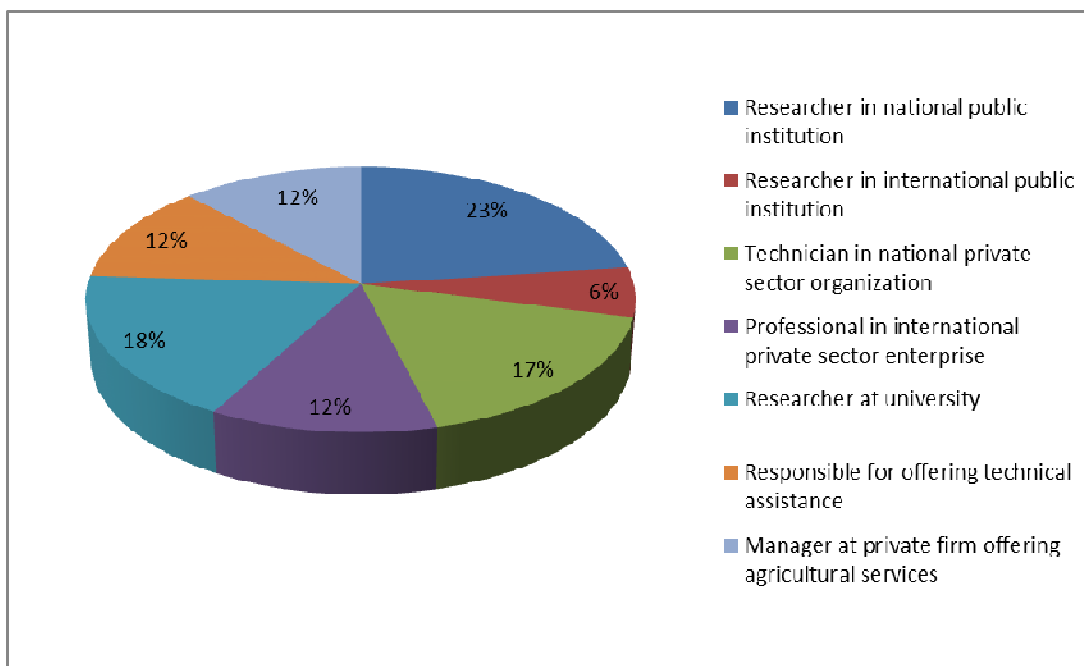


Figure 1. Current activities of actors who responded to the questionnaire

Source: Survey of 33 actors in the Central America AIS

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2. CENTRAL AMERICA IN CONTEXT

This section of the report provides information on the regional institutional base and the socio economic similarities and disparities in The Region. References to particular country conditions are reported as needed.

2.1 Regional institutional setting

The Region is made up of seven countries related through a regional institutional framework which includes the Central American Integration System (SICA) which brings together heads of state; the Central American Trade Secretariat (SIECA) made up of trade ministers; the Council of Economic Ministers (COMIECO), and the Central American Bank for Economic Integration (BCIE). Related to agriculture is the Regional Organization for Animal and Plant Health (OIRSA) which also includes Mexico, and the Agricultural Council (CAC), both involving the ministers of agriculture (all these bodies have permanent secretarial units); and the Regional System of Agricultural Research (SICTA) made up of the managers of the INIAs.

Several of the national agricultural producer-chain organizations have created regional federations. They include the ones for leading sector entities (FECAGRO) dairy cattle and industry (FECALAC), beef cattle and industry (FECESCABO) poultry (APAVIC), among others. They played an important role in the negotiations of the regional trade agreements and in the regional dialog on health and food safety regulations.

At the national level, the capacity of the public sector to undertake current challenges is often questioned, particularly because of the obsolescence of public institutions (Estado de la Region, 2011). Weaknesses in the public sector have given rise to well organized private sector organizations, which lead policy definitions for their own benefit. All countries have a powerful leading private sector council, which is very influential.

An important feature of the Region is its free intraregional trade condition. This was created in 1962, with the Limon Protocol, which established free trade among all local countries except for Panama and Belize. A special agreement to include Panama was signed in 2005. Free trade with Belize is under negotiation. Most agricultural products are under this regime, except for sugar and coffee. Delays in complementary rules limit

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the free trade of grain seeds; hence they circulate within the region without clear differentiation from regular grains.

In the last decade, the Region also signed free trade agreements with Mexico, Canada, the US and Europe. Although access to the US markets is free of tariffs, biosafety regulations are still a factor that limits exports for some countries. In the case of the EU, the agreement was signed two years ago and actual implementation is at a very early stage. In both cases there are complementary resources to assist Central American governments and companies to improve export capabilities.

All the above allows The Region, of near 40 million people, to be an important market for all member countries, and also for other regional countries and companies interested in the local markets. Export opportunities under these treaties should drive innovations in agriculture, as in fact they have in recent years.

2.2 Disparities and commonalities

The similarities and differences among countries are shown in Table 1. Although the countries do not have substantial differences in territorial and population dimensions, there are some differences in income and poverty. El Salvador and Belize are the smaller countries and Nicaragua is the largest. El Salvador is the most densely populated and Belize the least densely populated.

Table 1. Central America: summary of basic indicators

Indicator	Area	Population	GNP per capita	Poverty % a/	Position In the IHD	Gini Coefficient b/
	1000 SKM	Millions, 2009	Dollars, 2008	2008	2007	2005
Belize	22.96	0.56	2,231	26,7	--	--
Costa Rica	51.10	4.40	5.031	22,8	48	0,478
El Salvador	21.04	6.99	2.657	32,3	101	0,493
Guatemala	111.99	13.02	2.710	51,0	118	0,543
Honduras	112.49	7.37	1.159	67,8	117	0,587
Nicaragua	131.49	5.52	958	48,3	112	0,579
Panamá	78.00	3.28	5.217	36,8	58	0,548
Total	529.07	41.14	--	--	--	--

a/ Percentage of population below the poverty line

b/ Zero indicates absolute equity

Source: Estado de la Región, 2011

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Poverty in general and rural poverty in particular, in some of the countries, is still significant. Honduras has the largest poverty index, but Guatemala, being bigger than other countries, is the one with the largest number of poor. Costa Rica and Panama have the highest per capita income. Except for Costa Rica and Panama, all other countries rank low in the Human Development Index (IHD).

The political economy and the national institutional setting are factors to consider when analyzing innovations in different sectors of agriculture where large entrepreneurs, and in some cases, corporations, and poor peasants, are the dominant actors. Some of the countries, like Guatemala and El Salvador have gone through serious socio-political conflicts that have interrupted democracy. Land and its distribution have been leading issues in these conflicts. Polarization among segments of society is significant.

The countries of The Region share the same agro-ecological characteristics, with humid tropics on the Atlantic side and dry tropics on the Pacific side, with a larger proportion of the population in the latter area. In between the two areas are mountains of fragile lands, where most small-scale farming takes place.

Central America has two liabilities. On the one hand it has been recognized as the most climate-vulnerable region in the world (<http://www.germanwatch.org/klak/cr106.pdf>), a condition of much significance for agricultural decisions related to innovation. On the other hand, there is the increasing violence and corruption. In a recent meeting in Guatemala the World Bank representative highlighted that in Central America eight percent of GNP is destined to cover the public and private security bill (Guatemala Investment Summit, June 1, 2013). These facts are a deterrent to private investment, both foreign and national.

2.3 Conclusions

The highlighted issues about The Region are important for several reasons when defining a strategy for innovation in agriculture and the associated institutional capacity that is needed:

- The differences in income and therefore purchasing capacity are central to the direction that agriculture should take to generate income and food security. As observed below, some countries prefer supporting basic crops for local food, while others encourage income generation options

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- The regional institutional base, both public and private, is important to allow regional larger scale programs to assure economies of scale in research. The economies of scale at country level do not support the idea of national systems in isolation, and rethinking the regional bodies is needed.
- A common market of 40 million people is an asset, as international trade agreements offer opportunities, and also challenges, to compete with importable products.
- Vulnerability to climate conditions is a major challenge and determines the need and the possibilities for innovations in agriculture.

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3. AGRICULTURE AND ITS EVOLUTION

3.1 Agriculture in the economy

Primary agriculture in Central America contributes between 6 and 18 percent of GNP (in Panama and Nicaragua respectively), and when agroindustry is accounted for, the figures rise to 10 to 30 percent respectively. The economic importance of agriculture is in many territories, not just the one where the capital city is located, and is important as a source of income and employment. Only in Costa Rica are there other activities, such as ecotourism and agroindustrial *Free Zones*, which are important in rural territories. *Free Zones* are tax exempt clusters where export oriented industries are located. In Costa Rica there are some for pineapple processed fruit and juice, orange juice and tilapia.

Within agriculture, the livestock sector varies between 16 and 37 percent of agricultural value, as cattle, pigs, goats and poultry are important sources of income, food and assets for rural families. This is relevant when discussing innovation needs in agriculture, which in this region should not be limited to crops.

Although agriculture is not, in all cases, an important part of GNP, the agricultural labor force is a major proportion of the total labor force, especially in Guatemala and Honduras (see Figure 2.). Its productivity is low in comparison with other countries, which explains the low wages in agriculture and the magnitude of rural poverty.

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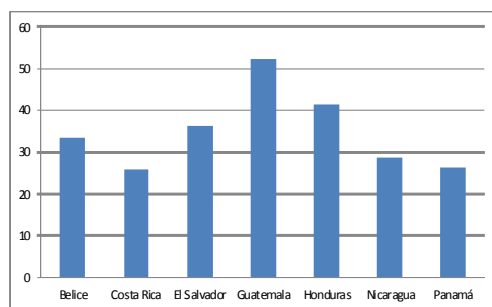


Figure 2. Central America, the relative participation of agricultural labor force in the total labor force (2009)

Source: Pomareda and Chavarría, 2011

Note: The vertical axis indicates the percentage of agricultural labor force on total labor force

3.2 Land in agriculture and other uses

The territory of Central America includes forests, lakes, pastures and crops, distributed as indicated in Table 2, below. Within agricultural land there are some important developments. On the one hand there is a decline in pasture land and on the other, an increase in permanent crops and a decline in annual crops. Among perennial crops is coffee, fruits, oil palm and bananas; but also two to five year crops such as pineapples and sugarcane.

Table 2. Central America, land utilization, 1990 and 2005 (thousand hectares)

Variable	1990	2005
Territory	49,864	49,864
Use of Land	48,793	48,793
Total Arable	7,793	7,799
--Annual Crops	6,182	6,866
--Permanent	1,611	1,903
Pastures	13,255	11,944
Forests	25,986	20,758

Source: CEPAL

Forests cover most of the land, yet the quality varies by country and within each country, by zones. Deforestation for extraction of wood and, thereafter crops and later on, pasture, still continues, yet at a slower rate than in the past. Agroforestry systems

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have been encouraged for cattle production, with limited success, due to the longer time frame needed to restore forests and renew pasture species. Given the above, innovations for sustainable land management as the payment for environmental services, are most important and offer major opportunities for a renewed vision based on bio economy principles.

Cropland use is distributed in the following way: Basic grains (maize, beans and rice), on average account for near 40 percent of cultivated land (60 percent in Guatemala). Export-oriented crops (coffee, sugar cane, oil palm, banana and pineapple) use around 45 percent of the cultivated land, with some variations among countries. Vegetables, cassava, fruits and other crops, add another 15 percent. Pasture is not included in this subtotal.

Figure 3 shows that in the last 30 years the five major crops have remained relatively unvaried and still account for 67 percent of the area cultivated. However, among the other 22 other crops there are important variations such as the large decline in cotton, wheat and sorghum, and important increases in pineapple, oil palm, nuts, vegetables, oranges and other fruits.

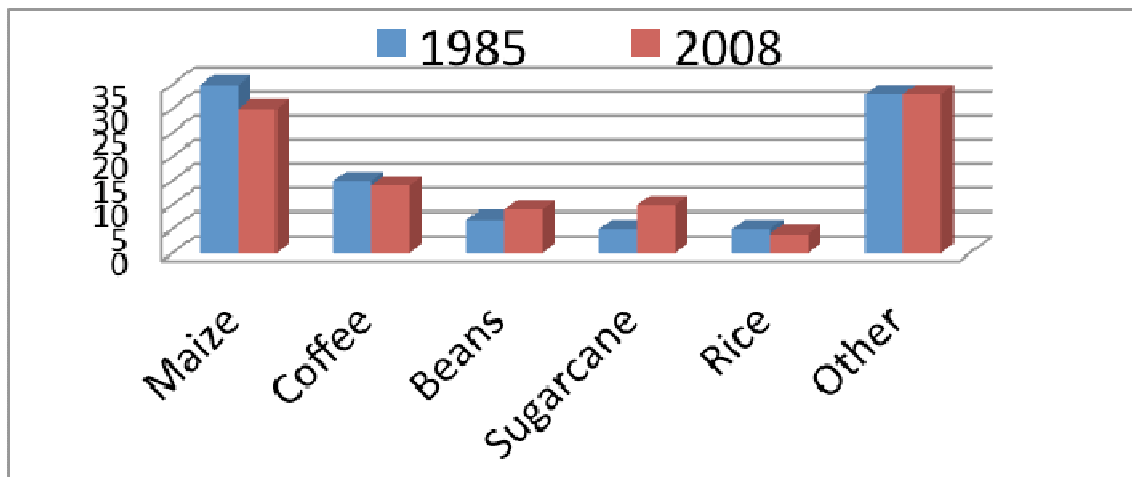


Figure 3. Share of different crops in the total area cultivated (1985 and 2008)

Source: FAOSTAT

Note: The vertical axis indicates the percentage of area cultivated that each crop represents in the total area cultivated

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Most small-scale farmers produce maize and beans, mainly in low fertility soils in hillsides, without irrigation and in highly climate-vulnerable environments. Table 3 indicates that 1.1 million small-scale producers produce maize and another 0.6 million produce beans. It should be noticed that given that some produce only one crop and some both, the total number is estimated around 1.2 million and not 1.7 million.

The average area cultivated with maize is 1.30 hectares and 0.87 hectares for beans, with much smaller areas in Guatemala (0.46) and Honduras (0.57). In most cases the production of maize and beans is for home consumption. Sales vary between zero and 60 percent of total production for maize and up to 95 percent for beans (SIDE, 2013). Small-scale producers derive part of their income from agriculture and the rest from off-farm work, which has implications for the dedication of time needed to innovate. Giving away reasonably stable, although low, off-farm income, in order to dedicate more time to the farm for uncertain income, is not an easy decision.

Table 3. CA maize and beans, number of producers, total area and average area per farm (2007)

Country	Maize number of producers	Area planted has	Average area Planted Ha/farm	Beans Number of producers	Area planted has	Average area planted Ha/farm
Costa Rica	3,000	7,288	2.43	8,000	16,349	2.04
Guatemala	589,377	589,960	1.00	292,961	135,000	0.46
Nicaragua	141,300	344,610	2.44	114,976	252,545	2.20
Honduras	268,152	304,284	1.13	205,000	117,806	0.57
El Salvador	151,173	247,341	1.64	78,171	87,100	1.11
Total	1,153,002	1,493,483	1.30	699,108	608,800	0.87

Source: RedSICTA, Mapeo de las Cadenas Agroalimentarias de Maíz y Frijol en Centroamérica, con datos de la FAO y de los Ministerios de Agricultura de la Región

Nearly 350 000 small agricultural producers keep cattle. This segment of producers is in a slightly better position than those limited to producing only basic grains. In the smallest operations, this activity is managed by the wife and children, who often process the milk to make white cheese and cream for home consumption and for close family and neighbors. Other farms sell their milk to nearly 2 000 microprocessors who produce artisan cheese and cream for local markets. They also sell their animals to around 580 rural slaughterhouses. Innovation in these small rural industries is a major demand, in order to comply with food safety standards and to add quality and value to livestock products.

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Amongst export-oriented crops there are some important differences. Coffee is produced by approximately 220 000 producers. Most of them grow between one and three hectares, an area that provides between two and five thousand dollars of gross family income per year, compared with 650 dollars for maize in the same area. Cacao is a product that provides complementary income to some of the poorer producers. Bananas, sugarcane and pineapples are produced primarily by corporations and large producers; although in some countries there are medium sized operations. All these crops, plus coffee, are the main sources of employment for the rural poor. Vegetables and fruits are grown mainly by smaller producers and are an important source of family employment. Some of the producers abandoned the production of basic grains and others still produce some for family food and generate income-producing vegetables. Few small vegetable producers have very low scale, modern drip irrigation.

The agriculture of Central America is basically rainfed. The total area irrigated adds up to less than seven percent of the total currently cultivated land. Sugarcane and rice account for the majority of irrigated land. Production of vegetables under drip irrigation and also in tunnels and green-houses, is growing, yet it is far from its potential. Drainage systems are limited to some banana and oil palm plantations; but the absence of these facilities causes much soil deterioration and crop losses in the Atlantic coastal region.

An important issue on small-scale agriculture concerns the choice between innovations to continue producing maize and beans; and/or innovations to produce other crops. Costa Rica is the only case where there has been a significant shift to other crops among maize and beans producers. As a result, there was improved income for producers and important benefits in the rural economies, together with a substantial rise in vegetable exports; but another consequence was a growing import bill for beans and maize. Lower scale changes towards vegetables and fruits are observed in Guatemala and El Salvador. Alternative perceptions about food security goals and international market risks influence national policies on this matter: while Costa Rica trusts a dependence on international markets, Nicaragua, Guatemala and Honduras prefer to produce their basic staples, (yet not enough to cut imports) in the case of maize at least.

3.3 Productivity gaps

Average productivity has grown slowly and has been almost nil in basic grains, with a few exceptions by crop and country (i.e. maize in El Salvador and rice under irrigation in Costa Rica). There are important increases in productivity in sugarcane and bananas.

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Other crops such as pineapples had high productivity when introduced. Had weather conditions been more stable, productivity of all crops would have had a larger average and smaller standard deviation within one year (within regions of a country), and between years.

Changes in yields in Central American agriculture deserve to be qualified in several cases. For example in sugarcane there are improvements in the content of sucrose and reduction of foliage (which allows easier harvest); in coffee, there are reduced gains in kilos per hectare, but improved quality of coffee beans; and in dairy, the improvements are in kilos of solids per fluid milk and absence of undesirable bacteria, etc. All these changes, as will be shown later, are the result of innovations.

Production over time grows through productivity and land utilization. Figure 4 shows that in basic grains the increases in production have occurred mainly due to the increase in areas planted, but much less in yields.

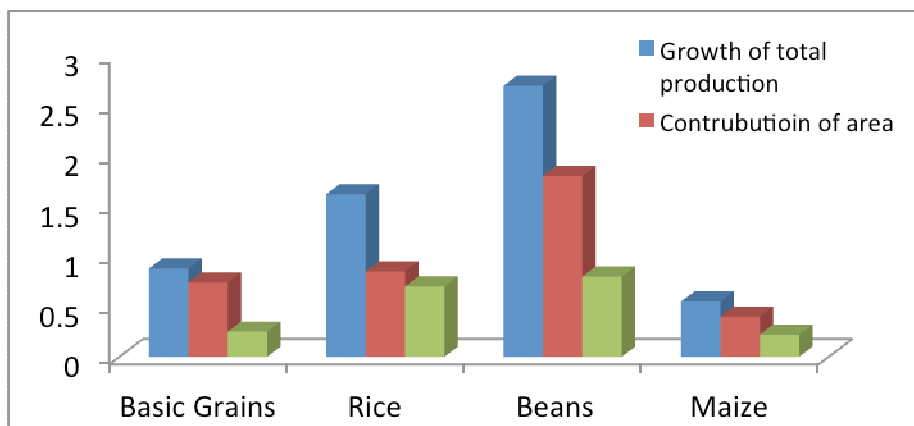


Figure 4. Central America, basic grains, growth rates of production, area cultivated and yields (1985 through 2008)

Source: Pomareda and Chavarría, 2011

Note: The vertical axis indicates the percentage growth of total production (blue column), of area planted (red column) and of yields (green column)

Comparing productivity of crops in the Region with that in other countries was not considered appropriate, due to substantial differences in varieties, farm size, current levels of fertilization, mechanization, etc. Comparing within the region and within each country was considered an option. Table 4 shows the potential to increase productivity when comparing data on farmers' fields, experiments in farmers' fields and results at the

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research stations, for two crops. A point to highlight is management. The table shows yields in maize in well managed and poorly managed (non progressive) farms.

Table 4. Indices of productivity in white maize and sugar cane in Costa Rica (2012)

Crop	Conditions at experiment station	Conditions in demonstration fields	Conditions at progressive farms	Conditions at non progressive farms
Maíze	100	80	65	30
Sugarcane	100	90	80	--

Source: Consultations of the author with researchers at LAICA (for sugarcane) and INTA (for maize) in Costa Rica

The next table illustrates the importance of irrigation as a key factor in increasing productivity and reducing instability in yields. In non-irrigated rice, yields are smaller and have a larger variation over time. With irrigation, two harvests per year are possible. The yield shown in Table 5 belongs to the total of the two harvests.

Table 5. Yields of rice with and without irrigation in Guanacaste, Costa Rica, 2008 to 2011 (kilos per hectare)

Production System	2008	2009	2010	2011	Average
Irrigated (Cañas)	12,300	11,450	12,140	11,050	11,135
Rainfed (Bagaces)	3,400	2,700	3,900	3,000	3,250

Source: Information provided to the author by producers of rice in Cañas and Bagaces, Guanacaste, Costa Rica.

This section has shown that changes in production of basic grains have emerged primarily from increases in area planted, as productivity has changed very little. In other crops there are some improvements. The potential to increase yields and quality is substantial through irrigation as it makes important differences for improved productivity and incomes of producers, for reduced vulnerability and the introduction of new crops. Research is needed to evaluate yields and incomes from small scale production of crops under irrigation, especially for vegetables under drip irrigation.

3.4 Agricultural and food trade

Agricultural products, primary and processed, were, until the 1980s, dominant in the export portfolio. On average they now represent 45 percent of total exports with a much lesser proportion in Costa Rica (28 percent) and much larger in Nicaragua (89 percent).

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Imports of agricultural products and inputs for agroindustry, such as soybeans and maize for animal feed, together with wheat and powder milk, have grown substantially. Imports of processed products are also growing due to higher incomes. They are projected to increase even further. In some products there is an absolute dependence on imports from out of the regions, as in the cases of yellow maize, wheat and soybeans. Nevertheless, the total agricultural and food import bill reaches only 22 percent of total imports.

Intraregional trade of agricultural products is also growing, especially exports of beans and artisan cheeses from Nicaragua to El Salvador and Guatemala, and exports of higher quality dairy products and other processed products from Costa Rica to all countries in the region.

3.5 Vulnerability to climate conditions

An important issue related to the nature of rainfed agriculture in Central America, relates to risk aversion. Small producers rely substantially on local traditional technologies because they consider that their basic food supply is at risk through innovations. The issue is very relevant, as this socioeconomic factor must be considered in the strategy to encourage innovations.

The references made here to structural conditions, specific products and other issues; highlight the main features of the agriculture of The Region. They refer to: the high duality of the agricultural structure; a large dominance of small-scale hillside farming; a variety of crops which render different income and employment; climate vulnerability; absence of irrigation; and related matters. They are aspects to be aware of when either analyzing innovations necessary to generate higher income to small-scale producers or considering the policies needed to increase production of maize and beans for basic food supply.

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3.6 Conclusions

The distribution of land reveals that almost 40 percent is dedicated to maize and beans, which in turn are on the most fragile lands on the slopes; very few farms have access to water for irrigation.

The agriculture in The Region is practiced by a very large number of small producers, many of them producing primarily maize and beans for home consumption and a small proportion for sales. In these cases the market drive is low; however it has proved positive to induce innovations.

A very small proportion of the land under cultivation is irrigated, less than seven percent. The potential to improve productivity and producers income through water utilization and irrigation technologies is significant in maize and beans, but especially in vegetables.

The food import bill is growing and the agricultural export portfolio, so far favored by trade agreements, is at risk, due to the low purchasing capacity of developed countries and overvalued exchange rates in the Central American countries.

The vulnerability of agriculture is a factor that makes productivity most variable and at the same time an element that adds to risk aversion. Innovations will have to seriously consider the way to contribute and to overcome this challenge.

The high duality of the agricultural structure; a large dominance of small-scale hillside farming; a variety of crops which render different income and employment; climate vulnerability; absence of irrigation; and related matters; are aspects to be aware of when either analyzing innovations necessary to generate higher income to small-scale producers or considering the policies needed to increase production of maize and beans for basic food supply.

4. POLICIES INFLUENCING INNOVATION IN AGRICULTURE

4.1 Introduction

Regarding policies that influence agriculture, four aspects are addressed in this section: The subject matter of policies; the coordination mechanisms; the implementation through policy instruments; and the institutional capacity for implementation.

Given space constraints, only a brief reference is made to them, using examples of countries to illustrate particular situations.

4.2 Diversity of policies and their influence in agriculture

In Central America, as in all countries, agriculture, agroindustry and food supply are strongly influenced by many policies. Table 6 provides a summary of current policies in several fields and their influence in agriculture. They include policies in the fields of macroeconomics, trade, financing, environment, food safety, rural roads and services, agricultural policies and food security policies. As can be expected, most of these policies are defined by others, rather than the ministries of agriculture. The table below takes a glance at the current status of these policies, with a strong caveat about the differences among countries regarding the application of specific policy instruments and their effectiveness.

The policies most influential in agriculture and agroindustry in The Region include macroeconomic and commercial policies, particularly in relation to monetary stability, control of inflation, taxation and trade liberalization. At a second level of influence are policies on rural infrastructure, especially regarding the provision of access and services to isolated communities; and environmental policies to favor water quality and the protection of forests.

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Table 6. Policies influencing agriculture and food supply in Central America.

Policy Area	Current Policy status	Influence on agriculture
Macroeconomic	Reasonable macroeconomic stability, inflation managed between 3 and 7 percent, overvalued exchange rate, low tax collection, allocation of government budget to agriculture below one percent	Stability favors investments, inflation effect on poverty is negligible, overvalued exchange rate penalizes exports and favors imports of food and agricultural inputs, low tax collection leaves governments always in budget anxiety, and low allocation to agriculture is partially compensated by allocation to roads and services
Trade	Free intraregional trade, agreements with US, Mexico, Canada and UE. Some countries have trade agreements with China and other South American and Caribbean countries. Free zones growing, few cases include agroindustries for export	Have created opportunities for agricultural exports; remaining restrictions on access for value added products limit their exports, food imports have increased at a higher rate than agricultural exports
Financing	Continuous decline in traditional preferential conditions for agricultural credit; credit cooperatives in rural areas have increased; rural financial services of public and private banks, and other money transaction facilities (Money Gram, Western Union) growing	Preferential financing for agriculture has declined; lenders place more emphasis in quality of projects and responsibility of borrower; investment in agriculture has not declined; more money circulates faster between rural and urban actors
Environment	Countries have created new ministries of environment and specialized agencies; and extensive legislation, application is far from desirable, more focus on controls and less on information, education and incentives. Costa Rica is more advanced	Excessive controls and bureaucracy limit medium size projects that are required to comply with paper work; corruption on deforestation permits continues; few countries have programs to pay for environmental services provided by agricultural activities, including biodiversity, watershed protection, carbon sequestration; and incentives for low gas emissions .
Food safety	Reasonable controls and sanctions in urban industries and food markets because more significant presence of ministries of health, municipal services and role of the media, creating consumers awareness.	Programs of clean agriculture are at early stage. Organic farming is welcomed yet no incentives are provided. Rural agroindustries big and small, formal and informal do not comply with environmental and food safety legislation
Rural roads and services	Public investments in roads, electrification education and health services, plus security, take most of the government budgets. Fortunately army expenditures, which used to be significant (except for Costa Rica) have declined in relative terms to other expenditures. Public employment still consumes the great majority of the public budget	Rural investments in these areas are a small proportion of the total, hence benefits for agriculture are limited in terms of more educated and healthier workers and lower transportation costs. Lack of support in these aspects has contributed to low private investments in agriculture and migration of the youth to the cities. In the case of Nicaragua migration to Costa Rica and in the case of El Salvador, to the US
Agricultural policies	Given the countries pursuance of liberalized economies beginning in the 90s, some agricultural policy instruments disappeared (subsidized credit and fertilizers, price controls) and other were substantially diminished (agricultural research and extension). Animal and plant health services received more support.	The decline in the provision of public agricultural services had two effects. On one hand many producers were left without any such services. On the other hand, producers that organized themselves manage to create cooperatives and private service programs more efficient than their public predecessors. Plant and animal health and food safety services have benefited more than the export-oriented sector.
Food security	In this area, all countries influenced by political motives, assemble all kind of policy instruments, hence it is hard to be explicit to identify the ones with the more significant impact.	Beginning in 2008 when prices for grains and other basic food products rose, the governments implemented programs of subsidies to fertilizers and seeds of basic grains. Currently, budget constraints have those programs under revision.

Source: Summary and update from Pomareda, Carlos. Políticas para la Innovación en la Agricultura de Centroamérica, 2008

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At the third level are sector policies, especially those related to agricultural health issues, and food safety, both with high influence on agricultural exports. Very unfortunate is the fact that policies to support agricultural research and innovation are at the bottom of the current policy portfolio. As it will be observed later, the current budget allocations in this policy area and limited institutional capacities testify for this low priority.

Food security policies in Central America are a mix of some of the above, but also relate to the food distribution mechanisms, international and national food aid, and relief programs which are implemented, especially in Guatemala, Honduras and Nicaragua. Unfortunately, the rural poor are not always the beneficiaries of these programs as the power of urban-based organizations and political interests favor the urban areas (Estado de la Region, 2010).

4.3 Coordinating mechanisms and policy dialogue

At least three levels are recognized in the policy dialogue mechanisms for policies influencing agriculture: Coordination within the public sector; agendas and complementary action between central government and local–municipal governments; and coordination between the public sector and the private sector organizations.

Regardless of the recognition of the wide array of policies and the number of ministries involved in the definition and implementation of policies influencing agriculture, the formal mechanisms for dialogue at cabinet level do not exist. Attempts were made in Honduras (Gabinete Agroalimentario) but its success was limited, as other ministers were busy on their own portfolio. The fact that the President led Cabinet, did not guarantee its success. The fact that the Cabinet did not have a Secretariat to follow up on agreements was also a fact that did not contribute to its functionality. In spite of this failure, this type of initiative deserves further attention (PIADAL, 2013)

Bilateral inter-ministerial consultations are common, on specific issues. Several of them take place regarding trade (for example in the case of rice in Costa Rica to meet WTO demands) and environmental matters, such as the new law on water in Guatemala.

Public-private dialogue tends to focus on specific matters for which group interests are the driving force. This has been for example the case of agricultural land taxation in Costa Rica. Civil society organizations have in cases taken also very active role as for

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example in the case of land deforestation by large wood dealers in Honduras. As will be seen later, the chain-producer organizations for tradable products are the most influential on policy definitions.

One of the issues of major concern relates the relations between central government agencies and municipal governments. A case in point has been the compliance by rural slaughter houses, depending on local municipal authorities; and the rules and regulations and demands to innovate presented by ministries of agriculture, health and the environment regarding animal health, food safety and management of residues. The municipalities are supposed to be responsible for the execution of the regulations, yet they give little attention to the subject.

Policy dialogue at regional level takes place with the Central American Council of Ministries of Agriculture (CAC) on specific sector policies, as for example, those related to intraregional trade barriers. Joint meetings of agricultural, trade and health ministers have taken place to discuss issues related to the trade agreements. Nevertheless the only mandatory regional agreements are those subscribed to by the economic ministers at the COMIECO, and by the ministers of trade at the board of SIECA.

4.4 Policy instruments

Regarding policy instruments, this is a major constraint especially in the field of agricultural policies. Cumbersome legislation and bureaucratic bottlenecks limit the effectiveness of these policies. Those constraints are of less magnitude in other policy areas. Also, since the ministries of agriculture were created more than 60 years ago, much of the legislation that governs them is very old. Furthermore, the ministries are still influenced by memories of past control of policy intervention mechanisms, which are no longer in place after the liberalization of economies and the structural adjustment programs of the 1990s.

Although several of the countries of Central America have introduced new policy instruments to create suitable environments for investment in agriculture, much work is needed in this area, especially to encourage innovation amongst small-scale producers. Transmitting market news by cellular telephone in Costa Rica, initiated in 2011, is an example (IICA, 2012). The Agropyme Program to encourage small-scale enterprises in agriculture in Honduras is another example (Agropyme, 2010). Some missing programs

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are those promoting small-scale cooperatives producing seeds, following the examples of the FAO project in the region (FAO, 2010).

4.5 Institutional capacity for policy implementation

Institutional capacity is one of the most serious constraints for adequate policy implementation that would benefit innovations in agriculture. Extensive reviews are provided by Trejos, Pomareda and Villasuso (2004), Piñeiro et al (2009) and Auguste and Manzano (2012), where there is evidence of institutional constraints at the ministries of agriculture and specialized agencies in the public agricultural sector.

This latter observation is picked up later in the report, as it is hypothesized that an improvement in capacity to support innovations in the agriculture of Central America, is jeopardized by limited institutional capacity in general, and in the public agricultural sector in particular.

4.6. Conclusions

Regarding policies influencing agriculture, the following conclusions are highlighted:

Policies influencing agriculture are defined and managed by many authorities, including the ministries of agriculture. All of them have important influence, but the most influential are ministries of the economy and trade.

Coordinating mechanisms intended for policy definition, resource allocation and implementation are very limited and tend to function for specific matters and short term emergency situations. Three levels are recognized for these mechanisms: Within the public sector; between central and local governments; and between the public sector and private sector organizations.

Effective policy instruments are the most important element to allow proper policy implementation. There is a need to review policy instruments to cope with new demands.

Institutional capacity for policy implementation in general and in agriculture in particular, is limited. The issue requires much attention considering increasing challenges.

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5. ACTORS IN THE AGRICULTURAL INNOVATION SYSTEM

5.1 A revised version of actors in the AIS

The literature is abundant referring to AISs with two biases: The focus on research, even when they call them innovation systems; and the missing link between research and farmers, limiting it to agricultural extension. A renewed dimension is given in this study to provide a wider view of innovation and by default, a more diverse set of actors in the innovation system.

The national AIS in Central America are described in Figure 5. The different groups of actors perform different functions according to their interests as public entities, nongovernmental and producer organizations, and private actors. Among the latter are all agricultural producers (including peasants), agroindustries (of all sizes and levels of formality), seed producers and providers of inputs and services. Cooperation and market relations are the means for interaction, and as will be shown, the latter have much influence in the process of innovation.

5.2 Actors in the AIS in the countries of Central America

Table 7 presents a summary of the number of actors in the different categories in each of the countries and for The Region as a whole. A brief comment relates to the large number of local producer associations (with very limited capacity) and cooperatives and stores that sell inputs, including seeds, fertilizers and veterinary products. This latter group and seed importers, are the most influential when considering the high level of chemical fertilizer use and other chemical inputs in agriculture.

Table 7. Number of actors in different categories in the NAIS in CA

Category	BEL	GUA	SAL	HON	NIC	CRC	PAN	Total
Universities with agronomy faculty	0	3	2	3	4	3	2	17
National agric research. centers	1	1	1	2	1	3	1	10
Regional agric. research. centers	0	0	0	1	0	4	0	5
Ministries of agriculture	1	1	1	1	1	1	1	7
Other ministries	1	3	3	3	3	3	3	19
Sector leading agr. prod. organizations	1	1	1	2	2	2	1	10
Chain producer organizations	2	5	5	7	5	8	5	37
Local producer organizations	10	34	45	54	54	35	23	255
Agricultural cooperatives	3	23	24	18	35	26	22	151
Input dealers	25	63	54	31	46	72	53	344
Seed importers and distributors	3	6	7	11	8	13	7	55
International research center offices	4	3	3	4	4	3	6	30
Total	51	143	146	137	163	173	124	937

Source: SIDE, Directorio de Actores Institucionales vinculados a la Agricultura en Centroamérica

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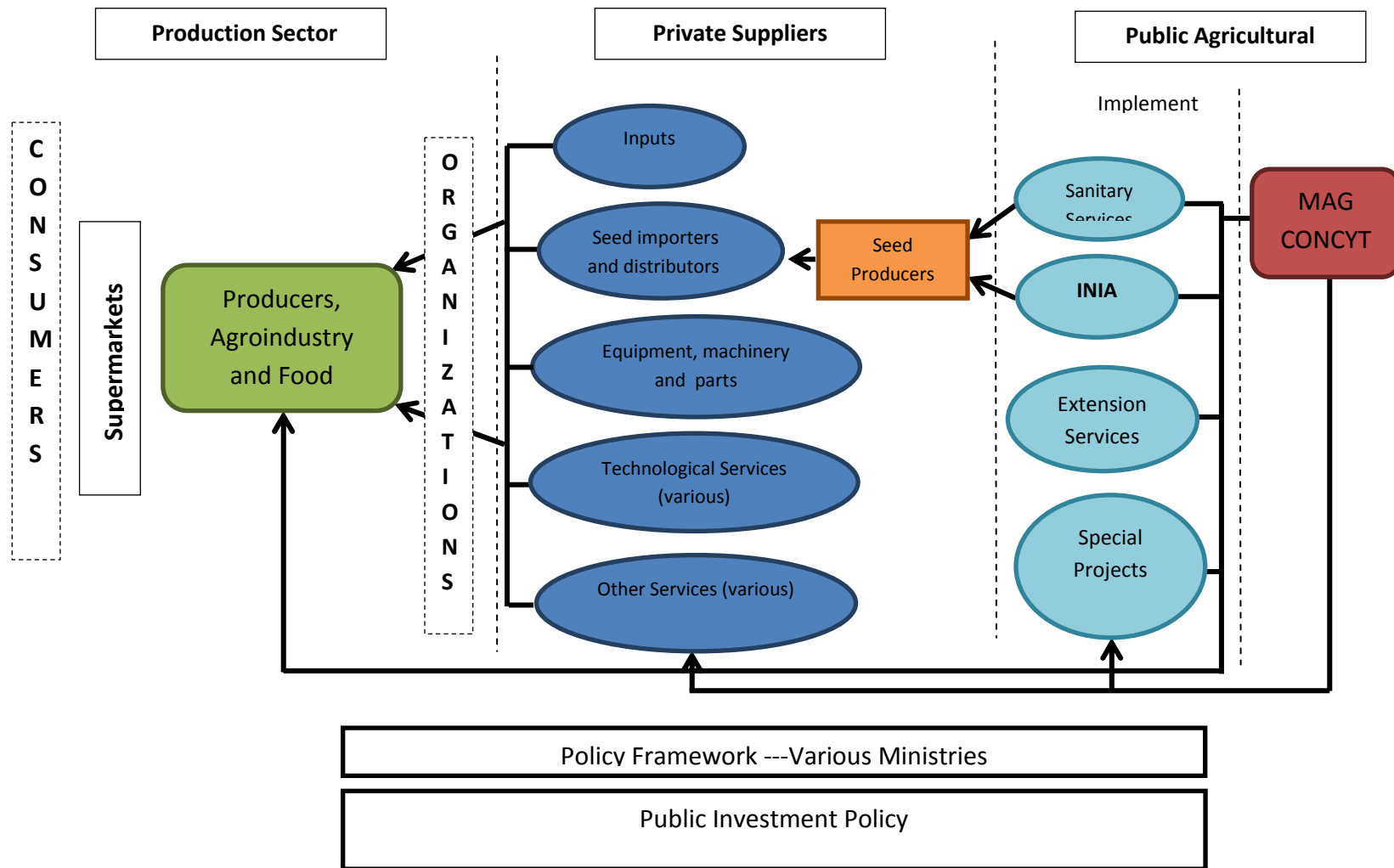


Figure 5. Categories of actors in the AIS

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Input suppliers are a most important set of actors. Even though the market for agricultural inputs is reasonably well developed, there are concerns about the quality of inputs and their prices. Publicity is the driving force for the increasing number of inputs whose quality and effectiveness are rarely tested by government agencies.

The situation is worrying regarding the market for agricultural services to foster innovations in agriculture. In very few cases, private technical assistance is provided by specialized professionals, firms and producer organizations. Veterinary services and equipment repairs are reasonably established. Other services such as soil, water and tissue tests and information services are missing, or limited to the agro-export sector. The informality in agriculture is one of the factors that limits the development of a market for agricultural services that could contribute to innovations and therefore to competitiveness (Pomareda, 2012).

5.3 Conclusions

Regarding actors in the national agricultural innovation system, the following points are emphasized:

NAIS include a wide array of such actors. All of them have different interests, whether they are public entities, universities and research centers or private enterprises; therefore it is important to know about those interests.

It is recognized that there are several means through which these actors interact, including alliances, contracts or just market relations.

In the case of Central America, nearly 1 000 such actors are identified and all of them play a role in the NAIS and have particular interests.

The reference to the NAIS made in this section is a new way of seeing and understanding the innovation systems in agriculture, previously perceived as a narrower structure that tend to exclude several of the categories here indicated.

6. CAPACITY FOR INNOVATION IN AGRICULTURAL CHAINS

6.1 Introduction

Analyzing Innovations in agricultural chains and the participation of different actors allows an appreciation of capacities, roles and different mechanisms. Such is the purpose of this section, based on the analysis of a sample of nine agricultural value chains in Central America. They were chosen to represent diverse conditions and the participation of different actors in the innovation process.

Previous sections have identified the variety of crops and livestock activities in The Region and a number of factors to consider in the development of innovations in agriculture. This section presents a summary of the innovations that have been introduced for the production of the main crops and dairy cattle; the participation of different actors in the innovation process; the current extension and depth of these innovations; and the factors that influenced them. The information was obtained from case studies and the analysis is based on the perceptions of actors involved in these issues. A section is also included regarding the capacity of actors and their role in policy definitions and the provision of services.

Note: The cases of the crops and dairy chains originally analyzed were submitted to consultations for which the tables of perceptions were elaborated. Complementary information is provided in this version of the Report, at the request of the TAP Team, on other chains, especially cassava, poultry and tilapia.

The information on the case studies was provided by a review of bibliography, interviews with professionals and producers who participated in the specific cases reported; and opinions of actors obtained through the electronic survey.

6.2 Innovation a la carte

Innovations and institutional arrangements were analyzed in nine crop chains (beans, maize, rice, vegetables, bananas, coffee, cacao, sugarcane and oil palm) and in dairy

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production (see Table 8). In some cases innovation in one product included several aspects. For example, in the case of beans it included new seeds, seed inoculants, fertilization, planting density, seed density, and post harvest packing. In dairy cattle, it included silvopastoral systems, small-scale silage, use of mineral supplements, clean milking, differentiated prices according to quality, etc. The completeness of the innovation used is referred in this study as the *depth* of innovations

The most commonly referred technological innovation was improved seeds. However, it was also reported that the lack of complementary relations with other recommended practices (such as fertilization and plant density), and a lack of support to develop local seed industries, did not allow for a deeper innovations and therefore a more complete benefit of using better quality seeds.

Regarding managerial innovations, there were also some related to managing the enterprise and others related to interaction with other actors. They included pricing for the different quality of milk; pricing for the different content of sucrose in sugar cane; planning vegetable plantings to take advantage of price seasonality; cooperative milk collection points; contract farming, and others.

Table 8. Summary of technical and managerial innovations

Product	Emphasis of technological innovation	Emphasis of innovation in management and marketing
Maize	Improved seeds and fertilization	Organization of producers
Beans	Improved seeds and fertilization	Organization of producers
Cacao	Cultural practices , sanitary	Quality in processing and price differentiation for native varieties
Dairy	Nutrition and management of cattle, clean milking	Price differentiation for quality and fat content
Rice	Improved seeds and fertilization	Organization of producers
Coffee	Cultural practices, sanitary	Value adding and branding
Vegetables	Water use and irrigation technology	Contract farming and programming to avoid price variation
Sugarcane	Genetics and crop management	Payment differentiated by sucrose content
Bananas	Genetics and crop management	Organization of producers
Oil Palm	Genetics and cultural practices	Organization of producers

Source: Built on the basis of opinions in survey and interviews

In many cases the innovations were not utilized by many producers associated to the chain. In other cases many incorporated them. This was referred as the *extent* of innovations or if expressed more specifically, the number of farmers who incorporated

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them. In very few cases there is knowledge about the depth and extent of an innovation. A good example is the case of sugarcane production in Costa Rica, where the producers and industry association (LAICA) keeps record of such process and reports that almost 80 percent of innovations are adopted by near 80 percent of the producers.

The study revealed that the amount of innovations reported is abundant, but the information about the benefits of each one is limited, particularly in terms of costs, income gains, inherent risks, stability of the innovation, etc. Although in all cases benefits are mentioned enthusiastically, supporting numbers are missing. This is one of the reasons why in some cases the innovations did not extend among potential users.

6.3 Institutional and other factors influencing innovation uptake

Several factor related to institutions, capacities and market forces have influence on the extension and depth of innovations in agriculture.

Farm size and farm level capacity

In general the most notorious innovations are found in farms where the owners capacity is a determinant factor. Farm size is not as relevant, although there is a coincidence in low rates of innovation in small farms dedicated to maize and beans. This low rate of innovation is however more associated to other factors, as explained below.

Some of the best results overall have been achieved through better management of water through irrigation technologies, as in the case of vegetables. Low cost water harvest using plastic tunnels for crops (built with materials available in the market); and low cost drip irrigation systems (also available in the market) have allowed important improvements of yields, year round production, better quality of products and better prices. The cases reported by Wal-Mart in Honduras and Costa Rica endorse this model of partnership (Wal-Mart, 2013).

Role of producer organizations

A factor limiting the extension and depth of the innovation was the role of the producer organizations and other actors who provide services to producers needed to innovate.

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When organizations were strong and contributed information, field days and general motivation to producers, the results of uptake of new technologies were very positive. Their effort providing services was essential to complement researchers, independently if they were in the public sector or within the organization. The cases of banana, palm oil, vegetables and sugarcane are good examples of the good results achieved through technological and managerial innovations. As observed in Table 9, the producers' organizations in these chains had the highest capacity among all.

The services required by producers to innovate include technical assistance, training, information, marketing facilities, financing, production services, veterinary services, laboratory services for soils, water and tissue tests, and many more. Lack of adequate services by the organizations, were reported in maize and beans. Previous studies in the Region (Pomareda, 2012) and in other regions (Wongtschooski, 2013) reveal the importance of services. Those studies make it clear that the market for services must develop through increased demand and supply and the lowering of transaction costs.

Leading firms

In several of the referred chains, there are leading firms usually involved in production, but primarily in processing and exporting. Some of them are vertically integrated. The leading firms have played a most important role in assisting incoming producers to innovate and introduce food safety practices.

Through its *Tierra Fertil* Program, Wal-Mart is a leading corporation in this field. Thanks to its support and guaranteed market access to small scale producers, in Honduras Wal-Mart increased vegetable production at a point that allowed imports of fresh vegetables in 2012 to be reduced to one third of the level in 2007 (Wal-Mart, 2013).

Vertical integration was a means to reduce transaction costs and to assure the provision of services. The cases of tilapia production in Costa Rica and poultry in all the countries provide important evidence on this issue. In both cases the processing industry provides producers with breeding material, technical assistance, certified veterinary products and feed. Also in both cases, small scale producers who fulfill some requirements are linked to the chains through contract farming (Pomareda, 2006). Some of the requirements include compliance with technical, crop and animal health and food safety related norms, and punctuality on delivery.

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Other companies which have played an important role in stimulating innovations are identified in the food industry and restaurants sector, but they have roots in the producing sector. One of them is Pollo Campero. Based in El Salvador, the company is the largest chain of fried chicken restaurants in Central America, also with stores in the US. The company has a program to assist over 300 broiler producers in Guatemala and El Salvador. It provides them with management systems, baby chickens, feed and veterinary services. The company guarantees compliance with international standards of animal welfare, environmental regulations and food safety.

Table 9. Main factors influencing innovations in agri-food chains

Product	Scale of farmers	Capacity of organization	Market drive	Participating agencies	Extent of innovations	Depth of innovations
Maize	VS, S	W	L	IN, EX, OP, CI, ON, CO	VL	L
Beans	VS	W	M	IN, EX, OP, CI, ON, CO	L	L
Cacao	VS	W	M	IN, EX, OP, CI, ON, CO	M	L
Dairy	S, M, L	W	M	IN, EX, OP, CI, ON, CO	H	L
Rice	S, M, L	M	M	IN, EX, OP, CI, ON, CO, PE	M	M
Coffee	S, M, L,	M	H	IN, EX, OP, CI, ON, CO	M	M
Vegetables	S, M	D	H	IN, EX, OP, ON, CO	M	H
Sugarcane	M, L	S	H	OP, CI, PE	H	H
Bananas	M, L	S	H	OP, PE	H	H
Oil Palm	L	S	H	IOP, PE	H	H

Source: Built on the basis of opinions in electronic survey and interviews. Qualifications in the different categories are subjective in the opinion of respondents

Producer scale: Very Small (VS) Small (S) Medium (M) Large (L)

Capacity of organization: Weak (W) Medium (M) Diverse (D) Strong (S)

Participating agencies: INIA (IN), Extension Service (EX) Organization of Producers (OP), Center International (CI), Private Enterprise (PE), NGO (ON), International Cooperation (CO)

Market drive: Low (L) Medium (M) High (H)

Extension of innovation: Very low (VL) Medium (M) High (H)

Depth of innovations: High (H) Medium (M) Low (L)

There are also leading firms in the seed industry which have played an important role in innovations. Some successful seed industries developed utilizing genetic material developed by the INIAs. This is the case of Cristiani Seeds (recently sold to Monsanto) based in Guatemala, which is an important producer of white corn hybrid seed

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distributed through Central America. It developed utilized genetic material from the Guatemalan National Agricultural Research Center (FAO, 2012).

In other cases the leading firm extended beyond the home country and beyond Central America. Palma Tica, a multinational firm based in Costa Rica, through its seed company ASD, became few years ago the leading exporter of seeds and clones to 35 countries worldwide. In Central America the company has a wide coverage program on research, training and technical assistance to oil palm producers. Palma Tica is also integrated to the margarine and oil industries (Palma Tica, 2013).

Market drive

One of the leading elements to pursue innovation has been *market drive*, that is, the motivation to produce for specific markets perceived as dynamic and with reliable buyers. The positive expectations on markets and therefore better prices, was a stimulus. Contract farming and the assurance of a buyer induced innovations in the cases of sugarcane and oil palm. Also, guaranteed purchases, as part of contract farming, determined investments in low cost tunnels for the opportune production of vegetables. Contracts provided by Wal-Mart program *Tierra Fertil* have allowed several hundreds of very small producers to innovate and produce quality certified vegetables in Honduras and Costa Rica. As observed, in the case of maize and beans, innovations were not very extended and not very deep, as both crops are produced mainly for home consumption; although, in the case of beans, some sales take place in some countries (SIDE, 2013).

The role of the agroindustry as an important member in the agricultural chain is also highlighted. In the case of the dairy industry, offering a higher price for clean milk with a higher content of fat and solids, induced innovations in feeding and producing clean milk (RUTA, 2007). Similarly, in the case of coffee, adding value required a better quality of coffee bean and an absence of chemical residues, which motivated better agronomic practices and organic fertilization, leading to lower costs to producers and higher prices for better quality coffee (RUTA, 2007).

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Institutional support and interagency cooperation

An important lesson of the study was the value of complementing efforts to generate and extend the innovations. In these efforts, the following types organizations participated in different degrees: the governments' agricultural research institutes (INIAs), the international centers of the CGIAR; regional and international cooperation organizations; and private firms in the seed industry, in technology generation services, in agribusiness, and agroindustry and marketing.

Universities were rarely mentioned in the cases analyzed; however there was some input from them in basic research in the case of beans contributed by the Zamorano School in Honduras; and in the case of cassava the University of Costa Rica.

The INIAs focused their effort in research and (in some cases) technical assistance to small producers of maize and beans. The prevailing argument is that the government must attend the needs of the poor. This has implied that attention was not provided, or it has been too limited, to other more profitable alternatives (see Trigo, Pomareda y Villareal). Furthermore, the regional programs and projects had also this focus as in the case of RedSICTA that provides information and technical assistance on maize and beans through networks of small producers (SIDE, 2013).

The role of the international centers working in the Region, CIAT and CiMMYT is well recognized in support to agronomic research, technological innovations and building local capacity at producers level. CIATs international program in cassava production built an alliance with Clayuca (a network of producers in Costa Rica) provided training on technical issues for cassava production, industrialization and supported building better capacity of producer organizations for marketing (Gallego, 2011). CATIE has collaborated with several national entities on cocoa research. The cocoa research program of the Honduran Agricultural Research Foundations (FHIA) is one that received this assistance for cocoa research.

Also noted is the fact that in the case of the most dynamic agricultural products, there was not a significant input from the government entities not from local universities and the primary contributor was the private sector and its international partners. The cases of oil palm and bananas are good examples.

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6.4 Overcoming capacity constraints to agricultural innovations

Forty percent of opinions of respondents to the electronic survey indicated that the innovations have been primarily on genetic material for higher yields and better quality of products; 20 percent cited value soil management and 10 percent, water management. Other issues account for the other 30 percent, including innovation in processing and ways to add value for appropriate marketing.

Regarding the benefits of innovations, sixty percent reported that higher yields were the main benefit and another fifty percent indicated that adaptation to climate change was a main benefit. Forty percent indicated that improved income was the greatest benefit.

A major concern is the limited adoption of innovations because they provide limited evidence of innovations to cope with weather instability and resistance to adverse climate conditions. All persons who responded the questionnaire recommended that focus had to be placed on tolerance to weather instability and related resistance to pests and diseases.

Table 10 below summarizes the actors' perceptions on why adoption of innovations is not more significant. Among them are highlighted the reluctance of farmers to follow recommendations; the weakness of the extension services, low participation of producer organizations and not taking traditions and local culture into account. Regarding the first issue, it was clarified that recommendations to producers referred to complementary aspects for innovation, but producers followed only some of them, i.e. a low *depth* of innovations. A typical case was the use of better quality seeds, but not the adequate amount of fertilizers. Input cost considerations by producers led them to these decisions. This issue is most important as it reveals the low connection between research and farmers needs and attitudes.

Also mentioned, related to the above, was the fact that in some cases the suggested innovations did not consider the producers social believes, particularly risk aversion when food security is jeopardized. High risk aversion is common especially among small producers that depend on maize and beans for basic food supply for the family. Another cultural issue refers to food preferences. In the case of beans, local seeds are preferred because of tolerance to weather instability, reduced cooking time and better taste of the product.

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Table 10. Factors that explain the differences in productivity and profitability with and without innovations

Factor	Percentage of responses
Recommendations are not followed by producers	25.00
Innovations require tools and equipment and there is no money to purchase them	20.00
Not sufficient support from government	15.00
Traditions and cultural matters are obviated when making recommendations	10.00
Inappropriate management of soil fertility	5.00
Limitations of the quality of the genetic material recommended for the tropics	5.00
Deficient organization of producers and limited market drive	5.00
Risk aversion of producers	5.00
Limited information on costs and returns of innovations recommended	5.00
Insufficient interest of producers for new technologies	5.00
Total	100.00

Source: Electronic survey to 33 persons

Overcoming constraints to foster innovations requires addressing several factors related to capacity and mechanisms to encourage partnerships and related matters. Table 11 highlights these factors. The most emphasized recommendation is to encourage market driven alliances and partnerships along the agricultural chain. Placed it in simple terms, Innovations are done by producers, when they have a positive expectation that increased yields and quality, will allow them to gain more money. Also, information and communication to producers using their language and farm level planning was suggested. Hence, partnerships between organizations specialized in agricultural research and extension with private enterprises must be encouraged.

On this latter issue there are new initiatives by governments and private sector organizations and private firms, which are relying increasingly on networks and technology for communications. Some of the cases include the 2400 dairy producers affiliated to the Cooperative Dos Pinos in Costa Rica who receive electronically dairy information on prices and weekly bulletin on news, and the guarantee of purchase of milk by the cooperative, if compliance with quality is assured. Sugarcane producers in Costa Rica also receive continuous information by internet on training events organized by the producers and industries association (LAICA). This information refers also to availability of new genetic material, prices and reception of the sugarcane by the affiliated sugar mills.

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Table 11. Recommendations to overcome constraints to innovations

Recommendation	Percentage of responses
Market driven alliances and partnerships along the chain	27.27
Information utilizing the producers language	17.18
Farm level planning and integrated technical assistance	17.18
Better quality research according to ecosystems	8.59
Training on soil fertility management	8.59
Information on costs, returns and risk reduction features of innovations	4.80
Facilitating the recovery and conservation of local seeds	4.80
Provide comparative information on current practices and recommended innovations	4.80
Extend the benefits of innovations through producer organizations	4.80
Total	100.00

Source: Electronic Survey to 33 persons

6.5 Policy influence and other roles of actors

The case studies analyzed allowed gathering of information on the four major roles of institutional actors-organizations in the NAIS. They are included in Table 12.

Influence on Policy

An important message is provided by the information on policy influence. The universities and national agricultural research centers rank very low on this issue. Also, the international centers do not seem to have significant influence on policies important for innovations in agriculture. The limited participation on of these groups of organizations is explained in part by the following factors. On one hand, it is their limited dedication to generate information useful for policy decisions, probably because in most cases they do not know how to do it. On the other hand, it is their belief that policy has a political connotation; therefore they prefer not to get involved in such task.

Ministries of Agriculture, although responsible for sectoral policies, are referred as not having much influence on the policies that have the most influence on innovations in agriculture (see Table 6). The other ministries have high influence on policies relevant for innovations in agriculture, although this is probably not intentional. As it was discussed in section 4 of the Report, other ministries make decisions which influence the environment for business in agriculture. Hence, such decisions are determinant of

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farmers' willingness to make changes. The arrangements provided through Free Trade Agreements are an example of how expectations were created. The insufficient investment on rural governance, roads and communications is an example of how transaction and transportation costs work against innovations in agriculture.

The integrated-chain organizations appear the most influential. As was mentioned earlier, they influence particularly commercial policy for protection through barriers and also pledge for market access. They have been influential on government decisions regarding policies on agricultural health issues, taxation of revenues from agriculture land taxation.

The issue is most important as policies are fundamental for innovations to happen in agriculture. It calls for attention of all international agencies and the Centers of the CGIAR system to renew their current focus on research entities and therefore reconsider the selection of national partners. They need to work closely with those national entities that have the most influence on policies. This requires from them the generation of information that is useful for policy decisions and it also requires capacity to participate in policy dialogue.

Other roles of organizations

Participation in research is mainly at universities and the national, regional and international agricultural research centers. Some producer organizations have also been involved. However, this participation in research of other actors seems to be low, reflecting their limited interest. This has implications for research to respond to farmers needs and also for interested actors to contribute with financing of research activities.

Participation in extension services is clearly a generalized weakness among most actors. This explains why there is an important gap between research findings and actual innovation at farm level. In fact the agricultural extension service is generally of limited quality. In a recent study by FAO (2009) there is a good description of the evolution of the public agricultural extension services in Nicaragua, in which case, there some improvements. A similar pattern is observed in the other countries, because public extension has received greater attention than public research, however it is still below needs. IFPRI provides a review of the agricultural extension services in the

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Region (IFPRI, 2012); yet there is not available a comprehensive study about participation in extension services of other than public entities.

Table 12. Policy Influence and other roles of actors in the Central American AIS

Category	Influence on policy	Participation in research	Participation in extension	Participation in markets
Universities w. agronomy faculty	low	medium	very low	none
National agric. research centers	very low	medium	varied	none
Regional agric. research centers	low	medium	low	none
Ministries of agriculture	medium	low	medium	none
Other ministries	high	low	low	none
Sector leading agr. producer org.	medium	very low	very low	some
Chain producer organizations	high	medium	medium	medium
Local producer organizations	low	none	some	some
Agricultural cooperatives	low	none	low	medium
Input dealers	some	none	medium	high
Seed importers and distributors	high	medium	high	high
International Res. Centers in the Region	low	high	low	none

Source: Elaborated by the author on the basis of experience and interviews.

Regarding participation in market interactions, the most active participants are the dealers of inputs and seeds, who rely strongly on advertising. Local producer organizations and cooperatives have moved significantly in this field as in the cases of dairy and coffee. In response to advertising, the use for agricultural inputs has increased considerably. Some countries as Costa Rica rank very high at world level on amount of agrochemicals per hectare planted. The markets for seeds is only well developed for vegetables, hybrid corn and rice, but very limited for other crops.

6.6 Conclusions

Innovations along value chains reveal important features. In some cases there is a focus on technological issues and less attention to managerial factors. In others there a proper consideration of both aspects, rendering better results. This consideration implies that actors supporting innovations would benefit from learning more about the management of business in agriculture and from doing partnerships with those that know about it.

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The relevance of market drive as a force to induce innovations was recognized as most important. The leading role of some private enterprises which provide seeds and services and offer contract farming was highlighted, as well as the pull effect exercised by agroindustry. This message also brings into the agenda the need to revise approaches on agricultural extension which rely only on technical assistance.

The role of producer organizations and value chain organizations is recognized as important in the definition, organization and financing of research and as a force to stimulate the adoption of innovations. They can provide the associates with a sense of ownership when innovations relate to specific matters in the chain. These producer organizations need to be perceived as allies of government entities.

Public and private sector organizations have constraints on capacity for a more effective participation in the agricultural innovation systems. They include managerial aspects, qualified human resources, adequate strategy, etc. Economic limitations are greater in public entities, while a lack of incentives plays a more significant role in the private sector. Therefore, governments must give greater attention to measures that encourage capacity building in the public and private sector, with assistance to overcome specific constraints in each case. But most important, each organization willing to participate in innovation processes must do its own analysis of capacity constraints and take the actions needed.

Influence on policies relevant for innovations in agriculture is strong among most ministries, other than agriculture and the INIAs. Policy influence is significant by export-oriented value chain organizations, as well as among those seeking commercial protection. This reveals a gap, as policies must contribute to level the field for participation of all actors in the innovation system

The participation on research is found especially among national public entities, universities and the international centers. It is limited among producer organizations, with recognized exceptions. This reflects their low valuation of research. Arguments around not having the financial resources for research reveal the low priority given to this task. The weakness in the extension services is also serious, although some producer organizations have done important progress in this aspect. The few examples shown of organizations of producers participating on research, and contributing resources, are found when the research generates concrete outputs of utility to the producers and industry involved in the organization.

7. CAPACITY AT NATIONAL AGRICULTURAL INNOVATION SYSTEMS

7.1 Recalling the challenge of capacity building

The introduction to this report cited two definitions: Building overall capacity in a system and improving capacity in an organization. Those definitions are copied below with the purpose of bringing attention to two matters that are quite absent in the view of many entities, national and international, which provide only assistance to improve capacity of individuals..

Institutional capacity is understood in its broader sense referring to a system: This includes legislation and rules of the game, which must be understood and fulfilled by all actors; policies, when properly implemented, provide guidelines for private actors' decisions and investments; organizations (public and private) which have the adequate capacity (see below); mechanisms which facilitate the interaction and partnerships among actors (platforms, networks, etc.) and *ad hoc* financial mechanisms (venture capital, competitive funds, etc.) to facilitate private investment.

Capacity of organizations is the capacity to perform properly in a system. It requires among other things, qualified, motivated and well paid staff; efficient internal procedures; equipment; physical facilities; and information systems that allow fulfillment of tasks; sufficient and timely funding; proactive attitude; and positive image. Therefore, improving the capacity of an organization requires investments and not just training in personnel.

In this section an analysis is provided regarding the capacity of actors to fulfill specific functions and the capacity of the AIS in the countries of the Region. There is no specific reference to each country, as that is not the purpose of this study that covers seven countries.

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7.2 Capacity at the INIAs for research and for leading innovation

The INIAs in Central America have some important contributions in research and have participated in partnerships, as referenced in some of the cases presented on innovations in agricultural chains referred in the previous section. They have generated the most used varieties of white maize, beans and rice and some tropical fruits. Insufficient links to the national seed producers and weak relations with the extension services do not allow an evaluation of the outcome of the technological inputs generated in those cases.

Within the national agricultural innovation systems, the INIAs have traditionally been called to play the role of leader. Yet, their limited capacity and lack of tools to encourage dynamics within the system (competitive funds, special allocations for targeted research, information systems, etc.) have downgraded their role. A recent analysis of the twenty INIAs in Latin America by Trigo, Pomareda and Villareal (2012) allowed a breakdown of data for the seven INIAs in Central America. The analysis concludes that:

- The low capacity of the INIAs is inherently related to the capacity of the public agricultural sector, which has deteriorated substantially in the last 20 years.
- The budget of the INIAs has duplicated in the last six years, but little has been assigned to improving the quality of research and to hire more qualified personnel.
- Externally financed projects for institutional development were implemented some years before, but there are no current ones. Several of the INIAs have expressed interest in them.
- The Staff with higher degrees at the INIAs are a small proportion of the total. Less than 9 percent have a Masters degree and only 1.3 percent have a PhD degree; and in both cases, most of them are in administrative positions and not in research positions.
- Three of the seven INIAs also have responsibility for extension services, and in the other three cases the Ministry of Agriculture has the extension function, but it was argued that the extension function is highly politicized. In three of the countries, at the time of the grain price rise in 2008 and thereafter; the INIAs got busy on the free distribution of small amounts of seeds and fertilizers to small producers of maize and beans. This increased the budget of the INIAs for these activities, but not for more research.

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- Bureaucratic aspects have been noted as the most severe limitation in 48 percent of the cases; economic and human resources account for an important part of the other factors.
- Relations with other actors in the AIS are reported as good but weak and not leading to partnerships, because of insufficient agreement on joint responsibilities.
- The relations with the CGIAR centers were reported as good but weak and limited by excessive bureaucratic requirements and a slowness to create partnerships.

These limitations have held the INIAs in the Central American countries back from becoming more relevant players in the NAIS; especially as leaders and motivators of other actors. Capacities, the absence of mechanisms at their reach and a lack of understanding of their role, have limited their performance in the NAIS. It is therefore concluded from the analysis in this section that for the NAIS to perform better, the creation of a new public-private body providing leadership in the agricultural innovation system should be considered with renewed vision, more energy, the mechanisms and resources to mobilize actors, while INIAs role would be to focus on public sector strategic research.

On this latter issue, a recent experience in Perú was the creation of the Commission for Research and Agricultural Education (CONICA) and the National Program for Innovation in Agriculture (PNIA). The first is a council where main public, private and academic sectors are represented; and it has the task of recommending public policies to favor innovations in agriculture. The second is a Fund for US Dollars 180 million, created with government budget and loans from IADB and the World Bank. The loans are under negotiation (INIA, 2013). Also in Chile, the role of policy guidance and recommendations and the management of a Fund for innovation in agriculture (and other sectors) are in the hands of Fundacion Chile (Trigo, Pomareda and Villareal, 2012).

7.3 Capacity of other organizations in the NAIS

Regarding the capacity of other organizations in the NAIS, it has been valued in reference to three aspects: to influence policies, to participate and do research; and to provide assistance to producers for innovation. Table 13 summarizes the results of the

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electronic survey. It must be understood that these appreciations regarding capacity relates to several entities in each category in each country, hence, there are no specific analysis, as this was not performed, given the very large number of actors (see Table 7). A deeper analysis would have required individual evaluations, as was done, as part of the Trigo-Pomareda-Villareal study, for each of the INIAs in each country, which was used as a reference in the previous section.

Table 13. Indication of capacity of organizations in the Central American NAIS

Category	Capacity to influence on policies	Capacity for research	Capacity to provide assistance for innovation
Universities w. agronomy faculty	low	medium	low
National ag. res. centers	Very low	medium	low
Regional and agric. res. centers	medium	high	low
Ministries of agriculture	low	none	medium
Other ministries	high	low	none
Sector leading agr. prod. organizations	high	low	medium
Chain producer organizations	high	low	medium
Local producer organizations	low	very low	low
Agricultural cooperatives	low	none	medium
Input dealers	high	none	medium
Seed importers and distributors	high	low	medium
International Research Centers in the Region	medium	high	medium

Source: Valuation of the author on the basis of experience and interviews.

Institutional capacity relates to human resources, processes for planning and management, economic resources, adequate equipment, leadership and the existence of incentives.

In terms of the capacity to influence policies, it is in general low, with the exception of other ministries and the commercial sector organizations. This explains in part why in the previous section there was a similar pattern regarding their influence on policies.

Regarding the capacity for research, some of it is available at universities with agronomy faculty, national and regional agricultural research centers, and at the International research centers working in the Region, primarily CIAT and CIMMYT.

With regard to capacity to provide assistance for innovations in agriculture, meaning providing extension or advisory services to producers, in general it is found at

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reasonable level in public and private entities with mandate for this purpose several of the private sector organizations. Several producer organizations have created their extension services utilizing diverse means as bulletins, field days, fairs, service centers, telephone messages, etc.

Figure 6 summarizes the main aspects in which public and private entities have constraints that limit their capacity. While in the public sector seem more important the economic and human resources, in the organizations of the private sector the absence of incentives is given higher priority. Absence of incentives was reported as a lack of motivation to build capacity. If the NAIS were visualized as a more open space, and if the entity responsible to encourage the participation of actors had at hand the before referred mechanisms; it is most like that private actors will have an incentive to overcome their own constrains.

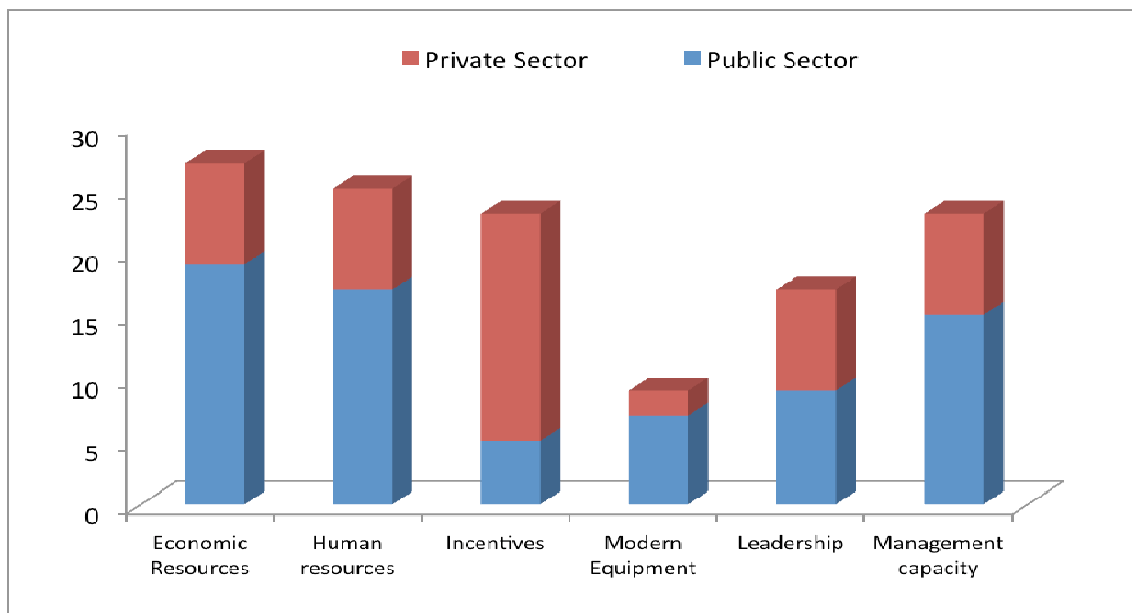


Figure 6. Main constraints among public and private actors in the NAIS
 Source: Electronic survey to 33 actors

Note: The vertical axis indicates the percentage of responses, which identified the constraints in the horizontal axis

The perceptions of actors consulted through the electronic survey, regarding the participation of institutional actors in the NAIS, highlight that presently all institutional

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actors have some participation in the NAIS, but it is low as indicated in Figure 7. The vertical axis in the Figure will reflect which actors have the greatest participation; and it is appreciated that there are no substantial differences. Universities and producer organizations seem to have slightly lower participation. This latter appreciation is of concern as both groups have been commonly signaled as the ones expected to have more contributions on research and assistance for innovation.

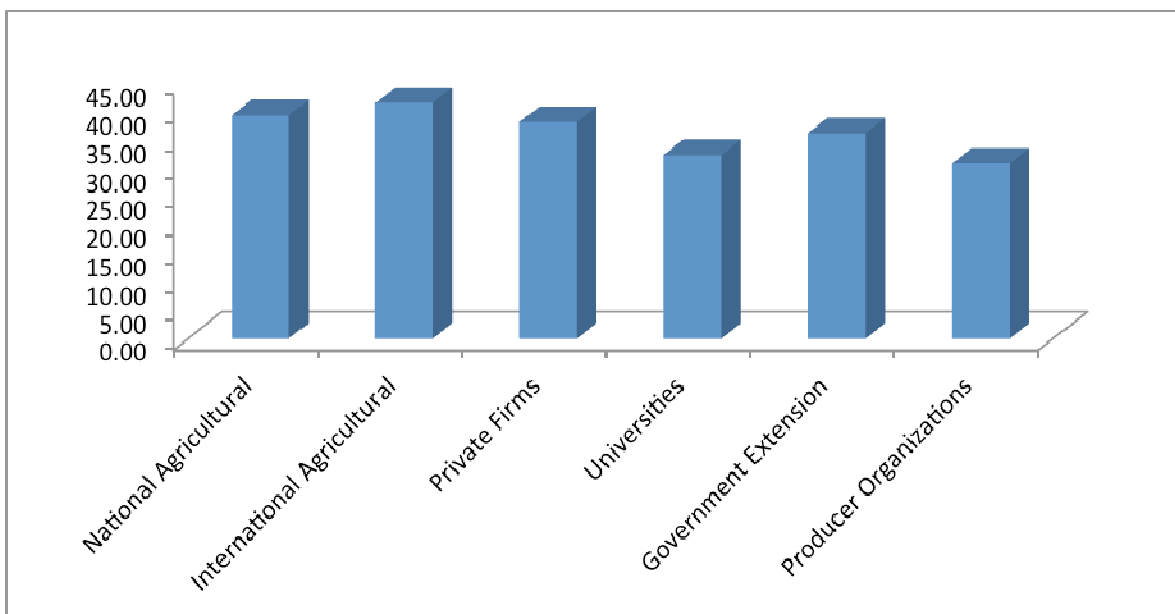


Figure 7. Intensity of participation of different entities in the NAIS

Source: Electronic Survey to 33 actors

Note: The vertical axis indicates the Respondents appreciation of the percentage of participation of the different types of organizations in the development and diffusion of innovations in agriculture

7.4 Mechanisms for the functioning of NAIS

A functioning NAIS is one where member actors interact, engage in partnerships and alliances and buy and sell inputs and services through market relations, The functioning of the AIS depends largely on the existence of four kinds of mechanisms: incentives, platforms, networks and information systems. The situation in Central America is referenced below.

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As shown earlier, there are a large number of actors in NAIS in the countries of the Region. Working relationships among them are primarily through market relations, yet they are not always in perfect competition. Incentives such as competitive funds and tax exemptions to encourage partnerships and joint investments are not used. Platforms are non-existent. Networks have grown, as national and regional projects use them as an instrument to share knowledge, as in the cases of SICTA, RedSICTA and PRIICA. Information comes in two forms: on the one hand publicity, which is quite abundant for agricultural inputs; and on the other hand, information on prices, business opportunities and new technologies. Some of the agricultural producer organizations are using these means more often. Also, the use of cellular telephones for information on prices has begun in Costa Rica. The Central American Agricultural Council (CAC) is promoting this system in the other countries.

The recommendations provided by those that responded the survey, to improve the performance of the NAIS, are summarized in Table 14. Of major importance was the suggestion to encourage the finding of common objectives, stimulate cooperation in value chains, and create platforms and competitive funds.

Table 14. Recommendations to overcome main constraints to more dynamic and effective Central American AIS

Recommendation	Answers %
Common objectives and joint planning and commitment	25.00
Encourage participation on chain networks	20.80
Platforms and consortia as public-private partnerships	16.40
Public policy and leaderships of MAGs	12.50
Competitive funds for research and support to innovation	8.45
Training of young people	8.45
Protocols for innovations at National and regional levels	4.20
Modernization of institutions	4.20
Total	100.00

Source: Electronic survey to 33 actors

Two issues of major concern in the consultation were the appreciation that only 25 percent of respondents consider that the producer organizations had proper participation in the setting of priorities and actual research; and only 46 percent recognized that there were benefits for women in agriculture. However, they were not included by interviewed persons in the recommendations provided in Table 14.

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At the PCCMCA (Central American Cooperation Program for Research on Basic Agricultural Products) meeting in Honduras, April 2013, participated near 200 professionals from the NAIS in Central America. Thirty of them participated in a three hour workshop to provide valuable insights into the issues previously addressed on this section, responding to four questions. Their comments are summarized in Table 15. These comments reaffirm the findings in the electronic survey and interviews.

Table 15. Contributions at the PCCMCA meeting

Questions	Comments
Is research responding to needs?	Clearly no. New issues are weak in the research agenda; research has focused on biological matters, neglecting social and economic issues; resources are too limited;
If research has provided some outputs why has innovation not grown?	Prevailing concern that public extension has not been replaced by alternatives; as a consequence increasing gap between needs of small producers and larger commercial ones; there is limited renewal of the technical assistance focused on technological aspects, with neglect of managements; little learning of early adopters; need for renewal of service methods and approaches; land renting does not motivate investment on innovations.
If there are so many actors in the NAIS, why aren't there more partnerships?	Interest in partnerships is short sighted to take advantage of funding opportunities; individualism of actors; lack of mechanisms to encourage partnerships: some positive experience as PITAs in Costa Rica and FHIA agroforestry in Honduras are good lessons: not always good relations between public and private actors.
If in Central American there are so many cooperation initiatives, why is cooperation not more effective?	Individualism of agencies persists; , weakness of governments to convey international cooperation into national guidelines; lack of methodology for effective cooperation.

Source: Consultation with actors at the Meeting of the PCCMCA, La Ceiba, Honduras, 24 April 2013

7.5 Conclusions

This section highlighted the following major issues: institutional capacity is generally low; larger and chain-oriented organizations of farmers are the most influential on policies; participation of actors in the NAIS is generally low; and there are no mechanisms that effectively stimulate more fruitful relations (such as information systems, competitive funds, technological fairs, etc.)

In relation to the functioning of the NAIS, the following points are highlighted:

- The capacity and role of the INIAs to stimulate and facilitate the interaction of actors is very limited; alternative entities must be created to take on this role.

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- Limitations in capacity are also evident among other actors in the AIS, and this affects their effective participation.
- Among the weaknesses in the systems are the absence of facilitating tools such as platforms and financial mechanisms such as venture capital, competitive funds and others.

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8. THE REGIONAL AGRICULTURAL RESEARCH SYSTEM

In Central America as a region there are regional partnerships, alliances and business transactions among many actors in many sectors of the economy, including industry, commerce and finance.

In agricultural research, two entities are recognized as key in the regional system: The Center for Research and Education in Tropical Agriculture (CATIE) and the Regional Agricultural Research Initiative (SICTA) a program under the Central American Council of Ministers of Agriculture (CAC).

8.1 CATIE and its contribution to institutional capacity

CATIE is the Center for Research and Education in Tropical Agriculture, located in Turrialba, Costa Rica. Although it is associated mainly with Central America, it also undertakes activities in other countries of Latin America. The Center is financed in a small amount by country quotas, an allowance of IICA and grants for research and for fellowships. CATIE's pillars are research, post graduate education and technical cooperation.

Research: The Center has six research programs—three of which are focused on production and three are cross-cutting—as well as an integrative and strategic program. They include agroforestry, livestock and environment and climate change. They are developed in partnership with international organizations and research centers, as well as with national institutions.

Graduate Education: On higher education CATIE is an international university established in 1946, the oldest tropical agriculture Graduate School in Latin America. The master's and doctoral students work alongside researchers to confront the technical, economic, social, institutional and political realities of sustainable rural development. The students also have a unique opportunity to complement their education with interdisciplinary research and technical cooperation.

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Technical Cooperation: Technical cooperation is offered through its network of National Technical Offices and official links with member countries. It created a network of strategic alliances, including universities, research and development centers, governmental and non-governmental institutions, cooperatives, small and medium sized businesses and corporations are part of this network. These alliances facilitate dissemination of scientific knowledge and practical experience. CATIE established National Advisory Committees composed of partners and strategic allies from the public sector and private. Their objective is to link the scientific-technical demand of the countries to CATIE's supply, and to be a mechanism for achieving a greater impact on public and private policies in each country. This task is however at very early stages.

The Center is well positioned as a prestigious international organization on research and education, yet its contribution to built national institutional capacity for research and innovation is only through human capital formation and not in the other aspects needed to develop institutional capacity. CATIE has had international discussions to move forward in this field, yet in order to implement actions it will require having the required staff and strategy.

8.2 SICTA and its contribution to institutional capacity

SICTA is the organization created in 1996 by the CAC with the task of promoting technological change in agriculture and strengthening the capacity of national agricultural systems to generate and transfer technology for agriculture. SICTA promotes partnership research networks for the main products and research collaboration, especially among the INIAs.

The INIAs in Central America and the Ministry of Agriculture and Natural Resources in Belize are members of SICTA and subscribe an annual quota. Most of the resources are contributed by IICA (which provides and finances the Secretariat), and contributions of the Swiss Cooperation Agency (COSUDE) and more recently overhead on Regional projects executed by SICTA and financed through grants. CATIE and IICA signed with SICTA also a cooperation agreement.

SICTA aims to become a mechanism to contribute to increased competitiveness in agriculture; contribute to integration within the region; stimulate cooperation among

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national agricultural research systems; and facilitate the capture of resources for the implementation of regional projects. Its main instruments include:

Regional networks of professionals involved in research. Some of the current networks include avocados, tomatoes, potatoes, beans, maize, genetic resources, climate change and others. Almost 100 regional professionals participate in these networks. There is also a directory with information about the participating professionals to facilitate bilateral cooperation.

Training: SICTA has done regional and national training in different aspects of agricultural technologies. Fellowships were provided on several occasions for a number of participating professionals, thanks to resources contributed by international and regional organizations.

Regional Fora: SICTA holds regional fora on issues of interest, including emergency matters requiring technical solutions, such as pests that affect crops. It has also provided support for the biannual meeting of the PCCMCA.

SICTA has achieved positive results by using the above referred tools to improve the capacity of the staff at the INIAs. It also has shared knowledge through the networks of professionals, where only some persons from other entities at the NAIS participate.

The instruments used by SICTA, especially training and knowledge sharing networks, are not enough to achieve the objective of contributing to increased national and regional institutional capacity for innovation in agriculture. To achieve this SICTA would have to engage in project preparation for public investments leading to improved institutional capacity for research and innovation at country level and to strengthen its regional mechanisms to facilitate interaction among partners in all countries of the Region. In fact the support provided by the SICTA Secretariat to the national institutes in Guatemala and Panama are good examples of what is possible. In these cases SICTA, in collaboration with staff from the respective INIAs, generated research plans and a proposal to strengthen the institutional capacity.

Yet, to perform this function, the Board of SICTA would have to agree on giving this mandate, and support the Secretariat in seeking funds to allow it to carry out this function. If it were decided that the Secretariat is not responsible for this task, then the Board would have to ask the CAC for political support and to the international agencies to assist the INIAs on a bilateral basis.

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8.3 Conclusions

CATIE has made valuable contributions to the development of human resources for research and education, with beneficiaries from all Latin American countries and some from other countries. Also, the outputs of research are well recognized throughout the region. However, the Center does not have a strategy not a specific program to assist countries in the built up of institutional capacity for agricultural research and innovation.

SICTA has played a useful role in facilitating the dissemination of knowledge on relevant research issues and in the upgrading of research staff at the INIAs, there is a strong need to rethink its role and functions and to include the participation of more actors beyond public research entities.

Both CATIE and SICTA have the potential for a more significant role in support to the development of institutional capacity for agricultural research and innovation. For this, they need this subject matter to be in their agenda and program structure; and to have the personnel with the required qualifications.

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9. REGIONAL SUPPORT TO NATIONAL INNOVATION SYSTEMS

9.1 Agencies, programs and projects

Central America is characterized by a proliferation of development initiatives. In the field of agriculture and rural development regional assistance is provided by the Central American public organizations, the international research centers, the international cooperation agencies, international NGOs, and bilateral sources of technical assistance, all participate.

Table 16. List of regional initiatives to assist innovations in agriculture in Central America

Executing agency	Financing agency	Name of the Initiative	Client organizations
FAO	AECID	Policies and assistance to seed production enterprises for basic grains in family farms	INIAs, producer organizations
	FAO-CA and FAO-HQ	Policies for sustainable cattle production	MAG, cattle associations
IICA	FONTAGRO, Countries, IADB	Regional Fund for Agricultural Technology	Fifteen INIAs and local organizations undertake bilateral or trilateral research projects
	European Union	Regional Program for research partnerships in value added chains for tomatoes, potatoes, avocados and cassava—PRIICA	INIAs, MAGs, producers associations in partnerships with processors
	INIAs, IICA COSUDE,	Sistema de Integración Centroamericana de Tecnología Agrícola—SICTA	INIAs
	COSUDE	Regional Network for research and support for innovations in maize and beans--RedSICTA	Maize and beans local producer organizations in 14 rural territories
	Governments, CIRAD, IICA	Program for coffee research and development –PROMECAFE	INIAs and national coffee producers associations
CATIE	World Bank, FAO	Development of silvopastoral systems and payments for environmental services	Ministries of agriculture in Central America and Colombia
	CIRAD, Biodiversity INCAE PROMECAFE	Forestry systems for coffee, banana and cacao—Mesoamerican Scientific Partnership Platform (PCP)	Research in partnership with national and local coffee, banana and cacao producers' organizations
	FONTAGRO	Adaptation of cattle production to climate change	Organizations of the cattle sector and ministries of agriculture
RUTA	USAID	Support to scaling up selected technological innovations for sustainable food production	Chain producer organizations
CIMMYT	Several	Cooperation for research in maize	INIAs
ILRI	CFC	Research assistance, technical assistance and policies for quality beef production and trade	INIAs, cattle producer associations
CIAT	Several	National and regional program for research on beans, rice, tropical pastures and cassava	INIAs, seed producers and farmers associations.

Source: Review of bibliography and consultations made by the author

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9.2 Features of cooperation

The following are some of the main features of international cooperation for agriculture in the Region.

All the above entities assist national partners through regional and national projects. The average duration of projects is between three and four years, but several of them are already in the third or fourth phase.

The analysis presented here refers only to regional initiatives and not to national cooperation. National cooperation projects in Honduras and Nicaragua account for 60 percent of the total for the region. Complementary regional and national initiatives are rarely in place.

Technical cooperation initiatives focus on building the individual capacities of farmers and staff at public bodies. In some cases assistance is provided to improve the capacity of small producer organizations. For that purpose, the tools are mainly training and the donation of equipment. In general, each one works in isolation from others, with some useful exceptions.

International agencies tend to compete for the attention of national authorities and technicians. This is a major concern as national capacity is limited.

9.3 Conclusions

International cooperation, especially in the form of regional and national projects is widespread. It has been helpful in improving the capacity of personnel, facilitating mechanisms for interaction and contributing to the quality of research, but there is not yet a strategy, nor is there evidence of having improved the capacity of public and private sector institutions involved in research and support to innovations in agriculture.

Most international cooperation agencies have the potential to make the required contributions because they know the research issues; they understand the conditions under which the activities at national partners are undertaken; they suffer the consequences of the national institutional limitations. What they do not have are specific goals, activities and strategies to contribute to overcome the institutional constraints.

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10. DEMANDS, WILLINGNESS, GAPS AND RESPONSE CAPACITY

The previous sections of the report recognized a number of limitations among actors in the agricultural innovation systems and in the functioning of the systems themselves. It was also recognized that there are valuable experiences where innovation was successful and where capacity is available. In the latter case the functioning of the system or subsystem was important, but it was not the only factor. Market opportunities and policies had much to do with the achievements.

This section identifies demands of actors in the NAIS of Central America and the willingness of governments to change the situation and the capacity of cooperating agencies to provide the necessary support.

10.1 Demands by actors and willingness of governments

To improve capacity in the NAIS, leading to better performance, it was considered useful to disaggregate actors and areas where capacity needs are identified. Table 17 departs from the diagram in Figure 5, in section 5, used to identify actors and Table 7, which provided the number of actors in the different categories. It is important to note that, because the focus is on institutional capacity, producer organizations and other actors are included, but not individual producers, nor individual firms.

Table 17 makes it possible to differentiate needs according to the role of different actors in the system. Given the similarity in the situation among the seven countries of the Region, there is no disaggregation by countries; yet a necessary step is for each country to make a deeper and more precise analysis. This differentiation of needs by actors is necessary as each type of organization has different objectives, goals, current constrains and perspectives. This disaggregation is better than a generalized expression of capacity needs, and it should be considered as a departing point for more in depth work. Furthermore, individual analysis of each organization, and plans to overcome constrains are required.

The quantity of **x** on each cell of the table is indicative of the importance this demand merits. Evidently the greater demands are on management issues, policy design and implementation and the provision of services, issues that were identified in the

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consultations. In terms of actors demanding assistance, ministries of agriculture, INIAs and producer organizations rank higher, just as in the analysis they showed the most serious limitations.

Table 17. Demands to improve capacity by actors at the National Agricultural Innovation Systems in Central America

Actors/areas of demand for assistance	Technical issues	Managerial issues	Policy design	Policy implementation	Provision of services	Monitoring and evaluation
Policy responsible authorities	xx	xxx	xxx	xxx	x	x
Ministries of Agriculture	xx	xxx	xxxx	xxxx	xxx	xxx
Units responsible for extension	xx	xxxx	x	xx	xxxx	x
Other ministries and C&T entities	xx	xxx	xxx	xxxx	xx	x
INIAs	xxx	xxx	xxx	xx	xxxx	xxx
Universities and other research centers	xx	xx	x	x	xx	x
Input and service associations	xx	xx	x	x	xxx	x
Producer associations	xx	xxx	xxxx	xxx	xxxx	xxx

Source: Built by the author on the basis of information from the electronic survey, interviews and bibliography review

In addition to improving the capacity of individual entities, there also needs to create mechanisms that allow efficient and effective interaction among actors, and the development of partnerships. Comments were offered in the text about successful cases on that regard.

It would be difficult to find disagreement on the needs to overcome these limitations; however there are major issues to be addressed:

First, authorities in agriculture have a short duration on the job; on the average not more than 8 months, in governments of four years (Trejos, Pomareda y Villasuso, 2004) thus, they usually do not take long term commitments, as the one needed to invest in institutional capacity development.

Second, making institutional changes leading to improved capacity usually requires legislative reforms, changing personnel, negotiating with syndicates, and other actions

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that in general require the government's willingness to absorb the cost of the unrest they create.

Third, improving capacity of organizations require investments that neither in the public or the private sector organizations and universities, are budgeted. Furthermore, they are not considered a priority hence rarely receive support.

Therefore, there is a gap between the demands and the willingness to undertake the actions needed. To change this situation governments and society need to rethink the contribution of agriculture to development and therefore the urgency of innovations and realize that unless institutional systems and organizations in agriculture improve, development may not occur (PIADAL, 2013). In the particular case on agricultural research and extension a most recent report prepared for USAID (Anderson and Roseboom, May 2013) recommend that *it will be helpful for an assessment team to interact with analysts from the Ministry of Finance or equivalent body, perhaps even through team membership, given the importance of such bodies in allocating resources for the public elements of a NARS. Parliamentarians should also be engaged.* Although the above two references are not specific to Central America, they endorse the arguments provided in this report.

10.2 Response capacity

From the identification of actors' needs, two issues need to be addressed: response capacity and who must take the lead? The issues emerged during the consultations at IICA, when preliminary findings of the report were presented for discussion.

In terms of response capacity to attend these needs, the first point is to recognize that building better institutional capacity for research and innovation in agriculture is a strong need that must be met at the level of the NAIS and at the level of each organization in the seven countries, hence it is an enormous task. The number of **X** marked in Table 17 as well as the recognition of the high number of actors, allows an appreciation of the magnitude of the task.

Public policy must address the issue of capacity to accompany the innovation process in the context of institutional reform in agriculture at large. The governments of the Region do not have specialized entities dedicated to built better governance or in

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particular to improve the capacity of organizations. This has to be encouraged by international influence on national policies and the allocation of public funds. The role of the international development banks in this aspect will be appreciated. After all, their responsibility is pending since they supported Agricultural Adjustment Programs in the late 80s, which was guided primarily by the simplistic principle of reducing the size of the public sector, but absence of proposal and loans to improve institutional capacity.

Experience in building better institutions in agriculture is not well established at international cooperation agencies like FAO and IICA. However, they do recognize the need and the importance, as revealed for example in the FAO supported research on agricultural institutions (Piñeiro et .al, 2009) and the creation by IICA of the Center for Strategic Analysis and Policy (CAESPA). IICA also has a program to support institutional capacity of agricultural innovation systems, yet this program itself requires strengthening to fulfill the assigned task. Both agencies could be useful in assisting in the creation of knowledge sharing networks about capacity building.

The contributions from FAO, IICA, the World Bank, IADB, IFAD and other agencies working on these issues deserves to be jointed to generate a strategy and to seek adequate funding. On the other hand their effort needs to be heard by a wider audience of national authorities that can make decisions on this matter. Of particular relevance is to convey the message to ministers of Planning and ministers of Finance.

In terms of the capacity to respond to needs of specific organizations, there ought to be a global search for agencies that do this type of work and case studies that show *how to* build better public institutions and private sector organizations. Many lessons can be learned from experiences of other countries outside Central America and organizations and systems outside agriculture. Extending this information would be most useful. An alliance of the above referred agencies with the Latin American Center of Administration for Development (CLAD) would be useful, given its experience in institutions and organizations in general.

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11. CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

The main conclusions are derived from the analysis made in each section and can be summarized as follows.

About **the Region**, the differences in income and therefore purchasing capacity are central to the direction that agriculture should take to generate income and food security. The regional institutional base is important in allowing regional programs to assure economies of scale in agriculture related research. A common market of 40 million people is an asset. Access to international markets favored by free trade agreements, should encourage innovations to generate new value-added products. Vulnerability to climate conditions is a major challenge and determines the need for, and the possibilities of innovations in agriculture.

Pertaining to **agriculture** the main features in the sector refer to the high duality on the agricultural structure; a large dominance of small-scale hillside farming; a variety of crops which result in different income levels; a good number of agricultural chains established; significant climate vulnerability; absence of irrigation; and related matters. They all have implications to be aware of when analyzing innovations, organizations capacity and policies to remove constraints to innovation.

The changes in production of basic grains have emerged primarily from increases in area planted, as **productivity** in most crops changed very little; in other crops there are some improvements revealed in the yields and quality of products. The potential to increase yields and quality is substantial. Using irrigation water and related technologies makes important differences to boosting productivity and incomes, to reducing vulnerability and for the introduction of new crops which render higher incomes to producers.

Innovations in agriculture tend to be specific to crops or livestock species. They are found in varied dimensions, such as genetic material, agronomic practices, soil nutrient management and water utilization. In their development and extension it has been

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fundamental the participation of institutional actors with complementary capabilities, and especially to the role of producer organizations, nevertheless this has not always been the case. The poor quality of research results, insufficient attention to market driven initiatives, and weak support from governments, all contribute to low rates of innovation in Central American agriculture.

In the **NAIS** of Central America, the different groups of actors perform different functions according to their interests as public entities, and in general interact very little. Among the actors are the INIAs, universities, nongovernmental and producer organizations and private actors. Included in the latter are all agricultural producers (including peasants), agroindustries (of all sizes and levels of formality), seed producers and providers of inputs and services. Within these systems the role of the INIAs is very limited because of low capacity and lack of instruments to encourage partnerships and alliances.

Policies that influence innovations in agriculture emerge from many institutions; yet there is little dialogue between authorities and private sector organizations to define them, and even less coordination for their implementation. As a result there are misleading signals, low effectiveness and wasted resources. Weakness in institutional capacity is a serious constraint, which leaves power groups as the most influential groups on policies. The actors most influential on policy are the ministries of finance and ministries of trade, leading organizations in value chains for export products and those that enjoy commercial protection. Seed and input importers are also quite influential. Market relations for inputs and services deserve greater attention to be able to evolve towards competitive scenarios.

In the **Regional Agricultural Research System**, CATIE has made valuable contributions to the development of human resources for research and education, with beneficiaries from all Latin American countries and some from other countries. Also, the outputs of research are well recognized throughout the region. SICTA has played a useful role in facilitating the dissemination of knowledge on relevant research issues and in the upgrading of research staff at the INIAs, there is a strong need to rethink its role and functions and to include the participation of more actors beyond public research entities. Both CATIE and SICTA have the potential for a more significant role in support to the development of institutional capacity for agricultural research and innovation. For this, they need this subject matter to be in their agenda and program structure; and to have the personnel with the required qualifications.

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Technical cooperation initiatives at the regional level are abundant, yet they do not have a strategy for developing institutional capacity. They focus on building the individual capacities of farmers and of staff at public entities. In some cases assistance is provided to improve the capacity of small producer organizations. For that purpose, the tools are mainly training and equipment donation. They usually work with little interaction, compete for the attention of local partners and government agencies, and depend heavily on grants.

Response capacity and willingness is at the heart of the solutions. The task has to be at several levels: improving the capacity of individual entities and creating mechanisms that allow efficient and effective interaction among actors, and the development of partnerships. The response has to be the result of a multi-agency initiative. The contributions from FAO, IICA, the World Bank, IADB, IFAD and other agencies working on these issues deserves to be jointed to generate a strategy and to seek adequate funding. On the other hand their effort needs to be heard by a wider audience of national authorities that can make decisions on this matter. Of particular relevance is to convey the message to ministers of Planning and ministers of Finance. The challenge is in the willingness of governments. On one hand, authorities in agriculture have usually a short period mandate hence no commitment to reforms which are in cases cumbersome and politically costly; and On the other hand they have limited influence in decisions for budget allocations to deal with the building of greater institutional capacity.

11.2 Recommendations

Following guidelines given by the TAP Secretariat, the main recommendations are organized in the three blocks of the TAP Strategy: Policy Dialog, Market Place and TAPipedia. They are directed towards Central American Authorities and the TAP regarding actions in Central America, yet they may be of interest in other regions.

As a general and most important issue it is suggested that TAP Secretariat conveys a Task Force that utilizes the suggestions made in the Regional capacity assessments to present a proposal for actions. On this regard it should be recognized that TAP is a forum of near forty international organizations, which can make group recommendations, yet it is not an executing agency. On the other hand, there is not

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currently a specialized body with operational capacity to undertake the tasks which have been recommended in this study, and summarized below.

Considering that this has to be a multidisciplinary effort, it is suggested that the Task Force of TAP is defined considering the potential contributions of international organizations as the World Bank, IADB, IFAD, FAO, IICA, CGIAR, GFAR and other agencies willing to commit to work on these issues. Regional work plans should be considered. This task Force should generate a strategy and to seek adequate funding, as *seed money* to promote country level strategies and investment programs in close relation with loans for agriculture. Their effort needs to be heard by a wider audience of national authorities that can make decisions on this matter. Of particular relevance is therefore to convey the message to ministers of Planning and ministers of Finance as improving institutional capacity requires funding, not usually included in current allocations.

This Task Force could use existing Fora to gain support. This includes for example the FAO Regional Conferences, the banks' annual meetings, the Interamerican Board of Agriculture (conveyed by IICA) and others. However, most important is to have first an action plan. The Task Force would benefit from contributing its message at key country level Fora for discussion if these issues.

On Policy Dialog

Considering the many policies influencing agriculture and food supply and particularly innovations in agriculture, governments would benefit from creating an agricultural council, in which relevant ministers participate. Leadership could be provided at presidential level and the agriculture minister could lead the secretariat. Representatives of the private sector in agriculture and the food industry could be invited to participate in the dialogue and to define policies, which as shown here, come from authorities in many entities.

As a result of dialogue, governments should define the most essential policies and commit public resources to high quality strategic research of value for agriculture in public entities; they should support other actors through competitive funding for research leading to public goods. There should pressure for this research to respond better to the needs of those most dependent on agriculture. This is essential to take

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advantage of the biodiversity of the Region and the challenges it faces on food security and adaptation to climate vulnerability. Attention must reach the most senior authorities and leading producer organizations.

Dialogue and action should be taken soon, in order to shift international cooperation from technical assistance to well conceived programs that contribute to improved institutional capacities. The joint effort of the CGIAR Centers, international cooperation agencies as FAO and IICA, and the development banks (World Bank, IADB, IFAD and BCIE), must be assured, as this is a multidimensional initiative and it must lead to investment to build capacity. Partnership with specialized agencies in institutional issues and organizations for development, as the CLAD, would also be beneficial.

For TAP and the international cooperating agencies in agriculture, partners in this initiative, the challenge is most significant because they are not used to handle policy issues beyond agricultural policies and because they interact very little with those authorities that make the most important decisions, including the allocation of government funds. Thus, within the scope of TAP, partnerships with entities as the multilateral banks and IFPRI should definitely be pursued in order to gain influence on developing capacity for design and implementation of policies.

On Market Place

Recognizing the low capacity of the INIAs, it is recommended to create a public-private council in each country with a technical secretariat responsible for leading the NAIS with a broader view of market relations. For this purpose guaranteed complementary government resources through competitive funds, as well as partners' contributions and commitment, must be assured and followed up to evaluate results. Create mechanisms that allow more intensive participation of actors in the Central American NAIS, including platforms and networks not limited to researchers in public entities, and incentives for cooperation among actors in the value chains, with others in the NAIS.

On TAPipedia

National AIS should evolve with strong international relations through networking, for which the CGIAR Centers, FAO and the regional organizations must provide guidelines and assistance.

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Public agricultural sector entities and producer organizations should share extensively any innovations in agriculture. Those referenced in this study for the case of Central America are only a sample of the many alternatives and cases. Advance estimates of costs and benefits must be made in order to improve the credibility of the recommendations.

Using renewed methods to extend knowledge (ICTs) requires much support, especially to gain more actors with a higher quality of useful information. Encouraging young people into small agricultural businesses and molding children on positive attitudes towards agriculture and nature has proved useful and must be pursued.

A final comment: ISNAR had a mandate on assisting countries to build agricultural research. The research and innovation systems have evolved substantially. A renewed approach is necessary. ISNAR, has not been replaced by a substantive effort to support the development of agricultural innovation systems within the scope of the challenges ahead, and there is a gap in international cooperation on these aspects. Therefore, the suggestion made regarding a Task Force to make proposal on this matter is commended.

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12. BIBLIOGRAPHY

AGRINATURA, 2012. Capacity development for agricultural research for development. AGRINATURA, Paris, France.

América Economía, 2012. FAO fomenta la creación de microempresas de semillas en Centroamérica. Guatemala, Guatemala.

Anderson, J. and J. Roseboom, 2013. Towards USAID Re-engaging in Supporting National Agricultural Research Systems in the Developing World, USAID, Washington DC, April 2013

CAC, 2008. Los Granos Básicos en Centroamérica, San José, Costa Rica

CIAT, 2011. CIAT en Centroamérica, Ciencia avanzada para que las Comunidades Rurales aprendan a competir, Conservar e innovar, Cali Colombia

Davis, L. E. and North, D. C. 1971. *Institutional Change and the American Economic Growth*. Cambridge: Cambridge University Press.

Estado de la Región, 2010. Estado de la Región-Centroamérica, San José, Costa Rica.
FAO. 2009. Evolución de los Servicios de Extensión en Nicaragua, Roma, Italia, 2009

FAO, 2011a. Buenas Prácticas de Extensión en América Central, FAO, Roma, Italia

FAO, 2011b. Annual Report on FAO activities in support of producers' organizations and agricultural cooperatives. FAO, Rome, Italy

FIDA, 2010. La Pobreza Rural en el Mundo. Roma, Italia.

FAO. 2012. Proyecto Regional de Apoyo al Establecimiento de Empresas Artesanales Producción de Semillas. FAO-AECID, Panamá.

Henríquez, P. and H. Li Pun (Editors), 2013. Innovaciones de Impacto: Lecciones de la Agricultura Familiar de ALC. FONTAGRO, Washington DC

FORAGRO, 2010. Agriculture and rural prosperity from the perspective of research and technological Innovation in LAC. GCARD, Montpellier, France

Tropical Agriculture Platform (TAP)
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Gallego, S. 2011. Alianza Clayuca/CIAT—Empresa privada: Desarrollo de productos alimenticios a partir de materias primas biofortificadas. Agrosalud, Costa Rica.

German Watch, <http://www.germanwatch.org/klak/cri06.pdf>

IFPRI, 2012. Review of Agricultural Extension Services. Washington DC

INIA, 2013. Propuesta del Programa Nacional de Innovación Agraria (PNIA) submitted to the Sistema Nacional de Inversión Pública (SNIP) Lima, Perú

Lele, U. et. Al. 2010. Transforming Agricultural Research for Development, GFAR, Rome. Italy

Monterroso, A. 2011. The Experience of Small Producers in Competitive Markets: Opcion/AJ Ticonel, Guatemala. In E. Biénabe, et al (Eds) Reconnecting Markets. GOWER, England.

North, D. C. 1997. *The Process of Economic Change. Conference presented at the Forum on "Present and Future of the New Institutional Economics"*, St. Louis, September 19-21

Palma Tica. 2013. ASD Seed Production and Distribution. Costa Rica

PIADAL, 2013. Agricultura y Desarrollo en América Latina: Gobernanza y Políticas Públicas. Editorial Teseo, Buenos Aires Argentina,

Piñeiro, M. (Editor). 2009. La institucionalidad Agropecuaria en América Latina: Estado Actual y Nuevos Desafíos. FAO. Santiago de Chile, 2009

Pomareda, C. 2006. Contract Agriculture: Lessons from experiences in Costa Rica Paper prepared for RIMISP as a contribution to the World Development Report 2008, Santiago de Chile, October 2006.

Pomareda, C. 2008. Análisis de Situación y Políticas en relación al alza de los Precios de Alimentos en Centroamérica, BID-RUTA, San José Costa Rica´

Pomareda, C, 2008. Políticas para la Innovación y la competitividad en la Agricultura de Centroamérica, SIDE, Costa Rica, 2008.

Pomareda, C. 2010, "Política Comercial y Seguridad Alimentaria en Centroamérica: Opciones e Implicaciones". Banco Interamericano de Desarrollo, Washington DC, 2010

Tropical Agriculture Platform (TAP)
Innovations in the Agriculture of Central America:
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CIAT-FAO

Pomareda, C. 2012. Los servicios no financieros para la competitividad de la agricultura. Conference at the International Seminar on Financing Agriculture. ALIDE and Banco Agrícola de La República Dominicana, Santo Domingo, 29/30 May 2012

Pomareda, C, 2012. Desafíos y Oportunidades a en la Agricultura de Costa Rica. En S. Auguste y O. Manzano (editores) *Tiempo de Cosecha?* , IADB, Washington DC.

Posthumus, E., Martin, E. and Chancellor. T. 2013. A systematic review of the impacts of capacity strengthening of agricultural research systems for development and the conditions for success. London: EPPI-Centre, Social Science Research Unit. Institute of Education, University of London ISBN: 978-1-907345-46-3

Rodriguez, I, 2003. Developing competitiveness and improving access to the fresh vegetables market in Honduras. Agropyme, Tegucigalpa, Honduras

RUTA, 2007. Estudios de casos para el análisis del financiamiento de las cadenas agrícolas de valor. RUTA. FIDA, San José, Costa Rica

SIDE, 2009. Recomendaciones para un Programa de Inversión Pública Estratégica en la Agricultura de Centroamérica. Document prepared for Banco Interamericano de Desarrollo, Washington DC

SIDE, 2013. Línea de Base de RedSICTA. Managua Nicaragua, Junio 2013

The African Capacity Building Foundation, 2013. African Capacity Indicators-2012: Capacity Development for Agricultural Transformation and Food Security,

The World Bank,2007. *Cultivating Knowledge and Skills for African Agriculture: A synthesis of an institutional, regional and International review.* Report 40997, Washington DC

Trejos, R., C. Pomareda and J.M. Villasuso, 2004. Políticas e Instituciones para la agricultura del Siglo XXI. IICA, San José, Costa Rica.

Trigo, E., Pomareda, C. and Villareal, F. 2012. Los INIAs de América Latina: Situación y Perspectivas. IICA, San José, Costa Rica.

Wal-Mart, 2013. Linking up with Central American producers of fresh fruit, vegetables and cereals to dynamic markets. Wal-Mart Central America.

Tropical Agriculture Platform (TAP)
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Wongtschooski, Mariana, et al (Editors) 2013. The Business of Agricultural Business Services: Working with Small Holders in Africa, FAO and Royal Tropical Institute, Rome, 2013

World Bank, 2002. World Report-2002: Institutions for Markets. Washington D.C.

World Bank, 2008. World Report-2008: Agriculture for Development. Washington D.C.

WTO. 2008. Annual Report-2004 Notes on Good Government and Institutions. Geneva

ANNEX A

Excel file of the electronic survey to 33 persons